UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
before the
ATOMIC SAFETY AND LICENSING BOARD

In the Matter of TEXAS UTILITIES ELECTRIC COMPANY et al. (Comanche Peak Steam Electric Station, Units 1 and 2)	)	Docket Nos. 50-445-OL 50-446-OL (Application for an Operating License)

AFFIDAVIT OF HOWARD A. LEVIN

Howard A. Levin, being duly sworn under oath, states the following:

1. I am a Vice President of Tenera, L.P., the Third Party Organization which prepared the "Piping and Supports Discipline Specific Action Plan" ("DSAP IX"), Rev. 2, June 18, 1987. Tenera also prepared the "Discipline Specific Results Report: Piping and Supports," Rev. 1, August 27, 1987, under the charter of the Comanche Peak Response Team ("CPRT") Program Plan. I was the Review Team Leader with the overall responsibility within Tenera for the preparation of both DSAP IX and the Discipline Specific Results Report: Piping and Supports. A statement of my professional qualifications is attached.

2. The copies of DSAP IX Rev. 2, June 18, 1987 and the Discipline Specific Results Report: Piping and Supports Rev. 1, August 27, 1987 attached hereto are true and correct and accurately describe the approach methodology, scope and results of Tenera's overview of the piping and pipe support design validation.

3. The matters set forth above are based on my personal knowledge and are true and accurate to the best of my knowledge and belief.

HOWARD A. LEVIN

Subscribed and sworn to before me this 13 day of May, 1988.

Notary Public

My Commission expires on My Commission Expires July 1, 1990.

HOWARD A. LEVIN
Vice President

Education

M.S. Structural Engineering, Massachusetts Institute of Technology
B.E. Civil and Mechanical Engineering, Stevens Institute of Technology

Summary of Experience

Mr. Levin has more than 15 years of engineering experience, 13 years of this experience in the commercial nuclear field with emphasis in nuclear plant design and construction, operating reactor safety, licensing, project management, and federal regulation. Mr. Levin's consulting activities have focused on the development of improved methods for design and construction verification, configuration management, project management and licensing of nuclear facilities under construction and in operation. He has provided leadership to an engineering staffs of over 250 professionals and has had responsibility for annual budgets of over $20M.

1981 - Present Vice President, TENERA, L.P. Responsible for development and management of special projects designed to solve complex engineering, quality and safety problems associated with the design, construction, licensing, and operations of power plants. Responsibilities include supervision of senior project managers, staffing and business development.

Vice President, TERA Corporation and Vice President TENERA Corporation. Responsible for management of the engineering analysis, geophysics, and computational analysis divisions within the Company's nuclear services subsidiary. Responsibilities included direction of a large staff of engineering professionals engaged in multidisciplined consulting projects, ranging in scope from the analysis and design of specific nuclear plant features to full scope design and construction verification of entire nuclear facilities. In this capacity he has frequently provided an interface with the NRC staff and has served as an expert witness before the ASLB.

1981 - Present (Continued)	Manager, Engineering, TERA Corporation. Responsible for the management and implementation of large engineering projects servicing nuclear utility and other clients in areas including engineering mechanics, probabilistic risk assessment, equipment qualification, seismic hazards analysis, systems analysis, and licensing.
1976 - 1981	Technical Assistant to the Director, Division of Engineering, NRC. Responsible for the development of policies and programs related to the technical review of license applications and operating reactor safety. Administered technical activities in the areas of mechanical, equipment qualification, structural, materials, chemical, hydrological, geotechnical, earthquake and environmental engineering. Represented the Director and provided testimiony before thre NRC, ACRS, ASLB, public hearings and industry meetings, presenting and justifying technical analyses and evaluations. Program Manager, Systematic Evaluation Program, NRC. Responsible for management of the SEP structural, mechanical, and seismic safety review of older operating reactors. Responsibilities included the development of program goals, scope, technical criteria, budget and scheduling. Senior Engineer, NRC. Responsible for the review of Safety Analysis Report information pertaining to complex structural, mechanical and materials issues related to all operating power and research reactor facilities. Coordinated technical assistance programs; prepared licensing criteria documents, codes and standards; documented and presented safety analyses and evaluations supporting licensing actions.
1974 - 1976	Structural Engineer, Stone and Webster Engineering Corporation. Responsible for the analysis and design of nuclear power plant structures, systems and components for normal and extreme loading conditions. Specific experience included dynamic analysis and design of structures, pipe rupture

1974 - 1976
(Continued) restraints, pipe stress analysis, major equipment supports, liners and conceptual layout and design. Developed new design concepts for prestressed concrete containment structures.

1972 - 1974 Held engineering positions with Slattery Associates and Hercules, Inc. Responsible for design of structural systems used in construction of bridges, subways, sewage plants, and process chemical plants. In charge of field surveying team.

Professional Affiliations

American Society of Civil Engineers
- Member, Dynamic Analysis Committee
- Chairman, Subgroup on Design and Construction Errors
- Member, Subgroup on Uses of Seismic Probabilistic Risk Assessment in the Design Process, Working Group on Seismic Probabilistic Risk
- Member, Working Group on Impact Loadings

Honors and Publications

Sigma Xi Scientific Honorary
Tau Beta Pi Engineering Honorary
M.I.T. Engineering Resident Fellowship
U.S. Naval Academy Appointment
Moles Heavy Construction Award
Outstanding Young Men of America

Selected Technical Papers and Publications

Prestressed Concrete Containments for Nuclear Power Plants; Operating Experience with Snubbers; Fracture Toughness and Lamellear Tearing of Component Supports; Equipment Response at the El Centro Steam Plant During the October 15, 1979, Imperial Valley Earthquake; Seismic Review of Operating Plants, Systematic Evaluation Program Seismic Review; Evaluation of Existing Nuclear Power Plant Facilities for Postulated Heavy Load Drop Consequences; Seismic Design Guidelines for Existing Nuclear Power Facilities in Light of an Expanding Data Base of Knowledge; Structural Evaluation of an Operating Floor Subjected to Postulated Heavy Load Drops; Assurance of Quality: An Approach to Design and Construction Verification.

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NUCLEAR REGULATORY COMMISSION

OFFICE OF SECRETARY
DOCKETING & SERVICE
BRANCH

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ATOMIC SAFETY AND LICENSING BOARD

In the Matter of TEXAS UTILITIES ELECTRIC COMPANY et al. (Comanche Peak Steam Electric Station, Units 1 and 2)	Docket Nos. 50-445-OL 50-446-OL (Application for an Operating License)

CERTIFICATE OF SERVICE

I, Thomas A. Schmutz, hereby certify that the foregoing APPLICANTS' MOTION FOR AN ORDER RESOLVING ALL PIPING AND PIPE SUPPORT DESIGN ISSUES was served this 17th day of May 1988, by mailing copies thereof (unless otherwise indicated), first class mail, postage prepaid to:

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*Adjudicatory File (2 copies)
Atomic Safety and Licensing
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Dated: May 17, 1988

COMANCHE PEAK
STEAM ELECTRIC STATION

UNIT 1 and COMMON

CORRECTIVE ACTION PROGRAM

PROJECT STATUS REPORT

LARGE BORE PIPING AND PIPE SUPPORTS

TU ELECTRIC

Generating Division

Revision 0

TU ELECTRIC
COMANCHE PEAK STEAM ELECTRIC STATION
UNIT 1 AND COMMON

STONE & WEBSTER ENGINEERING CORPORATION

PROJECT STATUS REPORT

LARGE BORE PIPING AND PIPE SUPPORTS

R P Klause

R. P. Klause
Project Manager

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This Project Status Report (PSR) summarizes the systematic validation process for safety-related large bore piping (larger than 2 in. nominal pipe size) and pipe supports implemented by Stone & Webster Engineering Corporation - Pipe Stress Analysis and Support Project (SWEC-PSAS) at Comanche Peak Steam Electric Station (CPSES) Unit 1 and Common[1]. This Project Status Report (PSR) presents the results of the design validation and describes the Post-Construction Hardware Validation Program (PCHVP). SWEC-PSAS's activities were governed by the TU Electric Corrective Action Program (CAP) which required SWEC-PSAS to:

1. Establish a consistent set of CPSES safety-related piping and pipe support design criteria that complies with the CPSES licensing commitments.

2. Produce a set of design control procedures that assures compliance with the design criteria.

3. Evaluate systems, structures, and components, and direct the corrective actions recommended by the Comanche Peak Response Team (CPRT) and those determined by the Corrective Action Program (CAP) investigations to be necessary to demonstrate that systems, structures, and components are in conformance with the design.

4. Assure that the validation resolves the piping-related design and hardware issues identified by the Comanche Peak Response Team (CPRT), external sources[2], and the Corrective Action Program (CAP).

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[1]Common refers to areas in CPSES that contain both Unit 1 and Unit 2 systems, structures, and components

[2]External issues are issues identified by the following:

NRC Staff Special Review Team (SRT-NRC)
NRC Staff Special Inspection Team (SIT)
NRC Staff Construction Appraisal Team (CAT)
Citizens Association for Sound Energy (CASE)
Atomic Safety and Licensing Board (ASLB)
NRC Region IV Inspection Reports
NRC Staff Technical Review Team (TRT) [SSERs 7-11]
CYGNA Independent Assessment Program (IAP)

Comanche Peak Response Team (CPRT) issues are issues identified by the following:

CPRT Design Adequacy Program (DAP)
CPRT Quality of Construction Program (QOC)

5. Validate that the design of safety-related piping systems is in conformance with the licensing commitments and that the installed hardware is in conformance with the validated design.

6. Produce a set of consistent and validated design documentation.

A consistent set of design criteria for CPSES safety-related piping and pipe supports has been developed and used by SWEC-PSAS for the design validation process. This set of design criteria and methodologies is in conformance with the CPSES licensing commitments. It has been independently and extensively reviewed and was accepted by Comanche Peak Response Team (CPRT) and by CYGNA Energy Services (CYGNA).

SWEC-PSAS established design control procedures to implement the design criteria and methodologies described above, and to govern the work flow and technical interfaces with other disciplines, for both the design and hardware validation processes. These procedures specify the processes (such as the validation of piping system inputs, piping and pipe support checklists, documentation control, and final reconciliation) that have been implemented throughout the safety-related large bore piping and pipe supports Corrective Action Program (CAP).

SWEC-PSAS has performed analyses to validate the design of as-built CPSES Unit 1 and Common safety-related large bore piping and pipe supports[3]. The results are documented in 384 pipe stress analysis packages[4] that contain approximately 12,020 pipe supports. The as-built hardware for safety-related large bore piping and pipe supports is being validated to the design by the Post-Construction Hardware Validation Program (PCHVP).

Methodologies have been incorporated into the SWEC-PSAS design criteria and the Post-Construction Hardware Validation Program (PCHVP) implementation procedures which have resolved the piping-related design and hardware issues identified by the Comanche Peak Response Team (CPRT), external sources, and the Corrective Action Program (CAP). Consequently, the validated design of the CPSES safety-related large bore pipe and pipe supports has resolved these piping-related issues.

The Post-Construction Hardware Validation Program (PCHVP) assures that the safety-related large bore piping and pipe supports are installed in confor-

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[3]Analysis of the ASME Section III (Reference 22) Code Class 1 piping for the Corrective Action Program (CAP) was performed by Westinghouse. SWEC performed the analysis of the ASME Section III Code Class 1 pipe supports as well as the ASME Section III Code Class 2 and 3 piping and pipe supports.

[4]The term "pipe stress analysis package" is used in this Project Status Report to describe the engineering documentation required to validate the design adequacy of piping.

mance with the validated design. SWEC-PSAS has reviewed and revised the CPSES piping-related installation specifications, construction procedures, and reviewed quality control inspection procedures to assure that the validated design requirements are implemented. The Post-Construction Hardware Validation Program (PCHVP) for safety-related large bore piping and pipe supports, including the inspections, engineering walkdowns and evaluations, implements the corrective actions recommended by the Comanche Peak Response Team (CPRT), as well as those required by Corrective Action Program (CAP) investigations.

SWEC-PSAS will provide TU Electric a complete set of validated design documentation for CPSES safety-related large bore piping and pipe supports, including the pipe stress and pipe support calculations, drawings, and interface discipline transmittals. This documentation, in conjunction with the updated specifications and procedures, can provide the basis for CPSES configuration control[5] to facilitate maintenance and operation throughout the life of the plant.

In-depth quality and technical audits have been performed by SWEC Quality Assurance, TU Electric Quality Assurance, and the independent Engineering Functional Evaluations (EFE). These audits, in addition to the third party overview performed by TENERA, L.P. (TERA) for Comanche Peak Response Team (CPRT) assured that the SWEC-PSAS procedures and the established design criteria complied with the licensing commitments.

The Unit 1 and Common safety-related large bore piping and pipe supports Corredtive Action Program (CAP) validates that:

- The design of the large bore piping and pipe supports complies with the CPSES licensing commitments.
- The as-built safety-related large bore piping and supports comply with the validated design.
- The large bore piping and pipe supports comply with the CPSES licensing commitments and will perform their safety-related functions.

[5] Configuration control is a system to assure that the design and hardware remain in compliance with the licensing commitments throughout the life of the plant.

ABBREVIATIONS AND ACRONYMS

AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ARS	Amplified Response Spectra
ASLB	Atomic Safety and Licensing Board
ASME Section III	American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Section III, Division 1, Nuclear Power Plant Components
BRP	Piping Isometric Drawing
CAP	Corrective Action Program (TU Electric)
CASE	Citizens Association for Sound Energy
CAT	Construction Assessment Team (NRC)
CFR	Code of Federal Regulations
CMC	Component Modification Card
CPE	Comanche Peak Engineering (TU Electric)
CPPP	Comanche Peak Project Procedure
CPRT	Comanche Peak Response Team (TU Electric)
CPSES	Comanche Peak Steam Electric Station
CYGNA	CYGNA Energy Services
DAP	Design Adequacy Program (CPRT)
DBCP	Design Basis Consolidation Program (SWEC-PSAS)
DBD	Design Basis Document
DCA	Design Change Authorization
DIR	Discrepancy Issue Report (CPRT-DAP)
DR	Deviation Report
DSAP	Discipline Specific Action Plan (CPRT)
DVP	Design Validation Package
DWG	Design Drawing
EA	Engineering Assurance (SWEC)
Ebasco	Ebasco Services Incorporated
EFE	Engineering Functional Evaluation
FSAR	Final Safety Analysis Report
FVM	Field Verification Method
GIR	Generic Issues Report
HELB	High-Energy Line Break
HVAC	Heating, Ventilation, and Air-Conditioning
IAP	Independent Assessment Program (CYGNA)
IEB	Inspection and Enforcement Bulletin (NRC)
Impell	Impell Corporation
ISAP	Issue-Specific Action Plan (CPRT)
IWA	Integral Welded Attachment
LOCA	Loss-of-Coolant Accident
MELC	Moderate Energy Line Crack
NCR	Nonconformance Report
NOV	Notice of Violation (NRC)
NRC	United States Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation (NRC)
NSSS	Nuclear Steam Supply System (Westinghouse)

NUREG	NRC Document
NUREG/CR	NRC Document Developed by NRC Contractor
PCHVP	Post-Construction Hardware Validation Program
PM	Project Memorandum
PSAS	Pipe Stress Analysis and Support
PSR	Project Status Report
PWR	Pressurized Water Reactor
QA	Quality Assurance
QAAD	Quality Assurance Auditing Division (SWEC)
QC	Quality Control
QOC	Quality of Construction and QA/QC Adequacy Program (CPRT)
RIL	Review Issue List (CYGNA)
SDAR	Significant Deficiency Analysis Report (TU Electric)
SER	Safety Evaluation Report (NRC, NUREG-0797)
SIT	Special Inspection Team (NRC Staff)
SRT	Senior Review Team (CPRT)
SRT-NRC	Special Review Team (NRC)
SSE	Safe Shutdown Earthquake
SSER	Supplemental Safety Evaluation Report (NRC, NUREG-0797)
SWEC	Stone & Webster Engineering Corporation
SWEC-PSAS	Stone & Webster Engineering Corporation - Pipe Stress and Support Project
TAP	Technical Audit Program (TU Electric)
TERA	TENERA, L. P.
TET	Thermal Expansion Testing
TRT	Technical Review Team (NRC Staff, SSERs 7-11)
UT	Ultrasonic Testing
VMG	Vibration Monitoring Group
VPB	Vendor Program Branch (NRC)

1.0 INTRODUCTION

In October 1984, TU Electric established the Comanche Peak Response Team (CPRT) to evaluate issues that have been raised at CPSES and to prepare a plan for resolving those issues. The Comanche Peak Response Team (CPRT) program plan was developed and submitted to the NRC.

In mid-1986, TU Electric performed a qualitative and quantitative review of the preliminary results of the Comanche Peak Response Team (CPRT) (References 80 and 81). This review identified that the Comanche Peak Response Team (CPRT) issues were very broad in scope and included each discipline. TU Electric decided that the appropriate method to correct the issues raised and to identify and correct any other issues that potentially existed at CPSES would be through one integrated program rather than a separate program for each issue. TU Electric decided to initiate a comprehensive Corrective Action Program (CAP) (Reference 49) to validate the entirety of CPSES safety-related designs.[1,2] The scope of the Corrective Action Program (CAP) has the following objectives:

- Demonstrate that the design of safety-related systems, structures and components complies with licensing commitments.
- Demonstrate that the existing systems, structures and components are in compliance with the design; or develop modifications which will bring systems, structures, and components into compliance with design.
- Develop procedures, an organizational plan, and documentation to maintain compliance with licensing commitments throughout the life of CPSES.

The Corrective Action Program (CAP) is thus a comprehensive program to validate both the design and the hardware at CPSES, including resolution of specific Comanche Peak Response Team (CPRT) and external issues.

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[1]Portions of selected nonsafety-related systems, structures and components are included in the Corrective Action Program (CAP). These are Seismic Category II systems, structures and components, and Fire Protection Systems.

[2]Nuclear Steam Supply System (NSSS) design and vendor hardware design and their respective QA/QC programs are reviewed by the NRC independently of CPSES, and are not included in the Corrective Action Program (CAP) as noted in SSER 13; however, the design interface is validated by the CAP.

TU Electric contracted and provided overall management to Stone & Webster Engineering Corporation (SWEC), Ebasco Services Incorporated (Ebasco), and Impell Corporation (Impell) to implement the Corrective Action Program (CAP) and divided the CAP into eleven disciplines as follows:

Discipline	Responsible Contractor
Mechanical	SWEC
-Systems Interaction	Ebasco
-Fire Protection	Impell
Civil/Structural	SWEC
Electrical	SWEC
Instrumentation & Control	SWEC
Large Bore Piping and Pipe Supports	SWEC-PSAS
Cable Tray and Cable Tray Hangers	Ebasco/Impell
Conduit Supports Trains A,B, & C >2"	Ebasco
Conduit Supports Train C $\leq$ 2"	Impell
Small Bore Piping and Pipe Supports	SWEC-PSAS
Heating, Ventilating, and Air Conditioning (HVAC)	Ebasco
Equipment Qualification	Impell

A Design Basis Consolidation Program (DBCP) (Referenc 30) was developed to define the methodology by which SWEC-Pipe Stress and Support Project (SWEC-PSAS) performed the design and hardware validation. The approach of this DBCP is consistent with other contractors' efforts and products.

The design validation portion of the Corrective Action Program (CAP) identified the design-related licensing commitments. The design criteria were developed from the licensing commitments and consolidated in the Design Basis Documents (DBDs) (References 1, 2, 3, 61, and 62). The DBDs identify the design criteria for the design validation effort. If the existing design did not satisfy the design criteria, it was modified to satisfy the criteria. The design validation effort for each of the eleven Corrective Action Program (CAP) disciplines is documented in Design Validation Packages (DVPs). The Design Validation Packages (DVPs) provide the documented assurance (e.g., calculations and drawings) that the validated design meets the licensing commitments, including resolution of all Comanche Peak Response Team (CPRT) and external issues.

The design validation effort revised the installation specifications to reflect the validated design requirements. The validated installation specifications also contain the inspection requirements necessary to assure that the as-built hardware complies with the validated design.

The hardware validation portion of the Corrective Action Program (CAP) is implemented by the Post-Construction Hardware Validation Program (PCHVP), which demonstrates that existing systems, structures, and components are in compliance with the installation specifications (validated design), including the modifications that are necessary to bring the hardware into compliance with the validated design.

The results of the performance of the Corrective Action Program (CAP) for each discipline are described in a Project Status Report (PSR). This Project Status Report (PSR) describes the results for the Large Bore Piping and Pipe Supports - Corrective Action Program (CAP).

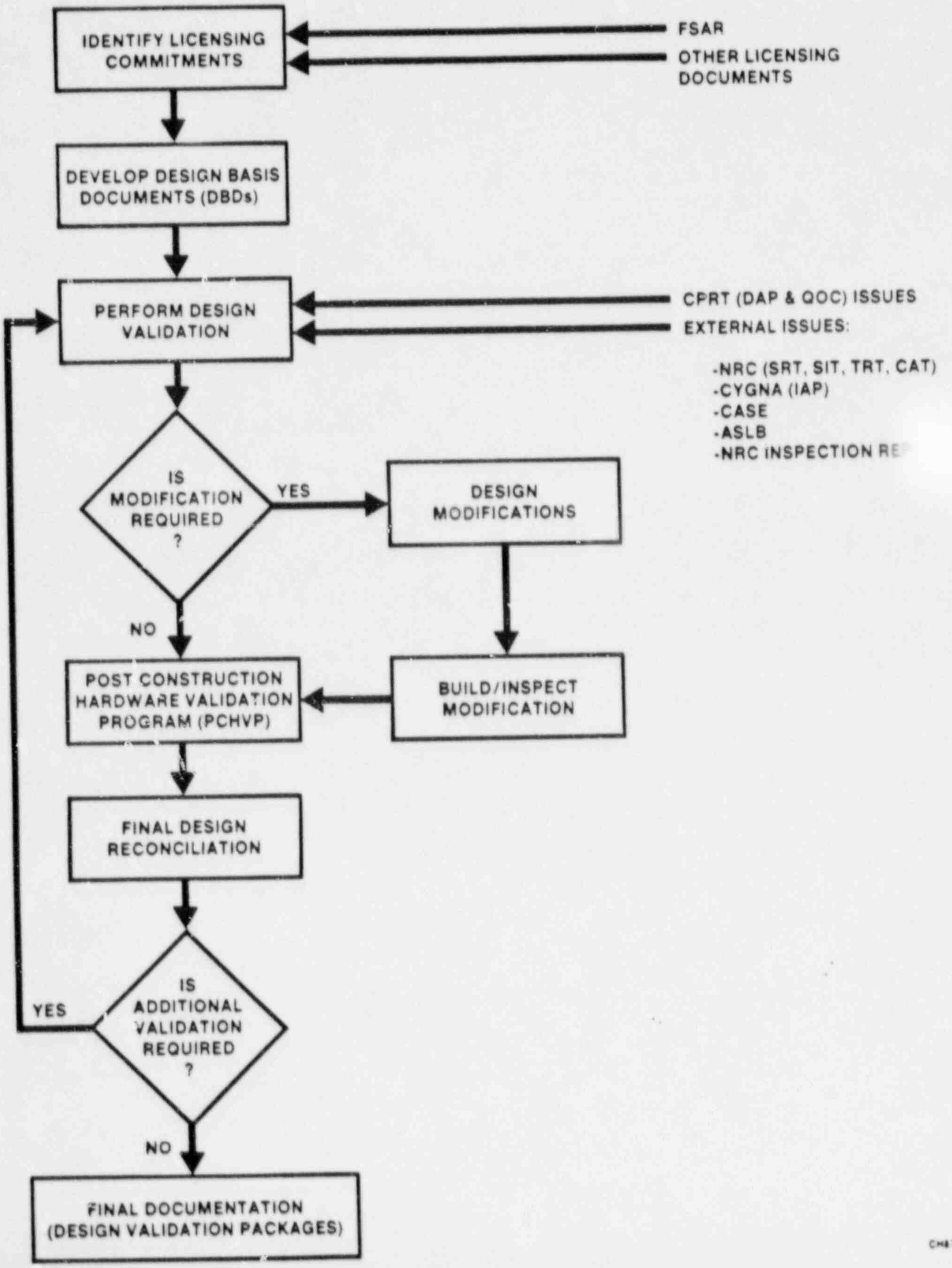
SWEC-PSAS performed a comprehensive design validation of safety-related large bore piping and pipe supports for Comanche Peak Steam Electric Station (CPSES) in order to demonstrate that the design of piping systems and supports complies with licensing commitments, and is performing the Post-Construction Hardware Validation Program (PCHVP) to demonstrate that the as-built piping and pipe supports comply with the validated design. SWEC-PSAS was initially contracted by TU Electric in 1985 to validate large bore piping and pipe supports at CPSES. When the TU Electric Corrective Action Program was created in 1986, it incorporated and expanded the existing SWEC-PSAS program. The validation process is conducted in accordance with the Piping - Design Basis Consolidation Program (Piping-DBCP), which controls implementation of the piping portion of the TU Electric Corrective Action Program (CAP). The Large Bore Piping and Pipe Support Corrective Action Program (CAP) encompassed the Comanche Peak Response Team Action Plan DSAP IX, Piping and Pipe Supports Discipline Specific Action Plan (CPRT-DSAP IX) (Reference 4). The Piping and Pipe Supports - Corrective Action Program (CAP), shown schematically in Figure 1-1, was developed by SWEC-PSAS to implement the corrective actions for the large bore piping and pipe supports discipline following the directions specified in the TU Electric's Corrective Action Program (CAP). The design bases of the Large Bore Piping and Pipe Support - Corrective Action Program (CAP) are contained within a consolidated set of CPSES Design Basis Documents (DBDs) for safety-related piping and pipe supports.

Validation of the CPSES large bore piping and pipe supports is accomplished by pipe stress and pipe support analyses and implementation of required field modifications. The results and the methodology used in implementing both the design and hardware-related validations for Unit 1 and Common large bore piping and pipe supports are presented in this Project Status Report (PSR).

This Large Bore Piping and Pipe Supports Project Status Report (PSR) represents a road map of the validation effort from the early stages of design criteria development through the establishment and implementation of the detailed design and design control procedures. The report traces the updating of design/installation specifications, construction and Quality Control (QC) procedures, the implementation of the Post-Construction Hardware Validation Program (PCHVP) to validate the as-built piping and pipe support design, and the completion of the Unit 1 and Common large bore pipe stress analysis packages and pipe support calculations.

FIGURE 1-1

LARGE BORE PIPING AND PIPE SUPPORT CORRECTIVE ACTION PROGRAM (CAP)



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2.0 PURPOSE

The purpose of this Project Status Report (PSR) is to demonstrate that the safety-related large bore piping and pipe supports in Unit 1 and Common are in conformance with the CPSES licensing commitments, satisfy the design criteria, and will satisfactorily perform their safety-related functions.

3.0 SCOPE

The scope of the Corrective Action Program (CAP) implemented for CPSES Unit 1 and Common large bore piping and pipe supports as summarized in this Project Status Report (PSR) includes:

1. Seismic Category I[1]

   - ASME Section III Code Class 2 and 3 piping and pipe supports.

   - ASME Section III Code Class 1 pipe supports.

2. Seismic Category II[2]

   - Piping and supports required to be included as extensions of a Seismic Category I Pipe Stress Analysis Package.

   - Piping and supports of high and moderate energy lines which are computer analyzed (for break and crack postulation purposes).

   - Other piping and supports, the failure of which could cause damage to Seismic Category I structures, systems, or components.

The CPSES Piping and Pipe Supports Corrective Action Program (CAP) is shown schematically in Figure 1-1 and discussed below. The program requires:

1. Establishment of large bore piping and pipe support design criteria which comply with licensing commitments.

2. Development of the Design Basis Documents (DBDs) for CPSES large bore piping and pipe supports, which contain the design criteria. These

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[1]Structures, systems, and components that are designed and constructed to withstand the effects of the Safe Shutdown Earthquake (SSE) and remain functional are designated as Seismic Category I in accordance with the requirements of NRC Regulatory Guide 1.29 (Reference 78). All ASME Section III Code Class 1, 2, and 3 piping and pipe supports in CPSES are Seismic Category I.

[2]Those portions of structures, systems, or components whose continued function is not required, but whose failure could reduce the functioning of any Seismic Category I system or component required to satisfy the requirements of Regulatory Guide 1.29 to an unacceptable safety level or could result in incapacitating injury to occupants of the control room, are designated Seismic Category II and are designed and constructed so that the Safe Shutdown Earthquake (SSE) would not cause such failure.

Design Basis Documents (DBDs) provide the basis for corrective and preventive actions through the life of the plant. These documents also identify the updated design/installation specifications, Quality Control (QC)/Construction procedures, and technical and design control procedures used in the validation process.

3. Implementation of design and hardware validations, consisting of analysis, identification and implementation of necessary modifications, and field verifications as identified in the Post-Construction Hardware Validation Program (PCHVP). The as-built design of all large bore piping and pipe supports is validated by Quality Control (QC) inspections, engineering walkdowns, and engineering evaluations. Analysis results are documented in Large Bore Piping Design Validation Packages (DVPs).

4. Resolution of the design and hardware-related issues of CPSES large bore piping and pipe supports and implementation of a corrective action plan for closure of these issues. These issues include external issues, Comanche Peak Response Team (CPRT) issues, and issues identified during the performance of the Corrective Action Program (CAP) (See Section 4.0).

5. The validated design documentation forms the basis for configuration control of CPSES large bore piping and pipe supports. The validated design documentation and updated procedures/specifications will be provided to TU Electric to facilitate operation, maintenance, and future modifications following issuance of an operating license.

Within Section 5.1, Section 5.1.1 describes the methodology by which the CPSES licensing commitments were identified, the design criteria were established, and the procedures were developed. These technical and design control procedures, in conjunction with the CPSES quality assurance procedures and design and installation specifications that were updated to meet the corrective actions for large bore piping and supports, are consolidated in the CPSES Design Basis Documents (DBDs).

Section 5.1.2 describes the design validation process, including the calculation input/output reviews and interface requirements with other disciplines, and the preoperational testing program.

Section 5.1.3 describes the Post-Construction Hardware Validation Program (PCHVP) process and the procedures for field verifications (inspections, engineering walkdowns, and engineering evaluations) required to be implemented to validate that the as-built large bore piping and pipe supports are in compliance with the design documentation.

Section 5.2 presents a summary of the design validation and Post-Construction Hardware Validation Program (PCHVP) results, including the hardware modifications resulting from the Corrective Action Program (CAP).

Section 5.3 describes the quality assurance program implemented for the validation process, including the SWEC Engineering Assurance audits, the Engineering

Functional Evaluation (EFE) audits, and the TU Electric Technical Auditing Program audits.

Section 5.4 describes the SWEC-PSAS inputs to the TU Electric preventive actions including the training of TU Electric Comanche Peak Engineering (CPE) personnel and the transfer of a complete set of the validated design documentation and procedures to CPE. This documentation and procedures can provide the basis for CPSES configuration control throughout the life of the plant.

The design of the Unit 1 and Common large bore piping and pipe supports has been validated as follows:

Description	Number of Large Bore Pipe Stress Analysis Packages	Number of Pipe Supports
Unit 1 and Common - ASME Section III Code Class 2 and 3 (Seismic Category I)	338 (SWEC-PSAS)	10,459 (SWEC-PSAS)
Unit 1 and Common - ASME Section III Code Class 1 (Seismic Category I)	30 (Westinghouse)	990 (SWEC-PSAS)
Unit 1 - High Energy (Seismic Category II)	16 (SWEC-PSAS)	574 (SWEC-PSAS)
TOTAL	384	12,023

Appendix A of this Project Status Report (PSR) describes the details of Corrective Action Program (CAP) resolution of the Comanche Peak Response Team (CPRT) and external issues.

Appendix B of this Project Status Report (PSR) describes the details of resolutions of issues identified during the performance of large bore piping and pipe supports Corrective Action Program (CAP). These issues are Significant Deficiency Analysis Reports (SDARs) (10CFR50.55(e)) (Reference 58) initiated by TU Electric.

Appendix C of this Project Status Report (PSR) describes the preventive action taken resulting from the implementation of the large bore piping and pipe supports Corrective Action Program (CAP).

4.0 SPECIFIC ISSUES

The large bore piping and pipe supports Corrective Action Program (CAP) resolved all the Comanche Peak Response Team (CPRT) issues, external issues, and issues identified during the performance of CAP. This section presents a listing of piping-related issues addressed in this Project Status Report (PSR). Technical review and resolution of external and Comanche Peak Response Team (CPRT) issues are described in Appendix A, including responses to the NRC staff evaluations within the CPSES Supplements to Safety Evaluation Report (SER) (Reference 28). Resolutions and corrective action taken for issues identified during the performance of the Corrective Action Program (CAP) are described in Appendix B.

External issues were identified in the Large Bore Piping and Pipe Supports Generic Issues Report (GIR) (References 5 and 35). This Generic Issues Report (GIR) was transmitted to NRC, Citizens Association for Sound Energy (CASE), and CYGNA Energy Services (CYGNA). Comanche Peak Response Team (CPRT) contracted TENERA, L.P. (TERA) to perform the Third Party overview (Reference 79) for the completeness and adequacy of these issues/resolutions, and the overview of corrective actions implemented by SWEC-PSAS to resolve these issues. The results of these Third Party overviews are presented by TENERA, L.P. (TERA) in the Discipline Specific Results Report (Reference 46).

Comanche Peak Response Team (CPRT) and external issues are listed below (issue number corresponds to subappendix number in Appendix A):

Issue No.	Issue Title
A1	Richmond Inserts
A2	Local Stress in Piping
A3	Wall-to-Wall and Floor-to-Ceiling Supports
A4	Pipe Support/System Stability
A5	Pipe Support Generic Stiffness
A6	Uncinched U-Bolt Acting as a Two-Way Restraint
A7	Friction Forces
A8	AWS Versus ASME Code Provisions
A9	A500, Grade B, Tube Steel
A10	Tube Steel Section Properties
A11	U-Bolt Cinching
A12	Axial/Rotational Restraints
A13	Bolt Hole Gap
A14	OBE/SSE - Damping
A15	Support Mass in Piping Analysis
A16	Programmatic Aspects and QA Including Iterative Design
A17	Mass Point Spacing
A18	High-Frequency Mass Participation
A19	Fluid Transients
A20	Seismic Excitation of Pipe Support Mass
A21	Local Stress in Pipe Support Members
A22	Safety Factors
A23	SA-36 and A307 Steel

Issue No.	Issue Title
A24	U-Bolt Twisting
A25	Fischer/Crosby Valve Modeling/Qualification
A26	Piping Modeling
A27	Welding
A28	Anchor Bolts/Embedment Plates
A29	Strut/Snubber Angularity
A30	Component Qualification
A31	Structural Modeling for Frame Analysis
A32	Computer Program Verification and Use
A33	Hydrotest
A34	Seismic/Nonseismic Interface
A35	Other Issues
A36	SSER-8 Review
A37	SSER-10 Review
A38	SSER-11 Review
A39	CPRT Quality of Construction Review on Piping and Pipe Supports

Issues identified during the performance of the Corrective Action Program (CAP) are listed below (issue number corresponds to subappendix number in Appendix B):

Issue No.	Issue Title
B1	SDAR-CP-86-33, Stiffness Values for Class 1 Stress Analysis
B2	SDAR-CP-86-36, Large Bore Piping and Pipe Supports
B3	SDAR-CP-86-63, Pipe Support Installations
B4	SDAR-CP-86-67, Preoperational Vibration Test Criteria
B5	SDAR-CP-86-73, ASME Snubber Attachment Brackets

5.0 CORRECTIVE ACTION PROGRAM METHODOLOGY AND RESULTS

5.1 METHODOLOGY AND WORK PERFORMED

5.1.1 Licensing Commitments, Design Criteria, and Procedures

SWEC-PSAS reviewed the piping-related CPSES licensing documentation (such as the FSAR (Reference 26), NRC Regulatory Guides, NRC Inspection and Enforcement Bulletins, ASME Section III Code, and NRC/TU Electric correspondences) and identified licensing commitments related to the large bore piping and pipe supports. SWEC-PSAS established design criteria to assure compliance with the licensing commitments. The design criteria are documented in the Design Basis Documents (DBDs). SWEC-PSAS then developed design procedures which encompass the following:

- Design criteria
- Resolution of Comanche Peak Response Team (CPRT) and external issues
- SWEC's experience gained through the design of piping and pipe supports for several recently licensed and operating United States nuclear power plants
- Regulatory and Professional Society Guidance, such as applicable codes and standards; Welding Research Council Bulletin 300, Technical Positions on Criteria Establishment (Reference 13); and Sections 3.6, 3.7, and 3.9 of NUREG-0800 (Reference 7).

SWEC-PSAS Procedures CPPP-7 (Reference 8) and CPPP-6 (Reference 9) are the primary technical and design control procedures, respectively, for the large bore piping and pipe supports Corrective Action Program (CAP).

Engineering methodology, based on SWEC-PSAS experience, has been incorporated within the SWEC-PSAS procedures. A list of typical technical and design control practices that are specified within the SWEC-PSAS procedures is presented in Table 5-9.

The governing procedures implementing the Corrective Action Program (CAP) of large bore piping and pipe supports are shown in Figure 5-1. These procedures assure compliance with the design criteria and the resolution of the Comanche Peak Response Team (CPRT) and external issues.

To assure that the licensing commitments related to large bore piping and pipe supports have been identified, appropriate design criteria established, and procedures developed which comply with the design criteria, several audits and overviews were conducted by the SWEC Corporate Quality Assurance Program and the Comanche Peak Response Team (CPRT). SWEC Quality Assurance audits were performed as described in Section 5.3. The Comanche Peak Response Team (CPRT) overview was performed by TENERA, L.P. (TERA), and the overview of SWEC-PSAS implementation is performed by the TU Electric Technical Audit Program (TAP). The TENERA, L.P. (TERA) conclusions are discussed in detail in the TERA

Discipline Specific Results Report: Piping and Supports (DAP-RR-P-001), Revision 1. In this report, TENERA, L.P. (TERA) states on page 1-2:

> "SWEC procedures were reviewed for compliance with applicable CPSES FSAR and licensing criteria. Licensing commitments applicable to CPSES were used to establish a listing of criteria which were then used to check SWEC procedures. The procedures were determined to be in compliance either with the existing criteria or criteria changes that were accepted by the NRC for submittals as FSAR amendments (see NRC letter to TUGCO dated November 4, 1986, Reference 7.4)."

The TU Electric Technical Audit Program (TAP) is auditing the Corrective Action Program (CAP) to assure that the design criteria are reconciled with the licensing commitments. In addition, CYGNA Energy Services (CYGNA) has reviewed and accepted SWEC-PSAS's resolution of piping and pipe supports issues that were identified by the Independent Assessment Program (IAP) of CYGNA.

5.1.1.1 Verification and Validation of Design Methodology

SWEC-PSAS performed two separate walkdowns of samples of Unit 1 and Common as-built large bore piping systems to verify and refine the design methodology used for the design validation process. These walkdowns were performed by experienced SWEC-PSAS personnel and are described below.

The first walkdown, called the Large Bore Walkdown, was conducted in accordance with SWEC-PSAS Procedure CPPP-5 (Reference 14). The results of this walkdown are documented in Reference 15. The large bore piping walkdown was performed to determine whether the existing design documentation was adequate to initiate the pipe stress analyses. As a result of this walkdown, the tolerance for orientation of pipe supports was tightened. The orientation of all large bore pipe supports, valves with extended operators, and component supports was reinspected, and the as-built condition was documented. Other design documentation which was inspected and reviewed was determined to be adequate to initiate pipe stress analyses.

The second walkdown, called the Engineering Walkdown, was performed in accordance with SWEC-PSAS Procedure CPPP-8 (Reference 10) to determine:

- Whether there were any additional technical issues related to the functional behavior of the piping system that should be evaluated during the Corrective Action Program (CAP).

- Whether additional design inputs (or refinements thereof), guidelines, or procedures were necessary to complete the large bore piping and pipe support validation effort.

The engineering walkdown was performed by 10 teams composed of both SWEC-PSAS pipe stress and pipe support engineers and encompassed 70 Unit 1 and Common large bore pipe stress analysis packages, including approximately 2,400 pipe supports. The results of this walkdown are documented in Reference 11. This walkdown identified the need for additional refinements that were then incorporated into the technical procedure, CPPP-7, and design control procedure, CPPP-6 (such as the requirement to validate the valve stem extension depicted on the as-built drawing, which was incorporated into CPPP-6, see also Table 5-9).

The engineering walkdown resulted in assurance that no additional technical issues existed, and that the SWEC-PSAS procedures, with the refinements incorporated, were satisfactory to perform the validation of the large bore piping and pipe supports.

Evaluation of Deviation Reports from CPRT - Quality of Construction (QOC) Program

SWEC-PSAS reviewed Deviation Reports (DRs) related to the piping system validation program generated by the Quality of Construction (QOC) program of the Comanche Peak Response Team (CPRT), as discussed in Subappendix A39. This review was performed in accordance with SWEC-PSAS Procedure CPPP-18 (Reference 17). The purpose of the review was to determine whether any additional refinement of SWEC-PSAS's design procedures was necessary, and to identify any deviations that should be specifically or generically addressed for potential impact on the piping Corrective Action Program (CAP). The review concluded that there were no changes required in the design procedures to account for the Deviation Reports (DRs) identified by the Quality of Construction program (QOC) (Reference 18). However, certain attributes for piping and pipe supports were added to the piping and pipe supports Post-Construction Hardware Validation Program (PCHVP) inspection attribute matrix as a result of the Deviation Report (DR) reviews. Corrective action for the hardware-related concerns identified by the Quality of Construction program (QOC) or SWEC-PSAS, such as missing washers, spacers, and locking devices, is implemented through the TU Electric Post-Construction Hardware Validation Program (PCHVP) as described in Section 5.1.3.

5.1.1.2 Resolution of Piping-Related Design Issues

SWEC-PSAS evaluated the issues described in Section 4.0 and Appendixes A and B, and developed technical and design control procedures to resolve the issues. The resolution of all issues in Appendix A were reviewed by TU Electric Comanche Peak Engineering (CPE), and resolution of issues in Subappendixes A1 through A35 were reviewed by TENERA, L.P. (TERA). The resolutions of the issues in Appendix B were reviewed by Comanche Peak Engineering (CPE) and the TU Electric Technical Audit Program (TAP). These resolutions were incorporated into the updated design and installation specifications, as well as the CPSES quality control and construction procedures.

The issue resolution and implementation processes were as follows:

1. For each issue that affected the large bore piping and pipe supports validation effort, SWEC-PSAS reviewed the associated documentation to gain an understanding of the background. SWEC-PSAS then defined its understanding of the issue.

2. With the issue thus defined, SWEC-PSAS developed and executed an action plan to resolve the issue.

3. The resolutions were implemented in appropriate SWEC-PSAS project procedures used for the CPSES Corrective Action Program (CAP). Compliance with these procedures is assured by the SWEC Corporate Quality Assurance program.

Third Party Overview Results

The methodology to resolve Comanche Peak Response Team (CPRT) and external issues was documented in SWEC-PSAS's Evaluation and Resolution of Generic Technical Issues Report dated June 27, 1986. Final revision to this Generic Issues Report (GIR) dated July 24, 1987, updates the resolution sections to encompass current revisions of SWEC-PSAS's procedures and memorandums, and its contents have been incorporated into Appendix A of this report.

TENERA, L.P. (TERA), the lead contractor for the Comanche Peak Response Team (CPRT) Design Adequacy Program (DAP), conducted the third party overview to assure that all CPRT and external issues are clearly identified and resolved in accordance with the CPRT Discipline Specific Action Plan IX (DSAP-IX). The scope of third party overview included the completeness of issue identification, adequacy of issue resolution, and technical procedures implemented by SWEC-PSAS. During performance of Design Adequacy Program (DAP) overview, TENERA, L.P. (TERA) identified and documented issues in Discrepancy Issue Reports (DIRs). SWEC-PSAS has responded to and closed all of the 972 Discrepancy Issue Reports (DIRs) received from TENERA, L.P. (TERA).

TENERA, L.P. (TERA) has completed the third party overview and presented the results in the Discipline Specific Action Plan Results Report for Piping and Pipe Supports. As described on page 2-1 of Reference 46, three areas of overview identified in the Discipline Specific Action Plan IX (DSAP-IX) are discussed as follows:

1. Issues

   "The Third Party identified, reviewed, and tracked external source identified issues which were raised regarding pipe analysis and pipe support design. This effort also included consideration of TRT Issue V.c (Reference 7.5), which addresses design considerations for piping between seismic Category I and nonseismic Category I buildings. The criteria and methodology used by the Project (SWEC) for analysis of these systems were reviewed by the Third Party. This review provides reasonable assurance that the external source issues have been identified and that criteria and methodology used by the Project address all identified issues."

2. Commitment Verification

   "The Third Party verified that commitments which establish piping and support-related design criteria and standards are adequately addressed in procedures and other Project documents. The commitment sources included the FSAR, design specifications, and the ASME Codes of Record for piping (Reference 7.6) and piping supports (Reference 7.7). For each criterion source and standard identified, the appropriate criteria and commitments were summarized. These criteria were used in the development of checklists for the review of specific program areas. This review ensures that Project procedures are consistent with applicable criteria and commitments.

Where criteria changes have been submitted by the project to resolve differences between the approved FSAR and Project procedures (documented on C-DIRs) closure is based on the assumption that the NRC will approve the amendments."

3. Procedure Review

"The Third Party reviewed procedures (including appropriate SWEC Project Management memoranda) developed by the Project (SWEC) for the performance of the SWEC scope involving large bore piping analysis and support design to verify, by evaluation of the supporting analyses, that they are adequate to achieve their intended purpose. This review verifies that the project procedures resolve the external source issues."

TENERA, L.P.'s (TERA) conclusion on the Third Party review is cited in their Discipline Specific Action Plan Results Report No. DAP-RR-P-001 on page 1-2.

"For each of the thirty-two issues, the resolution methodology has been reviewed by the Third Party and found to be responsive to the concern and in compliance with applicable FSAR and licensing criteria. The Third Party has concluded that the overall objectives of the review have been met, and considers all piping-related external source issues applicable to the large bore piping scope to be closed with respect to the methodology being applied to the requalification effort assuming the NRC approves the FSAR amendments."

CYGNA Independent Assessment Program

CYGNA Energy Services (CYGNA), a consulting firm, was originally contracted by TU Electric to perform a project review identified as the Independent Assessment Program (IAP). As a result of this review, CYGNA Energy Services (CYGNA) identified issues which they summarized in the CYGNA Pipe Stress Review Issues List, Revision 4 (Piping-RIL) (Reference 81) and the Pipe Support Review Issues List, Revision 4 (Supports-RIL) (Reference 16).

CYGNA Energy Services (CYGNA) and SWEC held public meetings on November 13 and 14, 1986, at SWEC's Cherry Hill office and December 15 and 16, 1986, at CPSES site to discuss the issue resolutions contained in the CYGNA Review Issue List (RIL) in conjunction with SWEC project procedures CPPP-7 and CPPP-6. CYGNA Energy Services (CYGNA) then performed audits on the basis of SWEC-PSAS design criteria between November 1986 and May 1987.

At the public meeting in Glen Rose, Texas, on May 19, 1987, CYGNA Energy Services (CYGNA) announced that all pipe stress and pipe support issues were closed. All issues relating to embedment plate design, anchorage allowables, spacing, and edge distances were transferred to the Civil/Structural Review Issues List, Revision 0, dated July 12, 1987 (Reference 19), and their resolution is reported in the Civil/Structural Project Status Report (PSR) (Reference 63).

5.1.2 Design Validation Process

The SWEC-PSAS design validation program assures that the design conforms to the licensing commitments. The program can be visualized as a three-step process. The first step, described in Section 5.1.2.1, is to establish the input and the analytical models of the pipe stress analysis packages, to identify and implement the necessary pipe support optimizations and modifications in the analyses, and to produce a set of pipe stress analysis results (e.g., pipe stresses, support loads, and equipment nozzle loads). The first-step results, described in Section 5.1.2.2, provide the pipe support design loads and determine that the computerized pipe stress analysis results are within the ASME Section III Code allowables. The second step includes the detailed evaluation and design of pipe supports (described in Section 5.1.2.3), the local stresses in piping (integral welded attachments), equipment nozzle and containment penetration loads, valve accelerations, pipe break locations, and floor-to-ceiling/wall-to-wall supports, as specified in SWEC-PSAS Procedures CPPP-6 and CPPP-7. Discrepancies identified in this step are resolved either by support modifications or by additional analyses. The third step, or final reconciliation, described in Section 5.1.2.7, is the final process to consolidate analysis, hardware modifications, and inspection documentation from Step 2 into the piping design documentation. The technical interfaces and flow charts for the large bore piping and pipe supports Corrective Action Program (CAP) are shown schematically in Figures 5-2, 5-3, and 5-4.

5.1.2.1 Piping System Input Validation

The design validation process of piping and supports requires a large quantity of input information, as identified in Table 5-1. The SWEC-Mechanical Group and the SWEC-Civil/Structural Group validate the piping system input. The piping system input validation by SWEC and the design inputs developed by SWEC-PSAS are described below.

<u>SWEC-Mechanical Group</u>

The SWEC-Mechanical Group reviewed CPSES system design and operating conditions, which describe the temperatures and pressures of piping systems. These design and operating conditions are evaluated and revised as necessary based on the validated design. Design and operating system temperatures and pressures for a wide range of plant conditions were documented and transmitted to the SWEC-PSAS pipe stress analysts for use in validation. The SWEC-Mechanical Group validation effort is described in the Mechanical Project Status Report

(PSR) (Reference 64). The SWEC-Mechanical Group identified essential[1] safety-related piping systems and components, high energy lines, and potential system fluid transients for evaluation by the SWEC-PSAS Fluid Transients Group. These fluid transients (such as quickly opening or closing control valves, relief valve discharge, pump startup or trip) were identified by following the guidance given in NUREG-0582 (Reference 23), using SWEC's past experience with other pressurized water reactors (PWRs), and by an overall review of the CPSES system design descriptions and flow diagrams.

The SWEC-Mechanical Group reviewed the CPSES flow diagrams and stress boundary isometric drawings (BRPs) to assure that applicable piping lines were included in the pipe stress analysis packages.

SWEC-PSAS Fluid Transient Group

The SWEC-PSAS Fluid Transient Group was responsible for developing the fluid transient loads (e.g., water hammer or steam hammer) from the potential transients identified by the SWEC-Mechanical Group. These loads were used to validate the design of safety-related piping systems. These efforts were necessary to address the issue of Subappendix A19. The fluid transient loads developed by SWEC-PSAS for safety-related piping are summarized in Table 5-2.

The fluid transient loads used for CPSES design validation process are documented as specified in CPPP-10 (Reference 21). Criteria for evaluation of the piping system responses due to fluid transient loads are described in CPPP-7.

SWEC-Civil/Structural Group

The SWEC-Civil/Structural Group has provided validated seismic Amplified Response Spectra (ARS), as discussed in the Civil/Structural Project Status Report (PSR) (Reference 63).

5.1.2.2 Pipe Stress Analysis

Stress analysis of piping computes the responses (such as pipe stresses, loading on pipe supports, valve accelerations, and equipment nozzle loads) of a piping analytical model under the specified loading combinations (such as loads from deadweight, thermal, pressure, seismic, fluid transients, and Loss of Coolant Accident [LOCA]). In Unit 1 and Common, there are 384 large bore Seismic Category I and Seismic Category II pipe stress analysis packages with approximately 12,020 pipe supports.

SWEC-PSAS has validated 341 ASME Section III Code Class 2 and 3 (Seismic Category I) and 16 high energy Seismic Category II pipe stress analysis packages.

[1]Essential systems and components are required to shut down the reactor and mitigate the consequences of a postulated piping failure, without offsite power.

Westinghouse validated the other 30 ASME Section III Code Class 1 (Seismic Category I) pipe stress analysis packages, including the continuations of Class 2 and nonsafety-related piping within the pipe stress analysis package boundary. The pipe stress validation flow chart is shown schematically in Figure 5.3.

SWEC-PSAS Piping and Pipe Support System Review

Prior to the initiation of the pipe stress analysis, each pipe stress analysis package, including the associated pipe supports, was jointly reviewed as a system by the pipe stress and pipe support engineers. The purposes of this review were to establish the piping physical configuration, to determine the location and orientation of the pipe supports with respect to the piping configuration, to evaluate the appropriateness of support types, and to identify areas of piping or pipe support designs which may require special modeling techniques to account for the interactions between the pipe and the pipe supports.

SWEC-PSAS reviewed the pipe support drawings and support location drawings to determine whether the existing supporting system was appropriate and could perform its safety-related function. SWEC-PSAS reviewed the pipe support drawings to determine the appropriate stiffness values for the input to the pipe stress analysis. The piping and pipe support system review also determined whether certain snubbers or other supports should be considered for elimination and whether additional pipe support optimization should be performed.

The results of this review were documented as a separate piping system review/stiffness assessment calculation for each pipe stress analysis package, which was used as design input for the pipe stress analysis. By the incorporation of this review into the validation process, SWEC-PSAS has assured that an integrated process, with consistent criteria for both pipe stress analysis and pipe support design, was used.

Piping Analytical Model

The first step in the pipe stress analysis is the formation of the pipe stress isometric drawings and mathematical models, which are developed by using the input information shown in Table 5-1, in conjunction with the results of the Piping and Pipe Support System Review.

The mathematical model analytically describes the piping configuration, mass, and boundary conditions. Piping mass is considered, including the applicable pipe support mass that affects the dynamic responses. Eccentric masses such as valve operators also are accounted for in the pipe stress analytical model. Sufficient mass points are included to assure that all significant dynamic modes are represented. Appropriate representation of pipe support stiffness from the piping and pipe support system review is included.

Static and dynamic piping analyses were performed using the computer program NUPIPE-SW (Reference 24). The computer program output consists of pipe stresses, displacements, valve accelerations, and interface loadings (e.g., loadings at pipe supports and equipment nozzles). This output was used to qualify the piping, pipe supports, and related components in accordance with the applicable codes and licensing commitments as specified in the governing Design Basis Documents (DBDs).

Static analysis was used for deadweight, thermal, and anchor movement loading cases. The time-history analysis method[2] was used for fluid transient loading cases, and the response spectrum analysis method[2] was used for seismic loading cases. Modal contributions above the cutoff frequency in the response spectrum method analyses were addressed by an analytical technique in accordance with NUREG/CR-1161 (Reference 25). This technique, which incorporated the resolution for the issues in Subappendix A18, assures that high frequency dynamic responses are included in the response spectrum analysis.

Based on the mathematical model and specified inputs, the computerized pipe stress analysis validates the following: the piping pressure boundary integrity, the piping system structural adequacy, and that maximum calculated stresses are within the specified Code allowables.

Additional results (other than the computed pipe stresses) that were generated from the computerized pipe stress analysis and transmitted to other interfacing disciplines for acceptance (see Figure 5-3), are summarized as follows:

Pipe Stress Analysis Results

1. Pipe support loads
2. Equipment nozzle loads
3. Containment penetration loads
4. Expansion joint movements
5. Valve accelerations
6. Valve operator support loads
7. Valve nozzle loads
8. Flange loads
9. Pipe movements at wall or floor sleeves
10. Instrument root valve movements
11. Pipe movements at branch lines
12. Pipe movements at pipe rupture restraints
13. Stress levels for pipe break/crack evaluations

Transmittal of Pipe Stress Analysis Results Package

Following completion of each pipe stress calculation, a results package that contains a summary of pipe stress analysis results was compiled and distributed to the SWEC-PSAS Pipe Support Group and other interfacing disciplines as shown in Figure 5-2. The results package, consisting of information such as the equipment nozzle loads and valve accelerations, was sent to other disciplines

[2]Analytical technique used to determine the responses of structures to dynamic loads.

for acceptance. The pipe support summary transmittal identifies supports requiring modification and/or deletion and lists for each pipe support the support function, orientation, loads, and movements.

Integral Welded Attachment Analysis

A separate analysis was performed for each location on the piping which is fitted with an integrally welded pipe support attachment to assure that the local piping stress is within the allowable stress limit. For Integral Welded Attachments (IWAs) that could not be validated by the standard methods used by SWEC-PSAS for typical lug and trunnion configurations, the validation was based on finite element analysis techniques for the specific support, comparison to a similar specific support analysis, or comparison to a parametric finite element analysis study.

Pipe Break/Crack Analysis

As part of the CPSES licensing commitments, the locations of the postulated high energy line breaks (HELBs) and moderate energy line cracks (MELCs) have been evaluated and assessed using the validated results of SWEC-PSAS pipe stress analysis. Piping stresses, including the local pipe stress from Integrally Welded Attachment (IWA) pipe supports, were reviewed to postulate break and crack locations in accordance with SWEC-PSAS Procedure CPPP-20 (Reference 65). New mandatory break and crack postulation points were compared to previous locations, and the results were forwarded to the Ebasco Services Incorporated (Ebasco) - System Interaction Group to determine the impact. This impact may include elimination or addition of pipe rupture restraints or jet impingement shields, jet impingement system interaction studies, or reanalysis of the pipe stress if the consequences of the new postulated break locations are unacceptable. The evaluation results from System Interact[illegible] Group are described in the Mechanical Project Status Report (PSR).

Piping and Pipe Supports Attached to Secondary Walls

Special pipe stress analyses were performed in accordance with SWEC-PSAS Procedure CPPP-35 (Reference 59) to validate supports/penetrations that have been identified as being attached to a secondary wall.

5.1.2.3 Pipe Support Analysis

Based on the pipe support loads from the SWEC and Westinghouse stress analyses results (see Figures 5-3 and 5-4), individual calculations for all large bore pipe supports were prepared to assure code compliance with the design criteria. The pipe support validation process is shown schematically in Figure 5-4 and can be summarized as a process whereby the support analysis in conjunction with required modifications provide the final validation of the pipe support design.

Pipe support analysis results are distributed to the interfacing organizations for acceptance as shown in Figure 5-4. The validated pipe support calculations and drawings are distributed and filed in accordance with project procedures and are included within each Piping - Design Validation Package (DVP).

The CPSES Unit 1 and Common pipe supports can be categorized into three types as follows:

1. Standard Component Supports - Struts, spring hangers, and snubbers

2. Structural Frame Supports - Including supports for multiple pipes

3. Integrally Welded Attachment (IWA) Supports - Trunnions and lugs

Validation of these pipe support types is described below.

Standard Component Supports

Standard component supports were evaluated to assure that they are suitable to perform their design function. Loads from the pipe stress analysis were compared with the manufacturer's standard component support capacities. In addition, the relative displacements under all specified load conditions were evaluated to validate the displacement ranges and swing angles of standard components.

Structural Frame Supports

Frame type supports were validated by using hand calculations with standard structural analysis methods for simple designs or by computer analysis using STRUDL, STRUDAT, and SANDUL computer programs (described in CPPP-7) for more complex designs. In addition to validating the adequacy of local stresses in the pipe, the validation included the evaluation of:

- Member stress versus applicable stress allowables

- Reactions at support joints, including local stress effects on tube steel members

- Weld adequacy at welded joints

- Adequacy of bolted connections, including washer plate design and local stress effects on tube steel members

- Adequacy of concrete anchors and base plates

- Adequacy of clearances between piping and the frame

Special Pipe Support Frame Analysis

Two special groups of pipe support frames, (i) the wall-to-wall and floor-to-ceiling supports and (ii) corner supports, required special analysis to address the effects of differential building movement at the support attachment locations to the building and for restrained thermal expansion of the wall-to-wall and floor-to-ceiling supports. These designs are validated in accordance with the criteria contained in Attachment 4-19 of CPPP-7 in resolution of the external issue described in Subappendix A3.

Integral Welded Attachment Analysis

A separate analysis was performed for each location on the piping with an integrally welded pipe support attachment to assure that the local piping stresses and support member stresses are within the applicable stress allowables. The piping local stress is discussed in Section 5.1.2.2.

5.1.2.4 Validation of Seismic Category II Large Bore Piping and Pipe Supports Over Seismic Category I Equipment

SWEC-PSAS developed a Field Verification Method (FVM) CPE-SWEC-FVM-PS-82 (Reference 52) to validate the integrity of seismic Category II piping and pipe supports in accordance with CPPP-30 (Reference 56). The purpose of this validation process is to provide additional assurance by engineering walkdown and evaluation that during or after a seismic event, Seismic Category II piping systems will not fall and damage nearby Seismic Category I systems, structures, or components. This Field Verification Method (FVM) specifies the engineering field walkdowns necessary to assure that the as-built Seismic Category II piping and pipe supports are in compliance with the acceptance criteria. A detailed discussion of this validation process is contained in Section 5.1.3.1.

5.1.2.5 SWEC-PSAS Clearance Walkdowns

SWEC-PSAS developed a Field Verification Method (FVM) CPE-SWEC-FVM-PS-80 (Reference 50) to assure that sufficient clearance exists around validated piping in accordance with SWEC-PSAS Project Procedure CPPP-22 (Reference 32). Clearance is required to permit those anticipated piping displacements that could occur under plant operating conditions without any impediment to those displacements. Impediment is defined as any structure, system, or component (e.g., pipe, conduit, cable tray, equipment) that encroaches on the envelope of anticipated pipe displacement. A detailed discussion of this validation process is contained in Section 5.1.3.1.

5.1.2.6 Testing

The CPSES preoperational and startup testing program provides assurance that piping systems, components, supports, and related structures have been adequately designed and installed. The correctness or conservatism of assumptions made in predicting plant responses is validated by analyzing data obtained in a controlled testing environment.

The testing includes verification by observation and measurement (as appropriate) to assure that movement, vibration, and expansion of piping and components are acceptable for:

- ASME Section III Code Class 1, 2, and 3 piping systems.
- Other nonsafety-related high energy piping systems inside seismic Category I structures whose failure could reduce the functioning of any seismic Category I structure, system, or component.

- Seismic Category I portions of moderate energy piping systems located outside the containment.

The testing program consists of the following categories:

Vibration Testing

The CPSES vibration testing program is set forth in SWEC-PSAS Procedure CPPP-25 (Reference 57). This program follows the guidelines of NRC Regulatory Guide 1.68 (Reference 82) and ANSI/ASME Standard OM-3 (Reference 27) for steady state and transient vibration testing of piping systems. Piping systems are classified as Vibration Monitoring Group (VMG) VMG-1, VMG-2, or VMG-3, as defined in Reference 27. Piping systems which have no potential vibration problems are classified as VMG-3. If unexpected vibrations are observed during testing, additional inspections are performed to determine the degree of the problem and the resolution.

If a piping system is identified as posing a potential vibration problem, the affected portion of the system is classified as Vibration Monitoring Group 2 (VMG-2). This piping will be instrumented during testing to provide a means for ascertaining the maximum vibration response.

Piping systems which exhibit a response not characterized by simple piping vibration modes, and piping systems for which the methods of Vibration Monitoring Group 2 (VMG-2) and Vibration Monitoring Group 3 (VMG-3) are not applicable, are classified as Vibration Monitoring Group 1 (VMG-1). In these cases, more refined monitoring methods are utilized during testing.

All personnel who perform pipe vibration observations and measurements receive training and must pass a written certification examination (Reference 53).

The vibration data is analyzed subsequent to collection. Transient vibration test data which does not meet the acceptance criteria established by CPPP-25 must be referred to SWEC-PSAS for further analysis and resolution. When appropriate, corrective action is implemented and retesting is conducted to verify final acceptance.

For steady-state pipe vibration, if vibration can be visually observed, then vibration measurements are taken. When the measured peak-to-peak pipe velocity exceeds the acceptance criteria, displacement measurements are obtained and compared to calculated allowable values. If the system steady-state displacement exceeds the calculated allowable values, corrective action will be implemented and appropriate retesting will be conducted to verify final acceptance.

Thermal Expansion Testing

As part of the piping and pipe support validation program, SWEC-PSAS has reviewed the impact of analysis and modification on thermal expansion tests (TET). Systems or portions of systems which require testing have been identified.

SWEC-PSAS Procedure CPPP-24 (Reference 66) sets forth the methods for identifying piping for thermal expansion tests, for identifying the locations and the supports to be monitored, for establishing acceptance criteria, for reconciling results, and for recommending modifications to correct discrepancies. Upon completion of all thermal expansion tests, an engineering report will be prepared summarizing the results.

In summary, the CPSES piping and pipe support validation program encompasses appropriate field testing. Rigorous requirements for evaluating and documenting piping systems under static, dynamic, steady-state, and transient conditions are set forth in SWEC-PSAS procedures. The results of field testing will provide physical confirmation that large bore piping and pipe support design and installation comply with the design criteria.

5.1.2.7 Final Reconciliation of Large Bore Piping and Pipe Supports

The purpose of final reconciliation is to resolve and incorporate pipe stress and pipe support analysis results (see Figure 1-1) with the final design input and as-built configuration. The final reconciliation process is conducted in accordance with SWEC-PSAS Procedure CPPP-23, Pipe Stress/Pipe Support Reconciliation Procedure (Reference 29). The final reconciliation of large bore piping and pipe supports incorporates the following:

- The Post-Construction Hardware Validation Program (PCHVP) results which provide the as-built large bore piping and pipe support configurations (see Section 5.1.3).

- Resolution of the open items in NRC Staff positions in Supplementary Safety Evaluation Reports (SSERs) as described in Subappendixes A36, A37, and A38.

- Resolution of the piping-related Comanche Peak Response Team (CPRT) issue-specific action plans (ISAPs) and external issues.

Final reconciliation also includes confirmation that the interfacing organizations have accepted the SWEC-PSAS results as compatible with their validated design. Interfacing organizations receive results as described below and in Figure 5-2:

- SWEC-Mechanical Group - Required reflective insulation removal at sleeves, penetrations, or frame supports; expansion joint movements.

- Ebasco System Interaction Group - Postulated pipe break locations; pipe movements at pipe rupture restraint locations

- Westinghouse - Results of ASME Section III Code Class 1 pipe supports validation, loads imposed by SWEC-PSAS analyzed piping on ASME Section III Code Class 1 piping, support reaction loads on Westinghouse-designed equipment supports, and valve accelerations and equipment nozzle loads for Westinghouse-supplied valves and equipment.

- SWEC-Civil/Structural Group - Structural interface reaction loads, including penetration loads, load patterns on embedments.

- Impell Equipment Qualification Group - Valve nozzle loads, valve accelerations and valve operator support requirements, and pipe movements at sealed sleeves.

- SWEC-Instrument and Control Group - Root valve movements for instrument systems.

In addition, the validated piping weld locations are provided to TU Electric for the identification of locations for preservice and inservice inspections.

Closure of open items, observations, and deviations related to large bore piping and pipe supports that were identified by TU Electric Quality Assurance, SWEC Engineering Assurance, and Engineering Functional Evaluation (EFE) are resolved prior to the completion of this reconciliation phase. Open items from the NRC Notices of Violation (NOVs), and the TU Electric Significant Deficiency Analysis Reports (SDARs) (10CFR50.55[e]) are also resolved during the final reconciliation.

Each pipe stress analysis package, at the conclusion of final reconciliation, will be compiled into the Piping - Design Validation Package (DVP) as described in Section 3.0 and SWEC-PSAS Procedure CPPP-23. The Piping-DVP consists of the pipe stress analysis calculations, the hanger location drawings (identifying the pipe support locations and stress problem boundaries), the pipe supports calculations and drawings (including the design changes and as-built modifications) within its pipe stress analysis package boundary, and related interface transmittals.

5.1.3 Post-Construction Hardware Validation Program (PCHVP)

The Post-Construction Hardware Validation Program (PCHVP) (Reference 48) is the portion of TU Electric's Corrective Action Program (CAP) which validates the final acceptance attributes for safety-related hardware. The Post-Construction Hardware Validation Program (PCHVP) process is shown diagrammatically in Figure 5-5.

The input to the Post-Construction Hardware Validation Program (PCHVP) is contained in the installation specifications. The installation specifications implement the licensing commitments and design criteria of the Design Basis Documents (DBDs), which were developed during the Corrective Action Program (CAP) Design Validation process.

Final acceptance inspection requirements identified in the validated installation specifications were used to develop the Post-Construction Hardware Validation Program (PCHVP) attribute matrix. This matrix is a complete set of final acceptance attributes identified for installed hardware. The Post-Construction

Hardware Validation Program (PCHVP), by either physical validations or through an engineering evaluation methodology, assures that each of the attributes defined in the attribute matrix is validated.

Physical validation of an attribute is performed by Quality Control inspection or engineering walkdown, for accessible components. Quality Control inspections and engineering walkdowns are controlled by appropriate Field Verification Method (FVM) procedures.

The Post-Construction Hardware Validation Program (PCHVP) engineering evaluation depicted in Figure 5-5 is procedurally controlled to guide the Corrective Action Program (CAP) responsible engineer through the evaluation of each item on the attribute matrix to be dispositioned by the engineering evaluation method. Dispositions of each attribute will be clearly documented. If the technical disposition of the final acceptance attribute is "not acceptable" or the attribute cannot be dispositioned based on available information, an alternate plan consisting of additional evaluations, testing, inspections/walkdowns or modification as necessary will be developed to demonstrate and document the acceptability of the attribute.

Recommendations from the Comanche Peak Response Team (CPRT) effort comprise a significant portion of this evaluation. A major component of the Comanche Peak Response Team (CPRT) program has been the inspection of a comprehensive, random sample of existing hardware using an independently derived set of inspection attributes. The inspection was performed and the results evaluated by third party personnel in accordance with Appendix E to the Comanche Peak Response Team (CPRT) Program Plan (Reference 33). The scope of the inspection covered the installed safety-related hardware by segregating the hardware into homogeneous populations (by virtue of the work activities which produced the finished product). Samples of these populations were inspected to provide reasonable assurance of hardware acceptability in accordance with Appendix D to the Comanche Peak Response Team (CPRT) Program Plan.

Corrective action recommendations were made to TU Electric based on the evaluated findings when a Construction Deficiency existed, an Adverse Trend existed, or an Unclassified Trend existed, as defined in accordance with Appendix E to the Comanche Peak Response Team (CPRT) Program Plan.

The Post-Construction Hardware Validation Program (PCHVP) assures that all Comanche Peak Response Team (CPRT) recommendations are properly dispositioned.

Figure 5-5 illustrates that during the evaluation of a given attribute from the Post-Construction Hardware Validation Program (PCHVP) attribute matrix, the initial task of the Corrective Action Program (CAP) responsible engineer is to determine if any of the following statements are true:

a. The attribute was recommended for reinspection by the Comanche Peak Response Team (CPRT).

b. Design Validation resulted in a change to design or to hardware final acceptance attribute that is more stringent than the original acceptance attribute, or Comanche Peak Response Team (CPRT) did not inspect the attribute.

c. Design Validation resulted in new work, including modification to existing hardware.

If the Comanche Peak Response Team (CPRT) had no recommendations and Items b or c above do not apply, the attribute under consideration will be accepted. This conclusion is justified by the comprehensive coverage of the Comanche Peak Response Team (CPRT) reinspection and the consistently conservative evaluation of each finding from both a statistical and adverse trend perspective. The attribute matrix is then updated to indicate that neither the engineering walkdown nor quality control inspection of the attribute is necessary. A completed evaluation package is prepared and forwarded to the Comanche Peak Engineering (CPE) organization for concurrence. The evaluation package becomes part of the Design Validation Package (DVP) after Comanche Peak Engineering (CPE) concurrence is obtained.

If any of the three statements are true, it is assumed that the final acceptance attribute must be further evaluated as follows:

Determine Attribute Accessibility

The Corrective Action Program (CAP) responsible engineer will determine if the attribute is accessible. If the attribute is accessible, a field validation of the item's acceptability will be performed and documented in accordance with an approved Field Verification Method (FVM).

If the Corrective Action Program (CAP) responsible engineer reaches the conclusion that the attribute is inaccessible, an engineering evaluation will be conducted by technical disposition of available information.

After completing the attribute accessibility review, the responsible engineer will update the attribute matrix as necessary to reflect the results of that review.

Technical Disposition

The Corrective Action Program (CAP) responsible engineer identifies the data to be considered during the subsequent technical disposition process. Examples of such items used in this disposition may include, but are not limited to:

- Historical documents (e.g., specifications, procedures, inspection results)
- Comanche Peak Response Team (CPRT) and external issues
- Construction practices

- Quality records
- Test results
- Audit reports
- Authorized Nuclear Inspector (ANI) records
- Surveillance reports
- NCRs, DRs, SDARs, and CARs
- Inspections conducted to date
- Results of Third Party reviews
- Purchasing documents
- Construction packages
- Hardware receipt inspections

After compiling the data identified as pertinent to the attribute, the technical disposition will be performed. The actual steps and sequence of actions required for each technical disposition will differ; however, the tangible results from each technical disposition will be consistent. These results will include at a minimum:

a. A written description of the attribute.

b. A written justification by the Corrective Action Program (CAP) responsible engineer for acceptance of the attribute.

c. A written explanation of the logic utilized to conclude that the attribute need not be field validated.

d. A chronology demonstrating that the attribute has not been significantly altered by redesign.

e. All documents viewed to support the disposition.

f. Concurrence of the acceptance of the attribute's validity by Comanche Peak Engineering (CPE).

If the Corrective Action Program (CAP) responsible engineer concludes that the data evaluated represents evidence of the attribute's acceptability, the conclusion will be documented. The documentation will be reviewed and approved by Comanche Peak Engineering (CPE) and filed in the Design Validation Package (DVP). If the Corrective Action Program (CAP) responsible engineer determines that the data reviewed does not provide evidence of the attribute's acceptability, the documentation will explain why the attribute cannot be accepted and recommend an alternate course of action. The alternate course of action may take various forms such as making the attribute accessible and inspecting it, or testing to support the attribute's acceptability. This alternate plan, after approval by Comanche Peak Engineering (CPE), will be implemented to validate the attribute.

In summary, the Post-Construction Hardware Validation Program (PCHVP) is a comprehensive process by which each attribute in the PCHVP attribute matrix is validated to the validated design. The TU Electric Technical Audit Program (TAP) will audit the Post-Construction Hardware Validation Program (PCHVP). This audit program is complemented by the Engineering Functional Evaluation being performed by an independent team comprised of Stone & Webster, Impell, and Ebasco engineering personnel working under the Stone & Webster QA Program and subject to oversight directed by the Comanche Peak Response Team's (CPRT) Senior Review Team. The Post-Construction Hardware Validation Program (PCHVP) will provide reasonable assurance that the validated design has been implemented for safety-related hardware.

SWEC-PSAS prepared Post-Construction Hardware Validation Program (PCHVP) implementation procedures for large bore piping and pipe supports. The hardware validation process includes modifications, whenever necessary, to bring the piping and pipe supports into compliance with the validated design. The attributes contained within the Post-Construction Hardware Validation Program (PCHVP) Attribute Matrix for piping and pipe supports incorporate the recommended corrective actions in the CPRT-QOC Issue-Specific Action Plan, ISAP-VII.c Results Report (Reference 36), thus resolving the hardware-related issues (see Subappendix A39). The complete tabulation of piping-related inspection attributes to address CPRT-QOC recommendations is presented in Table 5-3.

5.1.3.1 Post-Construction Hardware Validation Program (PCHVP) Procedures

SWEC-PSAS developed procedures to validate that the as-built large bore piping and pipe supports are in compliance with the validated design procedures listed in Table 5-7. These procedures are designated as Field Verification Methods (FVMs) and are described below.

FVM-81, Piping and Pipe Supports Inspection and Hardware Validation

SWEC-PSAS developed the Field Verification Method (FVM) CPE-SWEC-FVM-PS-81 (Reference 51) to coordinate the Unit 1 and Common piping and pipe support inspection validation activities.

These piping inspections are performed and documented by Quality Control (QC) personnel to assure that applicable inspection attributes are acceptable. The piping inspection attributes are as below:

Equipment and piping configuration
Piping wall thickness at shop/field bends

Radial weld shrinkage at stainless steel piping joints
Equipment anchoring
Remote valve operators
Branch connections
All pressure boundary items installation/base metal defects
Valve orientations
Pipe/sleeve details
Permanent pipe support installation (no temporary or voided supports)
Verify location (span) dimensions/tolerances
Applicable dielectric insulating sleeves over bolts/studs
Linear dimensions of piping segments and in-line components

The hardware validation of pipe supports assures that the removable items on a pipe support are installed as required by the design documentation. The hardware validation is implemented by Quality Control (QC) personnel in compliance with the validated support drawing. Quality Control personnel verify and document that all applicable hardware attributes listed on the hardware validation checklists are acceptable. The following pipe support hardware validation checklists are used, as applicable:

Adjacent Weld Checklist
Bolted Connection Checklist
Hilti Bolt Checklist
Pipe Clamp Checklist
Richmond Insert Checklist
Snubber Checklist
Support Checklist
Sway Strut Checklist
Through Bolt/Embedded Bolt Checklist
U-Bolt/Bolted U-Guide Checklist
Variable/Constant Spring Checklist

In addition to the hardware validation pipe support inspections, Quality Control (QC) personnel also conduct inspections for pipe support configuration attributes as below:

Material acceptability
Support configuration compliance with validated design drawing, including dimensions
Support overhang length/tolerance
Support projection length/tolerance
Sway strut/snubber pin-to-pin dimension/tolerance
Alignment and circumferential deviation of shear lugs
Hilti bolt size/embedment
Weld length of structural member on base plate
Welded connection in accordance with validated drawing
Edge distance for structural members and base plates
Slope of bolted part with bolt head or nut
Shim size/weld

FVM-080, Clearance Walkdowns

SWEC-PSAS developed the Field Verification Method (FVM) CPE-SWEC-FVM-PS-80 to assure that sufficient clearance exists around the validated piping. Clearance is required to permit those anticipated piping displacements that could occur under plant operating conditions without any impediment to those displacements. An impediment is defined as any structure, pipe, conduit, cable tray, equipment, etc, that encroaches on the envelope of anticipated pipe displacement.

This field verification effort is performed by the SWEC-PSAS engineering personnel. SWEC-PSAS has established clearance criteria and is responsible for training the clearance walkdown teams, evaluating clearance problems, and issuing design changes to correct any clearance violations, as follows:

1. SWEC-PSAS Site Engineering Group shall establish and train the clearance walkdown teams, consisting of a stress engineer, a pipe support engineer, and others as required.

2. Displacement and clearance criteria established by other disciplines will be used in the walkdown (e.g., conduit displacements, equipment displacements, proximity of heat sources), as applicable.

3. A table will identify each pipe stress analysis package and the associated maximum displacements for other components, such as equipment, conduit, cable trays, piping, and pipe supports.

4. An engineering walkdown is being performed for each pipe stress analysis package to validate the as-built clearances acceptance criteria. A Clearance Evaluation Form shall be completed for each violation of the clearance criteria.

Quality Control (QC) personnel will periodically accompany the SWEC-PSAS engineering walkdown teams and perform surveillance inspections to assure compliance with the Field Verification Methods (FVMs).

FVM-82, Validation of Seismic Category II Large Bore Piping and Pipe Supports Over Seismic Category I Equipment

SWEC-PSAS developed the Field Verification Method (FVM) CPE-SWEC-FVM-PS-82 to validate the integrity of seismic Category II piping and pipe supports over Seismic Category I equipment as specified in CPPP-30. The purpose of this Field Verification Method (FVM) is to assure, by engineering inspection and evaluation, that during or after a seismic event, the Seismic Category II piping systems will not fall and damage nearby Seismic Category I systems, structures, or components. This Field Verification Method (FVM) specifies the engineering field walkdowns required to assure that the installation of the piping and pipe supports is in compliance with the validated design.

The field verification effort is performed by SWEC-PSAS engineering personnel using the acceptance criteria for the configuration of the supports and the tolerances specified in Piping Erection Specification No. 2323-MS-100 (Reference 38). Tables 5-6 and 5-8 contain the piping and pipe supports checklists for this field verification effort.

Quality Control (QC) personnel will periodically accompany the SWEC-PSAS engineering walkdown teams and perform surveillance inspections to assure compliance with the Field Verification Methods (FVMs).

5.2 RESULTS

This section discusses the results of the SWEC-PSAS Large Bore Pipe Stress and Pipe Support Corrective Action Program (CAP).

5.2.1 Pipe Stress Analysis Results

The pipe stress analysis packages validated by SWEC-PSAS are within the allowable stress criteria of the ASME Section III Code.

The pipe stress analysis results are described below.

- Pipe Support Optimization (As a Result of Pipe Stress Design Validation Process)

  A total of 583 snubber supports were deleted through the pipe support optimization process. Approximately 300 additional snubber supports were converted to rigid supports, bringing the total number of snubbers eliminated for Unit 1 and Common to 1,182 (some snubber supports contain more than one snubber). This large reduction of snubbers (approximately 50 percent of the original total) is part of the overall plant improvement incorporated into the SWEC-PSAS validation effort. It represents a significant improvement in plant reliability and reduction in inservice inspection, worker radiation exposure, and cost of maintenance.

- Integral Welded Attachments (IWAs)

  A total of 1,166 Integral Welded Attachments (IWAs) in large bore pipe stress analysis packages within Unit 1 and Common were analyzed, and 309 require modification.

- Pipe Rupture Analysis

  High energy piping arrangement in CPSES Unit 1 and Common utilized the design criteria of postulated pipe ruptures protection by physical separation. Consequently, of the 384 large bore pipe stress packages, pipe rupture analyses are required for 68 high energy and 49 moderate energy large bore pipe stress analysis packages. These stress analyses were analyzed with the following results:

  High Energy Line Break (HELB) Postulation - A total of 37 mandatory postulated intermediate breaks were identified.

  Moderate Energy Line Crack (MELC) Postulation - A total of 91 mandatory postulated cracks were identified.

- Piping and Pipe Supports Attached to Secondary Walls

  The piping and pipe support validation procedure for secondary wall displacements, CPPP-35 is used to qualify 377 supports/penetrations that have been identified as being attached to a secondary wall.

Approximately 83 percent of these supports comply with the flexibility criteria of CPPP-35, and no further evaluation is required. Those supports which did not comply with the flexibility criteria affect 33 large bore pipe stress analysis packages in Unit 1 and Common. This validation requires the modifications of 10 pipe supports that spanned secondary and primary walls within these large bore pipe stress analysis packages.

5.2.2 Pipe Support Analysis Results

The Pipe Support Analyses validated that approximately 12,020 pipe supports within the 384 large bore pipe stress analysis packages comply with the design criteria. During the SWEC-PSAS pipe support validation process, required support modifications were identified. The pipe support modifications are categorized as follows:

1. Prudent - Supports in this category may have been technically acceptable; however, more time and expense would have been involved in the detailed analysis than that required to physically modify the support and qualify the modification.

2. Recent Industry Practice - Modifications implemented to eliminate snubbers to enhance plant maintainability, reduce inservice inspection, and minimize worker radiation exposure during operating plant conditions.

3. Adjustment - Minor modifications (such as retorquing or shimming) implemented to meet installation criteria contained in the resolution of the CPRT and external issues.

4. Cumulative Effects - Modifications that are required due to the combined effect of the previous issues.

From the results of the stress analysis, 1,452 supports were deleted and 186 supports were added (including the addition of 20 pipe anchors). The result of SWEC-PSAS pipe stress and support analysis has identified a total of 5,621 supports that require modification (including deletions and additions). Table 5-4 contains a description of the types of modifications by the above categories.

The plant modifications resulting from the Large Bore Pipe Stress and Support Corrective Action Program (CAP) has been determined by TU Electric to be reportable under the provisions of 10CFR50.55(e). TU Electric reported to the NRC the large bore piping modifications in the Significant Deviation Analysis Report SDAR-CP-86-36 (see Subappendix B2).

5.2.2.1 Pipe Support Modifications Identified Prior to Pipe Stress Analysis

The following types of pipe supports were identified for modification prior to stress analysis as a result of the resolution of the CPRT and external issues.

- Cinched U-Bolts on Single Struts or Snubbers

  To avoid lengthy detailed stress evaluations for the pipe, U-bolt, and crosspiece, all 353 cinched U-bolts on single strut or snubber large bore pipe supports for Unit 1 and Common are identified for elimination or modification.

- Cinched U-Bolt Trapeze Supports

  Of the 693 cinched U-bolt trapeze supports in Unit 1 and Common large bore pipe supports, 266 were identified for deletion, and the remaining 427 were identified for modification. Table 5-5 summarizes the types of modifications identified for the cinched U-bolt trapeze supports.

- Potentially Unstable Supports

  In addition to the cinched U-bolt supports, both single strut and trapeze, Project Procedure CPPP-7, Attachment 4-9, requires that potentially unstable supports be modified. Such configurations identified are trapeze supports with zero clearance box frames, spring hangers on trapeze, and spring hangers without a U-bolt. These supports are redesigned or eliminated during the validation process.

- Clearance on Rigid Supports

  The clearance between the pipe and the restraining surfaces for rigid restraints such as frames, straps, uncinched U-bolts and lugs is inspected and adjusted where required to meet the clearance requirements specified in Project Procedure CPPP-7, Attachment 4-11.

- Uncinched U-Bolts on Rigid Frames

  Uncinched U-bolts on rigid frames for pipe sizes 6 in. and smaller were analyzed and designed as two-way restraints in accordance with Project Procedure CPPP-7, Attachment 4-3. Where they existed on pipes 8 in. nominal size and larger, they were identified for elimination or replacement by a strap or a box frame, as appropriate, during the validation process.

- Single Tube Steel with Richmond Insert Bolts

  Supports with single tube steel Richmond insert connections loaded primarily in shear and/or torsion are modified by the addition of "outriggers" to increase the rigidity of the support.

- Long Tube Steel with Richmond Insert Bolts

  Pipe supports with long tube steel anchored by Richmond inserts and subject to LOCA temperature effects are modified by limiting the tube steel length. These supports were primarily "run together" multiple pipe supports.

5.2.2.2 Special Pipe Support Frame Results

Special analyses were required for certain supports to evaluate the effect of differential movement of the attachment points and/or restrained thermal expansion.

- Wall-to-Wall and Floor-to-Ceiling Supports

  Twenty-seven wall-to-wall and floor-to-ceiling pipe supports were identified in large bore pipe stress analysis packages within CPSES Unit 1 and Common. These supports were validated by meeting the requirements specified in Table 4.7.2-1 and Attachment 4-19 of SWEC-PSAS Procedure CPPP-7, and 19 required modification as a result of differential movement of attachment points and restrained thermal expansion.

- Corner Supports

  SWEC-PSAS Project Memorandum PM-39 (Reference 54) identifies the procedure for the identification, evaluation, and disposition of corner supports with wall-to-floor or wall-to-ceiling attachments encountered during the validation effort, with 221 corner supports identified in the large bore pipe stress analysis packages within Unit 1 and Common. The design of all corner supports on CPSES Unit 1 and Common has been validated by meeting the requirements specified in Table 4.7.2-1 and Attachment 4-19 of SWEC-PSAS Procedure CPPP-7, and no modifications were required as a result of differential building movements.

5.2.2.3 SWEC-PSAS As-Built Verification of Modifications

SWEC-PSAS performs the as-built piping validation of the CPSES Unit 1 and Common large bore piping and pipe support modifications in compliance with NRC I&E Bulletin 79-14. This process is conducted as part of the final reconciliation process described in Section 5.1.2.7 in accordance with SWEC-PSAS procedure CPSP-12 (Reference 37). The piping linear dimensions, elevations, valve orientations, angles, wall and floor sleeve penetrations, and interconnecting equipment are validated. The modified pipe supports are validated to the as-built drawings, including configuration, mark number, dimensional location, function, angularity, and directions.

5.2.3 Post-Construction Hardware Validation Program (PCHVP) Results

The Post-Construction Hardware Validation Program (PCHVP) is implemented through the verification of the hardware-related attributes described in Section 5.1.3 for the large bore piping and pipe supports in Unit 1 and Common.

These field verifications listed below are in progress:

- Field Verification Method (FVM) for hardware inspection/validation (CPE-SWEC-FVM-PS-081). To date, 2,877 pipe supports within the large bore pipe stress analysis packages have been validated to be in conformance with the acceptance criteria.

- Field Verification Method (FVM) for clearance walkdowns (CPE-SWEC-FVM-PS-080).

- Field Verification Method (FVM) for Seismic Category II large bore piping and pipe supports over Seismic Category I equipment (CPE-SWEC-FVM-PS-082).

5.3 QUALITY ASSURANCE PROGRAM

All activities of the Unit 1 and Common large bore piping and pipe support Corrective Action Program (CAP) were performed in accordance with SWEC's Quality Assurance (QA) program. This program is consistent with SWEC's Topical Report SWSQAP 1-74A (Reference 20), Stone & Webster Standard Quality Assurance Program, which has been approved by the NRC.

In accordance with the Quality Assurance (QA) program, a project-specific QA program (Reference 6) including procedures covering the essentials of the SWEC-PSAS validation process were developed. These SWEC-PSAS Project Procedures were distributed to all supervisory engineers and were readily available to SWEC-PSAS personnel. The issuance of design criteria, validation procedures, and major revisions of these documents was followed up with detailed training programs for applicable personnel. In particular, pipe stress and support engineers on the project received training in the technical procedure (CPPP-7), and the design control procedure (CPPP-6).

A Project Quality Assurance (QA) Manager, who is directly responsible to the SWEC Vice President of QA and has management experience in auditing and QA program procedure development for engineering activities, was assigned to the project in the earliest stages of project mobilization. This reporting responsibility assures independence of the Quality Assurance (QA) functions. The SWEC-PSAS Quality Assurance (QA) Manager has a staff of Engineering Assurance (EA) engineers assigned to assist him in his duties. SWEC's EA Division is an integral part of SWEC's QA Program (Reference 20). These individuals provide assurance that the QA program properly addresses all project activities and assist SWEC-PSAS personnel to understand and properly implement the QA program.

To date, more than 164,000 man-hours have been expended by SWEC in activities directly attributable to the overall Project Quality Assurance program (i.e., training, procedure development, auditing, and the project QA Manager's staff).

The adequacy and implementation of this Quality Assurance program was extensively audited by SWEC's Engineering Assurance Division, SWEC's Quality Assurance Auditing Division (QAAD), TU Electric Technical Audit Program (TAP), and the NRC's Vendor Program Branch (VPB) and Office of Nuclear Reactor Regulation. A total of 36 audits were performed by these organizations to date for both Units 1 and Common large bore piping and pipe supports Corrective Action Program (CAP) as follows:

SWEC - EA	22
SWEC - QAAD	1

TU Electric - TAP[4]	12
NRC	1

The SWEC, NRC, and TU Electric Technical Audit Program (TAP) audits evaluated the technical adequacy of the engineering product (e.g., calculations, drawings, and specifications) and assessed the adequacy and implementation of the SWEC Quality Assurance Program. A summary of these audits is presented in Sections 5.3.1 and 5.3.2.

TU Electric conducted technical audits as part of the TU Electric Technical Audit Program (TAP). The details of calculations, drawings, and procedural compliance and technical interfaces were evaluated. These technical audits have resulted in enhancements to the procedures and methods and thus contributed to the overall quality of the CPSES large bore pipe and support design.

The NRC Staff performed surveillances on SWEC-PSAS validation process, including in-process reviews of SWEC-PSAS's progress and methods of resolving the generic technical issues and verification of the adequacy of SWEC-PSAS walkdowns. The NRC-VPB performed an audit of the SWEC-PSAS piping and pipe support Corrective Action Program (CAP).

A Third Party organization (Tenera, L.P.) was contracted by CPRT to overview the adequacy of SWEC-PSAS large bore piping and pipe support design methodology as discussed in Section 5.1.1. The Third Party concluded that SWEC-PSAS's large bore pipe stress analysis and pipe support validation program was comprehensive and capable of resolving Comanche Peak Review Team (CPRT) and external issues. This third party overview provides additional assurance that the CPSES large bore piping and pipe supports meet the licensing commitments.

In addition to these audits, TU Electric has initiated the independent Engineering Functional Evaluation (EFE) program to provide an overview of the technical activities being conducted on the CPSES project. The Engineering Functional Evaluation (EFE) team has audited the SWEC-PSAS performance since June 1987. The large bore piping and pipe supports design has been reviewed to assure consistency with validated input data and to assure outputs have been transferred to appropriate interfacing organizations.

Surveillance activities have been conducted by SWEC Engineering Assurance personnel to assure conformance to procedures and standards. Similar surveillances are performed by the TU Electric Technical Audit Program (TAP).

[4]The TU Electric Technical Audit Program (TAP) has been in effect since January 1987. Prior to this the TU Electric Quality Assurance Department performed audits of selected engineering service contractors using technical specialists as part of its vendor audit program.

These audits described above represent a very detailed and complete assessment of the following:

1. Adequacy of the Project Quality Assurance program.

2. Implementation of the Quality Assurance program.

3. Technical adequacy of the design criteria and procedures.

4. Implementation of the design criteria and procedures.

These audits and surveillances identified instances in which some action was required to clarify or modify procedures to more clearly define some activities, revise calculations to address an omission of clarifying statements or more properly address a situation, and provide additional training or project guidance to assure continued compliance with procedures. A timely and complete response was developed for every item identified throughout the audit process. Whenever a question that suggests a need to improve any of these items was identified, the cause, extent of conditions, and any required corrective/preventive actions were determined, properly documented, and implemented. Subsequent audits have verified that appropriate actions were taken to address previously identified items and identified a trend of improved overall performance by SWEC-PSAS. No audit items which would result in questions of technical adequacy of SWEC-PSAS's overall validation program have been identified.

In addition to the audits and surveillances, a rigorous Quality Control (QC) inspection program is in place on the CPSES site. QC personnel are responsible for performing inspection of attributes as delineated in the inspection procedures before a particular installation is acceptable.

In summary, an appropriate level of attention has been given to the quality of activities; the Quality Assurance (QA) program is appropriate for the scope of work; project performance has been demonstrated to be in compliance with the QA program, and appropriate corrective and preventive actions were taken whenever they were required.

5.3.1 Summary of SWEC Engineering Assurance (EA) Audits

To date, SWEC EA has performed 22 audits of the SWEC-PSAS large bore piping and pipe support validation process. Each SWEC-PSAS project location has been audited at least three times. An average of five subjects were reviewed during each of these audits. The following list of audit subjects describes the depth of auditing that has been performed:

1. Adequacy of the SWEC-PSAS Design Procedures.

2. Adequacy of the SWEC-PSAS Project Procedures.

3. ARS Data Conversion.

4. Calculations - Technical adequacy.

5. Calculations - Documentation

6. Compliance with project procedures.

7. Construction support activities.

8. Document Control.

9. Field walkdown activities.

10. Indoctrination and training.

11. Licensing activities.

12. Records maintenance.

13. Maintenance of Project Procedure manuals.

14. Personnel qualification and experience verification.

15. System inputs to pipe stress and pipe support analyses.

A chronological tabulation of SWEC Engineering Assurance (EA) audits is presented in Table 5-10.

5.3.2 Summary of Audits by TU Electric-TAP, NRC-VBP, and SWEC-QAAD

In addition to the SWEC Engineering Assurance (EA) Audits, the SWEC-PSAS was audited by TU Electric Quality Assurance (QA), NRC Vendor Program Branch (VPB), and SWEC Quality Assurance Auditing Division (QAAD).

To date, TU Electric's Technical Audit Program (TAP) has performed 12 audits of the SWEC-PSAS. Each SWEC-PSAS location has been audited at least once. An average of nine (9) subjects were reviewed during each of these audits. These audits are essentially equivalent to the SWEC Engineering Assurance (EA) audits discussed in Section 5.3.1. Therefore, the list of audit subjects in Section 5.3.1 is representative for these audits. A chronological tabulation of the TU Electric Quality Assurance TAPs audits is presented in Table 5-11.

The NRC-Vendor Program Branch (VPB) performed one audit in mid-1986 of SWEC-PSAS validation process (Reference 31) and reviewed the following activities:

1. Design control (pipe stress and support analyses).

2. Document Control (incoming and outgoing).

3. Procurement control.

4. Training.

5. Audits (SWEC-EA and TU Electric-TAP).

The SWEC Quality Assurance Auditing Division (QAAD) performed one audit of the SWEC-PSAS. This audit was performed to assess the Project Quality Assurance Manager's adherence to Corporate QA Program requirements, the adequacy of the Project's QA Program (CPPP-1), the Document Control Program, and the Records Management Program.

5.4 CORRECTIVE AND PREVENTIVE ACTION

SWEC-PSAS has developed technical and design control procedures and updated the design and installation/inspection specifications to implement the corrective actions resulting from the large bore piping and pipe supports Corrective Action Program (CAP). These procedures and specifications are identified within the Piping - Design Basis Documents (DBDs) which contain the bases for validating the large bore piping and pipe supports in Unit 1 and Common. As a result of this effort, the Comanche Peak Steam Electric Station - Unit 1 and Common large bore piping systems and supports are validated as being capable of performing their safety-related functions.

This validation is documented in the drawings, calculations, and specifications. This validated design documentation will be provided to TU Electric. This validated design documentation can provide the basis for configuration control of CPSES large bore piping and pipe supports to facilitate operation, maintenance, and future modifications following issuance of an operating license.

At the completion of the validation, SWEC-PSAS will provide TU Electric Comanche Peak Engineering (CPE) with the complete set of drawings and calculations, contained within the Large Bore Piping - Design Validation Packages (DVPs) for Unit 1 and Common. SWEC-PSAS procedures used for large bore piping and pipe supports validation will be provided to Comanche Peak Engineering (CPE). Implementation of these procedures by CPE assures that future CPSES large bore piping and pipe supports design is performed in accordance with the licensing commitments.

Training for Comanche Peak Engineering (CPE) personnel will be provided by SWEC-PSAS. The training will cover background assumptions and the methodology used in the validation of the piping and pipe support design. The importance of quality assurance will be stressed throughout the training program.

Practical experience has been provided to Comanche Peak Engineering (CPE) engineers who have worked alongside SWEC-PSAS engineers during the ongoing validation process. Experience gained by CPE engineers included changes in design documents, and familiarization with procedures followed and regulatory requirements.

TU Electric Comanche Peak Engineering (CPE) is developing a program to assure a complete and orderly transfer of the engineering and design function from SWEC-PSAS to CPE. The program will provide for the identification of those tasks presently being performed by SWEC-PSAS which are to be transferred to CPE and the identification of all procedures, programs, training, and staffing requirements. The program will be based upon three prerequisites: 1) the piping-related Corrective Action Program (CAP) effort to support plant completion is finished for the particular task; 2) the Piping - Design Validation Packages (DVPs) are complete; and 3) any required preventive action taken, as discussed in Appendix C, is complete.

This program will assure the transfer of complete design document and procedures to Comanche Peak Engineering (CPE).

FIGURE 5-1

CORRECTIVE ACTION PROGRAM (CAP)
FLOW CHART AND GOVERNING PROCEDURES
LARGE BORE PIPING AND PIPE SUPPORTS

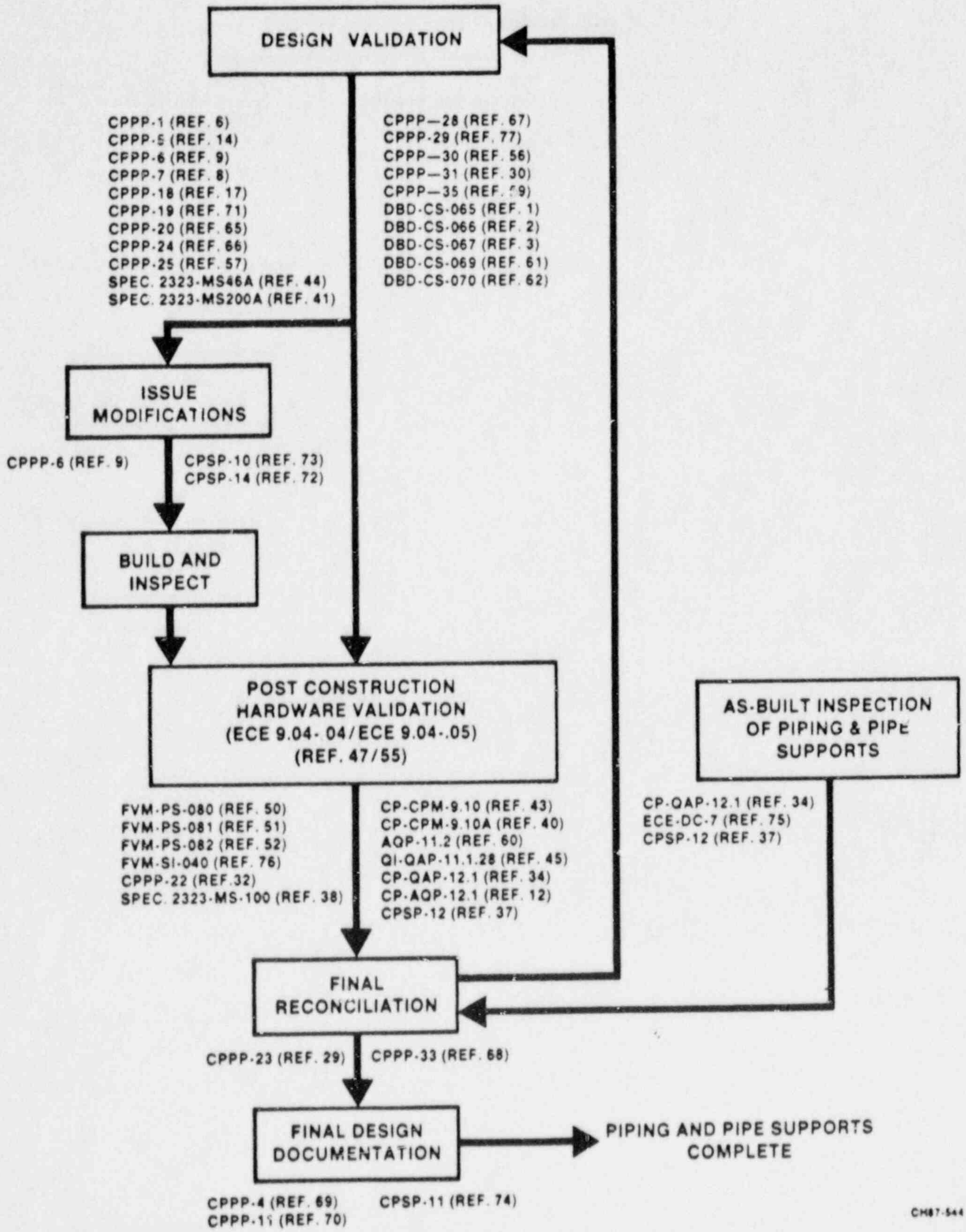


FIGURE 5-2

CORRECTIVE ACTION PROGRAM (CAP) TECHNICAL INTERFACES LARGE BORE PIPING AND PIPE SUPPORTS

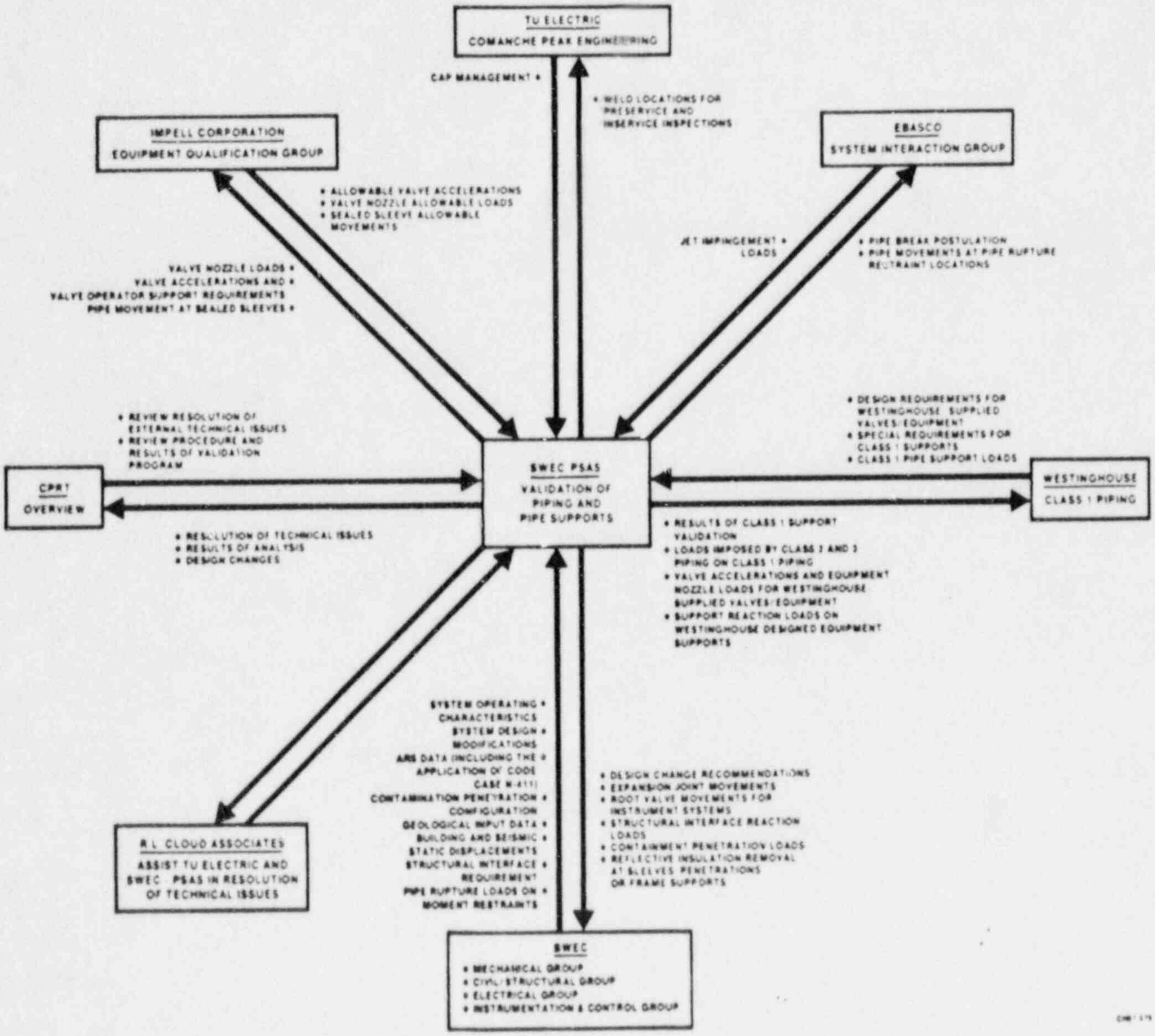
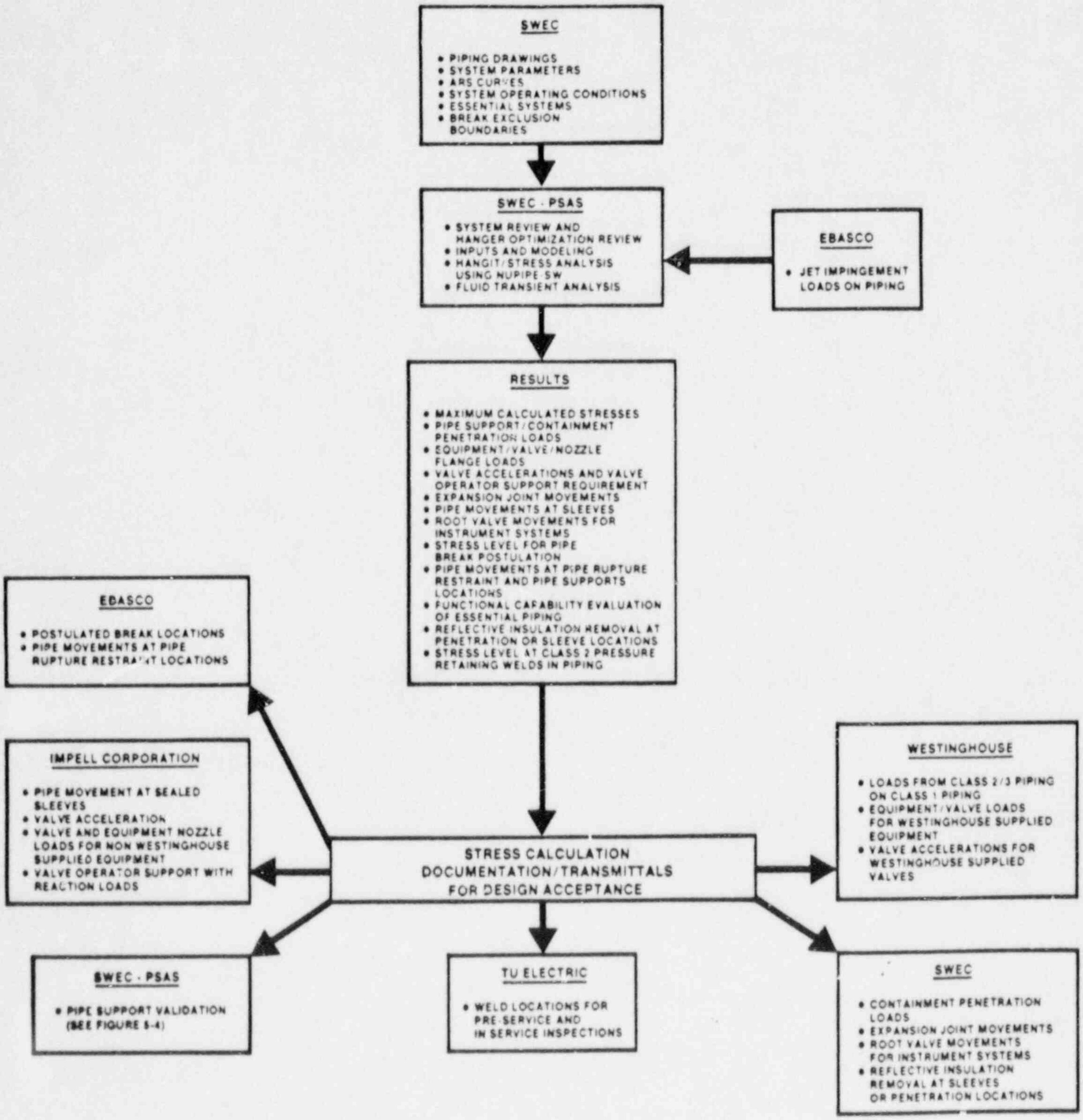


FIGURE 5-3

SWEC-PSAS PIPE STRESS DESIGN VALIDATION FLOW CHART



CH87-543

FIGURE 5-4

SWEC-PSAS PIPE SUPPORT DESIGN VALIDATION FLOW CHART

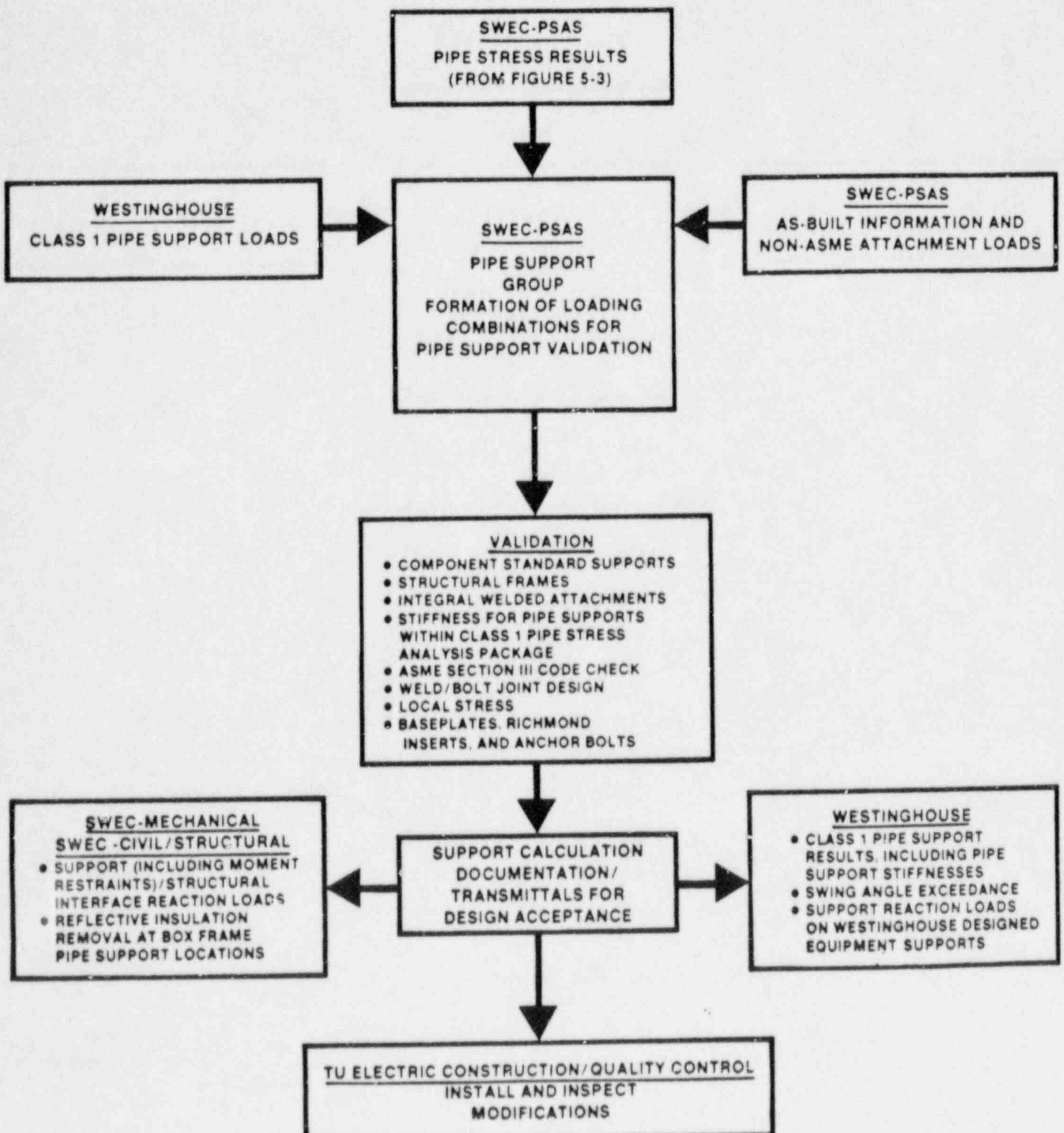


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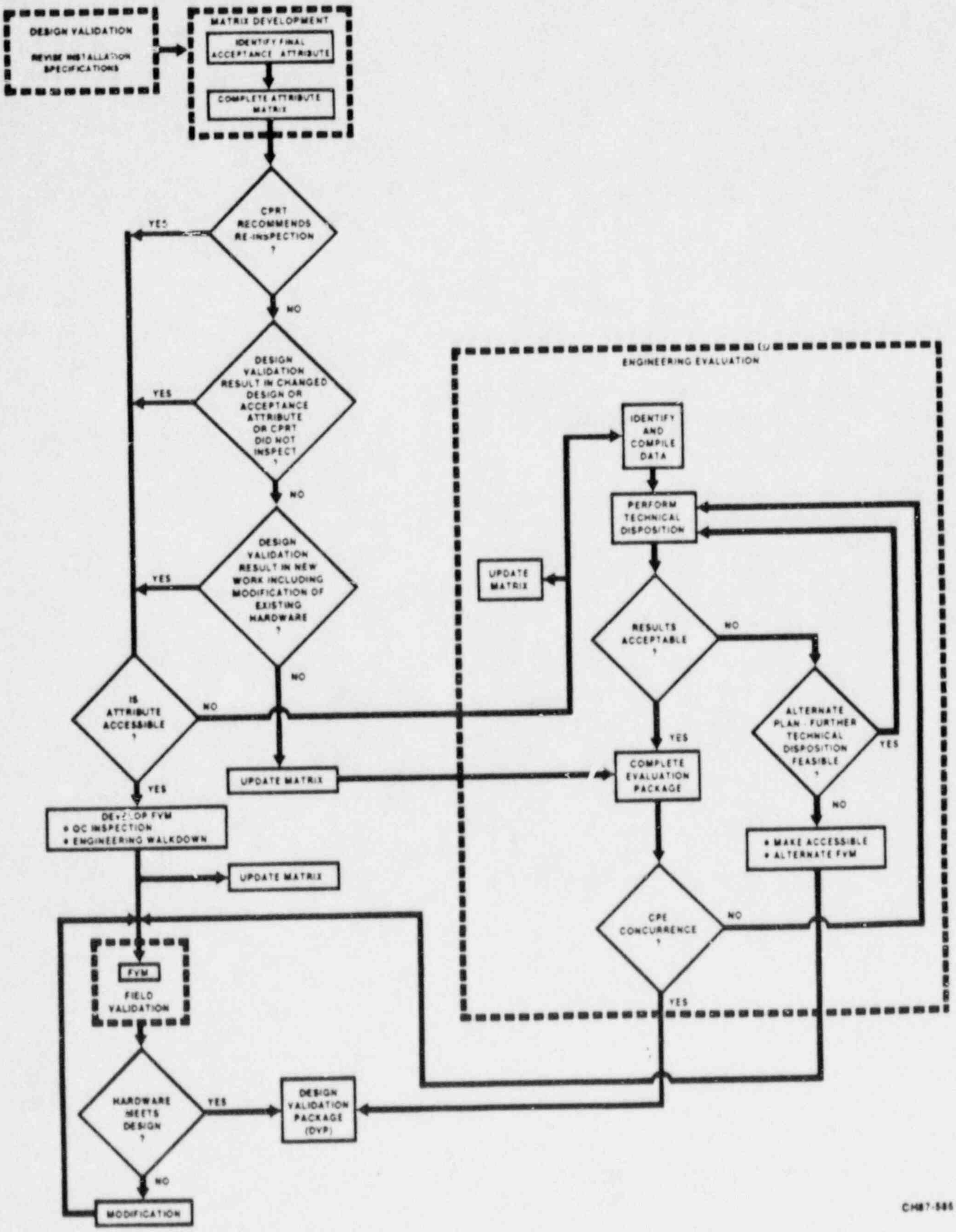
FIGURE 5-5

POST CONSTRUCTION HARDWARE VALIDATION PROGRAM (PCHVP)



<u>TABLE 5-1</u>

PIPING SYSTEM INPUT DATA

1. Final Safety Analysis Report (FSAR)
2. ASME III Code Class 1, 2, and 3 piping drawings and Seismic Category II piping drawings within the same piping stress analysis package
3. Pipeline designation list
4. Piping design specifications
5. Flow diagrams, system description and operating conditions
6. Seismic response spectra (including the application of ASME Code Case N-411)
7. Seismic structural displacements data
8. General arrangement and civil/structural drawings
9. As-built piping support location drawings
10. Pipe support drawings
11. Thermal structural displacements data
12. Containment pressure test displacement data
13. Wall and floor sleeve sealant design data
14. Jet impingement loads
15. Pipe whip impact loads
16. Structural and equipment layout drawings
17. Valve and valve operator weights (including extended attachments), center of gravity, yoke natural frequency and acceptable valve acceleration limit
18. Equipment movement data and allowable nozzle loads
19. As-built location of pipe with respect to wall and floor sleeves
20. Existing pipe break locations, pipe rupture restraint locations and detailed drawings
21. Valve nozzle allowables

TABLE 5-1 (Cont)

22. As-built pipe thickness
23. Westinghouse Class 1 pipe stress reports
24. ADLPIPE computer listing for each pipe stress analysis package
25. Containment displacements due to loss of coolant accident (LOCA)
26. Component drawings (equipment, penetration, valve, etc)
27. Calculations
    a. Pipe stress analysis (if applicable)
    b. Pipe support analysis and stress report (if applicable)
    c. Fluid transient analysis (if applicable)
28. Loads from non-ASME attachments on pipe supports
29. Geotechnical data for buried pipe analysis
30. Flexible hose design criteria and vendor's design report
31. As-built information for tie-back support
32. As-built pipe weld shrinkage and locations

TABLE 5-2

FLUID TRANSIENT LOADINGS

Containment Spray System

- Containment spray pump startup

Safety Injection System

- Check valve closure following pump trip

Service Water System

- Pump trip and pump start

Residual Heat Removal System

- Relief valve discharge

Chemical and Volume Control System

- Relief valve discharge

Main Steam System

- Main steam turbine trip
- Auxiliary feedpump turbine trip
- Feedpump turbine trip
- Safety and relief valve discharge

Feedwater System

- Check valve closure following pump trip
- Rapid closure of isolation or control valve
- Check valve closure analysis following postulated pipe rupture

Auxiliary Feedwater System

- Check valve closure following trip of one auxiliary feedwater pump

Boron Recycle System

- Relief valve discharge

Component Cooling Water System

- Relief valve discharge

TABLE 5-3

PCHVP REINSPECTION ATTRIBUTES AND RESOLUTIONS IN RESPONSE TO CPRT QUALITY OF CONSTRUCTION ISAP-VII.C RESULTS REPORT LARGE BORE PIPING AND PIPE SUPPORTS

Construction Work Category	ISAP-VII.c Results Report Recommendations	PCHVP Attributes FVM/Procedures
Large Bore Piping Configuration	Reinspect flow elements to verify that they are oriented in the proper direction	CPE-SWEC-FVM-PS-081 (Reference 51) CP-QAP-12.1 (Reference 34) Figure F.23
	Verify existing piping clearance criteria and walkdown all insulated large bore piping	CPE-SWEC-FVM-PS-080 (Reference 50) CPPP-22, Clearance Walkdown Procedure (Reference 32)
	Reinspect safety-related piping expansion joints	CPE-SWEC-FVM-PS-081 CP-QAP-12.1 Figure F.23
Pipe Welds and Materials	Reinspect butt welds in Schedule 80 or thinner stainless steel piping made prior to 1982 that are replacement welds and/or have received extensive repairs	CPE-SWEC-FVM-PS-081 CP-QAP-12.1 Figure F.23
Large Bore Pipe Supports - Rigid	Walkdown of pipe supports containing vendor-supplied components and replacement of nonconforming parts subject to appropriate engineering disposition	CPE-SWEC-FVM-PS-081 CP-QAP-12.1 Figure F.16
	Inspect for proper gaps between pipe and pipe supports and verify adequate clearance between pipe welds and pipe supports	CPE-SWEC-FVM-PS-080 CPPP-22, Clearance Walkdown Procedure CP-QAP-12.1 Figure F.9

TABLE 5-3 (Cont)

Construction Work Category	ISAP-VII.c Results Report Recommendations	PCHVP Attributes FVM/Procedures
	Inspect and install suitable locking devices on all vendor-supplied components that do not have high-strength bolting; install locking devices on all high-strength bolting that is not torqued to an acceptable preload	CPE-SWEC-FVM-PS-081 CP-QAP-12.1 Figures F.13, F.15, F.16, F.18, and F.20
	Walkdown reinspection of pipe clamps and replace nonconforming spacers or confirm they fall within the limits of bounding calculation	CPE-SWEC-FVM-PS-081 CP-QAP-12.1 Figure F.13
	Verify that jam nuts on all vendor-supplied components (sway struts, snubbers, and spring cans) are snug tight	CPE-SWEC-FVM-PS-081 CP-QAP-12.1 Figures F.15, F.16, and F.17
	Walkdown of all pipe supports having pipe clamps to verify security of attachment to the pipe	CPE-SWEC-FVM-PS-081 CP-QAP-12.1 Figure F.13
Large Bore Pipe Supports - Nonrigid	Reverify component adjustment during the startup and preoperational phases of the plant	CPE-SWEC-FVM-PS-081 CP-QAP-12.1 Figure F.20
	Inspect and install suitable locking devices on all vendor-supplied components that do not have high strength bolting, install locking devices on all high-strength bolting that is not torqued to an acceptable preload	CPE-SWEC-FVM-PS-081 CP-QAP-12.1 Figures F.13, F.15, F.16, and F.20

TABLE 5-3 (Cont)

Construction Work Category	ISAP-VII.c Results Report Recommendations	PCHVP Attributes FVM/Procedures
	Walkdown of all vendor-supplied components to ensure that proper angularity exists	CPE-SWEC-FVM-PS-081 CP-QAP-12.1 Figures F.15 and F.17
	Walkdown of all supports containing vendor-supplied components and inspect cotter keys and associated bolting	CPE-SWEC-FVM-PS-081 CP-QAP-12.1 Figures F.13 and F.20

TABLE 5-4

UNIT 1 AND COMMON LARGE BORE PIPE SUPPORTS MODIFICATION SUMMARY

Category	Number of Modifications
Prudent	1293
Recent Industry Practice	1883
Adjustment	393
Cumulative Effects	2052
TOTAL	5621

Description	Modification Category
Richmond Insert Single Tubes	Prudent
Allowable Stress Exceeded for Structural Member	Cumulative Effects
Support Deleted	Recent Industry Practice
Support Added	Cumulative Effects
Rigid Trapeze	Prudent
Trapeze Snubber	Prudent
Allowable Stress Exceeded for Welds	Cumulative Effects
Allowable Load Exceeded for Standard Component	Cumulative Effects
Allowable Load Exceeded for Concrete Anchor	Cumulative Effects
Cinched U-Bolt Modification	Prudent
Component Exceeds 5 Degree Offset	Adjustment
Revise Clearances	Adjustment
To be Modified Into a Clamp Anchor	Prudent
Box Frame on Pin Connection	Prudent
Modify to Increase Stiffness	Prudent
Preliminary Study Revises this into a Clamp Anchor	Prudent
Change from Rigid to Anchor or from Anchor to Rigid	Prudent
Change from Snubber to Rigid	Recent Industry Practice
Change from Rigid to Snubber	Cumulative Effects
Two Way Rigid Restraint Changed to a One Way Restraint or One Way Changed to Two Way Restraint	Cumulative Effects
Three Way Changed to One or Two Way Restraint	Cumulative Effects
U-Bolt on a Rigid Frame (One or Two Way Restraint)	Cumulative Effects
Change from Rigid Hanger to Spring or Spring to Rigid	Cumulative Effects
Relocate Hanger	Cumulative Effects
Pipe Bearing Stress Failure	Cumulative Effects
Reset Spring or Snubber Settings	Adjustment
Exceeds Lateral Movement for Spring	Adjustment

TABLE 5-5

SUMMARY - CINCHED U-BOLT TRAPEZE SUPPORT MODIFICATIONS

Description of Modification		Large Bore Piping
Single strut or snubber with a standard pipe clamp		223
Box frame		82
Trapeze with strap and lugs		59
Trapeze with welded attachment now constituting a rotation restraint		43
Single strut or snubber with a welded attachment		1
Single strut or snubber with a stiff clamp		19
Deleted		266
	TOTAL	693

TABLE 5-6

SEISMIC CATEGORY II LARGE BORE PIPING OVER SEISMIC CATEGORY I EQUIPMENT PIPING CHECKLIST

The field verification of Seismic Category II piping located over Seismic Category I systems, structures, or components is documented using a checklist addressing these attributes:

1. Establish seismic to nonseismic boundaries in piping systems and determine whether the boundary requires further evaluation to ensure the integrity of the seismic portion during a seismic event.

2. Determine if pipe supports restrain thermal expansion of a long straight piping run.

3. Determine if supports have existing design loads that are less than calculated threshold loads.

4. Determine if supports are next to a heavy concentrated weight (valves or components).

5. Determine if long straight runs or risers are not adequately supported for seismic in axial direction of pipe.

6. Determine if piping extends to different buildings.

7. Determine if the system design temperature exceeds 150°F.

8. Verify that hot piping configuration and component alignment are in accordance with the design drawings.

TABLE 5-7

PCHVP LARGE BORE PIPING AND PIPE SUPPORTS
INSTALLATION/INSPECTION PROCEDURES

SWEC-PSAS Field Verification Methods (FVMs) for large bore pipir ' pipe supports Post Construction Hardware Validation Program (PCHVP) are in compliance with the following procedures:

1. Comanche Peak Piping Erection Specification No. 2323-MS-100 (Reference 38)

2. Comanche Peak ASME Section III Code Class 2 and 3 Piping Design Specification No. 2323-MS-200 (Reference 41)

3. Comanche Peak Nuclear Safety Class Pipe Hangers and Supports Specification No. 2323-MS-46A (Reference 44)

4. Comanche Peak Structural Embedments Specification No. 2323-SS-30 (Reference 39)

5. Comanche Peak Construction Procedure CP-CPM-9.10, Component Support Installation (Reference 43)

6. Comanche Peak Construction Procedure CP-CPM-9.10A, Installation of Vendor-Supplied Component Supports Catalog Items (Refer-ence 40)

7. CPSES Quality Assurance Procedure CP-QAP-12.1, Mechanical Component Installation Verification (Reference 34)

8. CPSES Quality Assurance Procedure QI-QAP-11.1-28, Fabrication and Installation Inspection of Safety Component Supports (Reference 45)

9. CPSES Quality Assurance Procedure QI-QAP-11.1-26, Piping and Equipment Installation Inspection (Reference 42)

TABLE 5-8

SEISMIC CATEGORY II LARGE BORE PIPING OVER
SEISMIC CATEGORY I EQUIPMENT
PIPE SUPPORT CHECKLIST

The field verification of Seismic Category II piping located over Seismic Category I systems, structures, or components is documented using a checklist addressing these attributes:

1. General Support Requirements

   a. Location
   b. Function
   c. Orientation
   d. Dimensions/configuration/material per control drawing/ document
   e. Physical damage/completeness
   f. Hole edge distance in structural members
   g. Gap clearances
   h. Minimum 1 in. clearance
   i. Voided supports removed

2. Welding

   a. Weld type
   b. Welds properly wrapped

3. Base Plates/Anchor Bolts

   a. Bolt size
   b. Edge distance of holes
   c. Size and hole spacing
   d. Attachment location
   e. Nut tightness/thread engagement
   f. Locking devices
   g. Washers
   h. Clearance with adjacent Hilti bolt

4. Bolted Connections (Including Clamps)

   a. Bolt/pin size
   b. Thread engagement
   c. Nut tightness
   d. Locking devices/cotter pins
   e. Clamp size/proper spacer
   f. Tightness of bolt and clamp

TABLE 5-8 (Cont)

5. Snubber/Strut/Spring Components

   a. Size/type/load pin size
   b. Spherical bearing adequacy/free to swivel
   c. Angularity with tolerance
   d. Setting adequate per drawing
   e. Eye rod thread engagement/nut tightness
   f. Ends not binding
   g. Locking devices
   h. Extension weld adequacy
   i. Lubrite plate

6. Design Considerations

   a. Support instability (e.g., uncinched U-bolts)
   b. Threshold loads exceed previous design load
   c. Nonseismic interface loads
   d. Seismic loading inclusion in original support load
   e. Adequacy of gang support
   f. Integral attachment adequacy

7. Aircraft Cables

   a. Cable diameter
   b. Ceiling/wall connection
   c. Clamp type/rod type
   d. End loop configuration
   e. Eye nut tightness/lock washers
   f. Cable clamp tightness
   g. Cable slack/configuration
   h. Tie spacing/bundled cables tied together
   i. Support location/span
   j. Cable restraint modifications for 12 in. and 10 in. diameter pipe
   k. End of cables wrapped to prevent fraying

TABLE 5-9

TYPICAL SWEC-PSAS TECHNICAL AND DESIGN CONTROL PRACTICES

1. Add terminal anchors in the pipe stress problem boundary to bound the stress problem.

2. Establish a seismic-to-nonseismic piping interface anchor design requirement.

3. Revise pipe stress analysis package boundary decoupling requirement.

4. Establish branch line mass effect on main piping requirement.

5. Establish functional capability evaluation requirement.

6. Document the validation of thermal stress cycles and stress range reduction factor requirement.

7. Establish stiffness modeling of sleeve sealant.

8. Revise clearance requirement between pipe and structural frame.

9. Establish a clamp anchor design for 6 in. and smaller nominal size pipe.

10. Revise the seismic design loads for nonsafety-related piping attached to safety-related ganged pipe supports.

11. Revise the tube steel wraparound welding length evaluation requirement.

12. Document the strut, snubber, and spring hanger swing angle evaluation requirement, including thermal, seismic, and fluid transient movements.

13. Establish an integrated clearance validation program (engineering walkdown to validate clearance).

14. Establish the requirement to validate the valve weight list and the valve stem extension in the as-built drawing.

15. Establish the pipe stress and pipe support system review documentation requirement.

16. Establish the review and validation of CPSES plant design and operating conditions.

TABLE 5-10

SUMMARY OF SWEC ENGINEERING ASSURANCE AUDITS
LARGE BORE PIPING AND PIPE SUPPORTS

Engineering Assurance Audit No.	Location*	Dates of Audits	Audit Report Transmittal	Audit Response Transmittal
Site No. 1	at Site	07/31/85 - 08/01/85	IOM - 85/501, 08/22/85	No Response Required
Project No. 1	at NY	10/06/85 - 10/11/85	IOM - 85/610/CPI-653	CPO-134, 11/15/85
Project No. 2	at CH	10/28/85 - 11/08/85	IOM - EA-1735/CPI-1085	2CPO-34, 12/20/85
Project No. 4	at HOC	12/09/85 - 02/13/86	IOM - 86/042/CPI-1418	CPO-622, 03/13/86
SWCL No. 1	at SWCL	12/17/85 - 12/19/85	IOM - 86/015, 01/30/86	CPI-1468, 02/21/85 CPI-2115, 04/11/86
Project No. 3	at BOS	12/16/85 - 02/28/86	IOM - 86/002/CPI-1546	CPO-746, 04/03/86
Site No. 2	at Site	12/16/85 - 02/13/86	IOM - 86/088/CPI-1490	CPO-863, 04/15/86
Project No. 5	at BOS	02/10/86 - 03/07/86	IOM - 86/100/CPI-1768	CPO-746, 04/03/86
Project No. 6	at CH	02/18/86 - 03/13/86	IOM - EA-1791, 04/04/86	No Response Required
Project No. 7	at NY	03/24/86 - 03/28/86	IOM - 86/160/CPI-2192	CPO-1215, 05/14/86 CPO-1592, 06/19/86
Project No. 8	at HOC	04/28/86 - 05/02/86	IOM - 86/221/CPI-2457	CPO-1560, 06/18/86
Site No. 3	at Site	05/19/86 - 05/23/86	IOM - 86/256/CPI-2827	CPO-1958, 07/25/86
SWCL No. 2	at SWCL	06/02/86 - 06/06/86	IOM - 86/284/CPI-2819	CPI-3557, 08/12/86
Project No. 9	at BOS	07/21/86 - 08/15/86	IOM - 86/396/CPI-3966	CPO-2968, 09/30/86
Project No. 10	at CH	07/07/86 - 07/25/86	IOM - EA-1850/CPI-3852	2CPO-936, 09/29/86
Project No. 11	at NY	09/08/86 - 09/12/86	IOM - 86/521/CPI-4285	CPO-3466, 10/31/86
Project No. 12	at HOC	11/03/86 - 11/07/86	IOM - 86/596/CPI-4687	No Response Required
Site No. 4	at Site	01/19/87 - 01/23/87	IOM - 87/044/CPI-6064	IOM-237, 03/24/87
Project No. 14	at BOS	02/23/87 - 03/06/87	IOM - 87/120, 04/09/87	EMD File 16.1.2 (016)
SWCL No. 3	at SWCL	03/09/87 - 03/13/87	IOM - 87/108/CPI-6690	CPO-6496, 05/14/87
Project No. 15	at CH	03/16/87 - 03/27/87	2CPI-3336/CPI-6703	CPO-6432, 05/11/87
Project No. 16	at NY	04/13/87 - 04/24/87	IOM - 87/175/CPI-7022	2CPO-2543, 06/26/87
Site No. 5	at Site	06/22/87 - 06/26/87	IOM - 87/256, 08/03/87	2CPO-2664, 08/20/87

*Site: SWEC-PSAS at CPSES
HOC: SWEC-Houston
NY: SWEC-New York
SWCL: SWEC-Toronto
BOS: SWEC-Boston
CH: SWEC-Cherry Hill

TABLE 5-11

SUMMARY OF TU ELECTRIC AUDITS
LARGE BORE PIPING AND PIPE SUPPORTS

Audit No.	Location*	Dates of Audits	Audit Report Transmittal	Audit Response Transmittal
TSWEC-1	at Site	10/21/85 - 10/25/85	CPI-934/QXX-2774	CPO-317, 01/07/86
TSWEC-2	at NY	11/04/85 - 11/06/85	CPI-1185/QXX-2842	CPO-404, 01/31/86
TSWEC-3	at BOS	12/03/85 - 12/05/85	CPI-1266/QXX-2861	CPO-501, 02/21/86
TSWEC-4	at CH	01/21/86 - 01/24/86	CPI-1552/QVC-02	CPO-736, 03/31/86
TSWEC-5	at Site	04/14/86 - 04/18/86	CPI-2401/QVC-168	CPO-1388, 06/13/86
TSWEC-6	at SWCL	04/23/86 - 04/24/86	CPI-2510/QVC-195	No Response Required
TSWEC-7	at HOC	05/15/86 - 05/16/86	CPI-2755/QVC-227	CPO-1900, 07/18/86
TSWEC-8	at NY	09/16/86 - 09/19/86	CPI-4609/QVC-548	CPO-4255, 12/23/86
TCP-86-43	at Site	11/10/86 - 11/14/86	CPI-5077/QIA-331	CPO-4611, 01/16/87
TSWEC-9	at CH	01/05/87 - 01/09/87	CPI-5791/QVC-702	No Response Required
TSWEC-10	at BOS	02/17/87 - 02/20/87	CPI-6486/QVC-752	CPO-6368, 05/08/87
ATP-87-03	at NY	03/23/87 - 04/03/87	CPI-6850/ATP-7019	CPO-6750, 06/05/87
ATP-87-09	at CH	04/27/87 - 05/01/87	CPI-6985/ATP-7032	CPO-7415, 08/07/87
ATP-87-14	at CH	TENERA - 04/06/87	CPI-6905/ATP-7029	CPO-7056, 06/30/87
ATP-87-18	at Site	06/01/87 - 06/05/87	CPI-7320/ATP-7107	CPO-7315, 07/24/87
ATP-87-28	at Site	07/01/87 - 07/02/87		
	and at NY	07/06/87 - 07/10/87	CPI-7505/ATP-7173	CPO-7467, 08/13/87

*Site: SWEC-PSAS at CPSES
HOC: SWEC-Houston
NY: SWEC-New York
SWCL: SWEC-Toronto
BOS: SWEC-Boston
CH: SWEC-Cherry Hill

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APPENDIX A

COMANCHE PEAK RESPONSE TEAM (CPRT) AND EXTERNAL ISSUES

INTRODUCTION

This appendix describes the details of the resolutions of issues resulting from the Comanche Peak Response Team (CPRT) and from external issues. Each of thirty-nine issues listed below is described in an individual subappendix which includes discussions of resolution methodology and corrective and preventive actions.

SWEC-PSAS has reviewed the CPSES Supplemental Safety Evaluation Reports (SSERs) (NUREG-0797), and determined that the procedures and design criteria for the piping and pipe supports Corrective Action Program (CAP) are consistent with the actions required of TU Electric by the NRC Staff as stated in the SSERs.

Issue No.	Issue Title
A1	Richmond Inserts
A2	Local Stress - Piping
A3	Wall-to-Wall and Floor-to-Ceiling Supports
A4	Pipe Support/System Stability
A5	Pipe Support Generic Stiffness
A6	Uncinched U-Bolt Acting as a Two-Way Restraint
A7	Friction Forces
A8	AWS Versus ASME Code Provisions
A9	A500, Grade B Tube Steel
A10	Tube Steel Section Properties
A11	U-Bolt Cinching
A12	Axial/Rotational Restraints
A13	Bolt Hole Gap
A14	OBE/SSE Damping
A15	Support Mass in Piping Analysis
A16	Programmatic Aspects and QA Including Iterative Design
A17	Mass Point Spacing
A18	High-Frequency Mass Participation
A19	Fluid Transients
A20	Seismic Excitation of Pipe Support Mass
A21	Local Stress in Pipe Support Members
A22	Safety Factors
A23	SA-36 and A307 Steel
A24	U-Bolt Twisting
A25	Fischer/Crosby Valve Modeling/Qualification
A26	Piping Modeling
A27	Welding
A28	Anchor Bolts/Embedment Plates

Issue No.	Issue Title
A29	Strut/Snubber Angularity
A30	Component Qualification
A31	Structural Modeling for Frame Analysis
A32	Computer Program Verification and Use
A33	Hydrotest
A34	Seismic/Nonseismic Interface
A35	Other Issues
A36	SSER-8 Review
A37	SSER-10 Review
A38	SSER-11 Review
A39	CPRT Quality of Construction Review on Piping and Pipe Supports

SUBAPPENDIX A1

RICHMOND INSERTS

1.0 Definition of the Issue

There were several interrelated issues regarding the use of Richmond inserts (see Figure A1-1). The issues were related to design allowables, methods for calculating bolt loads in tube steel connections, and modeling of insert/tube steel connections. The specific issues are as follows (see References 4.1 through 4.9):

1.1 Safety Factors/Testing

The issue was that a safety factor of two was used for Richmond insert designs instead of the manufacturer's recommended safety factor of three. Related questions were raised regarding the tests performed by TU Electric on Richmond inserts to determine the load-carrying capacity of the insert and to examine the behavior of the connection for combined loading. In specific, the representativeness of the tests to actual plant conditions and the interpretation of the test results was questioned.

1.2 Concrete Strength

The issue was that Richmond inserts may have been installed in concrete weaker than the 4000 psi design strength used in the analyses.

1.3 Fatigue Life

The issue was that the reduction in fatigue life of the threaded rod in Richmond insert tube steel connections caused by cyclic loading was not considered.

1.4 Simplified Evaluation Method

The issue was that justification of the simplified method of Richmond insert design was based on improperly interpreted finite element analysi results.

1.5 Richmond Insert/Tube Steel Finite Element Modeling

The issue was that a simplified method was used in evaluating connectio made with tube steel without considering bolt angularity or bending in the bolt due to the torsion in the tube steel member.

Tube steel/insert connections were inconsistently modeled as pin or fixed connections. This affects the support stiffness, support frame stresses, and the evaluations of the loads on bolts/rods and inserts.

1.6 Allowable Spacing

The issue was that the lack of a structural attachment interface program may have resulted in a failure to consider spacing effects of nearby anchors/sleeves in the structural evaluation of inserts.

1.7 Allowable Shear Loads

The issue was that allowable shear loads for 1 1/2 in. Richmond inserts, which were extrapolated from test data for 1 in. and 1 1/4 in. size inserts, may not be conservative.

1.8 Thermal Expansion of Long Tube Steel Members

The issue was that thermal expansion of long tube steel members, under LOCA conditions, anchored by two or more inserts was not considered.

1.9 Tube Steel Local Stress

The issue was that the local stress in tube steel walls, which may cause punching-type failure, was not evaluated.

1.10 Oversized Holes

The issue was that the holes made in the connections are oversized, and therefore the sharing of shear loads cannot be assumed to be equal for all of the bolts.

1.11 Misuse of Allowable Loads

The issue was that tension and shear allowables for inserts were occasionally used to evaluate threaded rods/bolts in the analyses.

2.0 Issue Resolution

2.1 Safety Factors/Testing

SWEC-PSAS has specified a safety factor of 3 for Richmond inserts under normal, upset, and emergency loading conditions, as recommended by the Richmond Screw Company. For faulted conditions, a safety factor of 2 has been specified based on ACI 318-71 (Reference 4.10). The allowables are based on averaging TU Electric insert capacity failure loads based on test results as described in References 4.11 and 4.12. SWEC-Civil/Structural Group has verified (Reference 4.13) that the tests were representative of CPSES Richmond insert installation and that the tests were performed in accordance with the industry-wide accepted ASTM Standard E488-76 (Reference 4.14).

The allowable loads for Richmond inserts and threaded rods, based on the appropriate safety factors, are provided in Attachment 4-5 of CPPP-7.

2.2 Concrete Strength

This issue is addressed in Subappendix A36.

2.3 Fatigue Life

CPPP-7, Section 4.3.1, specifies that threaded rods used in Richmond inserts/tube steel connections are designed in accordance with AISC requirements. SWEC-PSAS has demonstrated by analysis that the number of equivalent stress cycles on pipe supports at CPSES is less than 7,000, and therefore in accordance with AISC 7th Edition (Reference 4.15), Sections 1.7.1 and 1.7.2 and Appendix B, fatigue is not a concern for threaded rods used in these connections.

2.4 Simplified Evaluation Method

The procedure developed and implemented by SWEC-PSAS for the qualification of Richmond inserts and bolts (Attachment 4-5 of CPPP-7) is independent of previously completed finite element analyses.

2.5 Richmond Insert/Tube Steel Finite Element Modeling

SWEC-PSAS established the tube steel to bolt load transfer mechanism for shear and torsion loads (with respect to the tube steel) and developed a conservative design methodology for evaluating these connections. R. L. Cloud and Associates (RLCA) performed an independent analysis of the tube steel to bolt load transfer mechanism and confirmed that the SWEC-PSAS methodology is appropriate (Reference 4.16).

The SWEC-PSAS model simulated a member with bolt properties (in the STRUDL computer program) to connect the center of tube steel to the face of concrete. Support joints were modeled as fixed except for the bolt's torsional moment. The force and moment reactions were first used directly in the interaction equation for qualifying the bolts and were later converted to tension for evaluating the inserts. This interaction equation was documented by both RLCA (Reference 4.17) and SWEC-PSAS (Reference 4.18). This method of analysis represents a conservative means of transferring shear and torsion loads from the tube steel to the bolts. Single tube steel members, subject to torsion, were modified by outriggers installed at the connections to eliminate the moment on the bolt.

Attachment 4-5 of CPPP-7 provides the modeling procedure for qualifying the Richmond insert when used in conjunction with tube steel for all support configuration types, including the proper interaction equation for qualifying the bolts/rods.

2.6 Allowable Spacing

Attachment 4-5 of CPPP-7 specified spacing requirements and the effects of reduced spacing on Richmond insert allowables. A project-wide program on Richmond insert spacing, conducted by the SWEC Civil/Structural Group as discussed in the Civil/Structural PSR (Reference 4.13), is being implemented (also see Subappendix A28, Sections 1.1 and 2.1).

2.7 Allowable Shear Loads

TU Electric performed additional tests (see Section 2.1 above and References 4.11 and 4.12) to establish shear allowables for all discrete sizes of Richmond inserts used at CPSES including the 1 1/2 in. Richmond insert. Design allowable values were based on these tests.

2.8 Thermal Expansion of Long Tube Steel Members

The effects of thermal expansion on long tube steel members anchored by two or more inserts was evaluated by RLCA in Reference 4.19, and limits on tube steel length were established.

Attachment 4-5 of CPPP-7 provides limits on tube steel length of long tube steel members anchored by two or more inserts due to the effects of LOCA-induced thermal expansion.

2.9 Tube Steel Local Stress

SWEC-PSAS developed and implemented a procedure for the evaluation of local stresses due to nuts bearing on tube steel walls. This was incorporated into Attachment 4-13 of CPPP-7. For additional discussion of this issue, refer to Subappendix A21, Section 2.0.

2.10 Oversized Holes

SWEC-PSAS procedures assume equal distribution of shear loads resulting from rod and hole fit-up tolerances, where tubing is anchored by two or more Richmond inserts. However, for Richmond inserts and threaded rods with high shear interaction ratios (greater than 0.25), potential unequal shear loading is addressed by checking that these Richmond inserts and rods are capable of resisting twice the calculated shear (Reference 4.20).

2.11 Misuse of Allowable Loads

The SWEC-PSAS procedure for the validation of Richmond inserts and bolts (Attachment 4-5 of CPPP-7) requires separate evaluations for the inserts and for the threaded rods/bolts using specified allowables and interaction equations.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).

- The corrective action to resolve the issues regarding the analysis and design of Richmond inserts used in conjunction with tube steel was accomplished through the implementation of the criteria provided in CPPP-7, Attachment 4-5 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

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4.4 Affidavit of CASE witness M. Walsh before the ASLB, September 11, 1984

4.5 Structural Embedments Specification No. 2323-SS-30, Revision 1, Gibbs & Hill, Inc., February 10, 1984

4.6 Richmond Inserts/Anchorages for Concrete Constructions, Bulletin No. 6, Richmond Screw Anchor Co., 1971

4.7 Testimony of N. H. Williams in response to CASE questions of February 22, 1984, to CYGNA Energy Services, April 12, 1984

4.8 June 20, 1984, and August 9, 1984, meeting with NRC Staff discussing Richmond Inserts' affidavit

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4.18 SWEC-PSAS Report No. 15454.05-N(C)-002, Interaction Relation for a Structural Member of Circular Cross Section, May 1986

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4.20 SWEC-PSAS Project Memorandum 141, Unequal Shear Loading Effect on Richmond Insert and Threaded Rods Used in Conjunction with Tube Steel

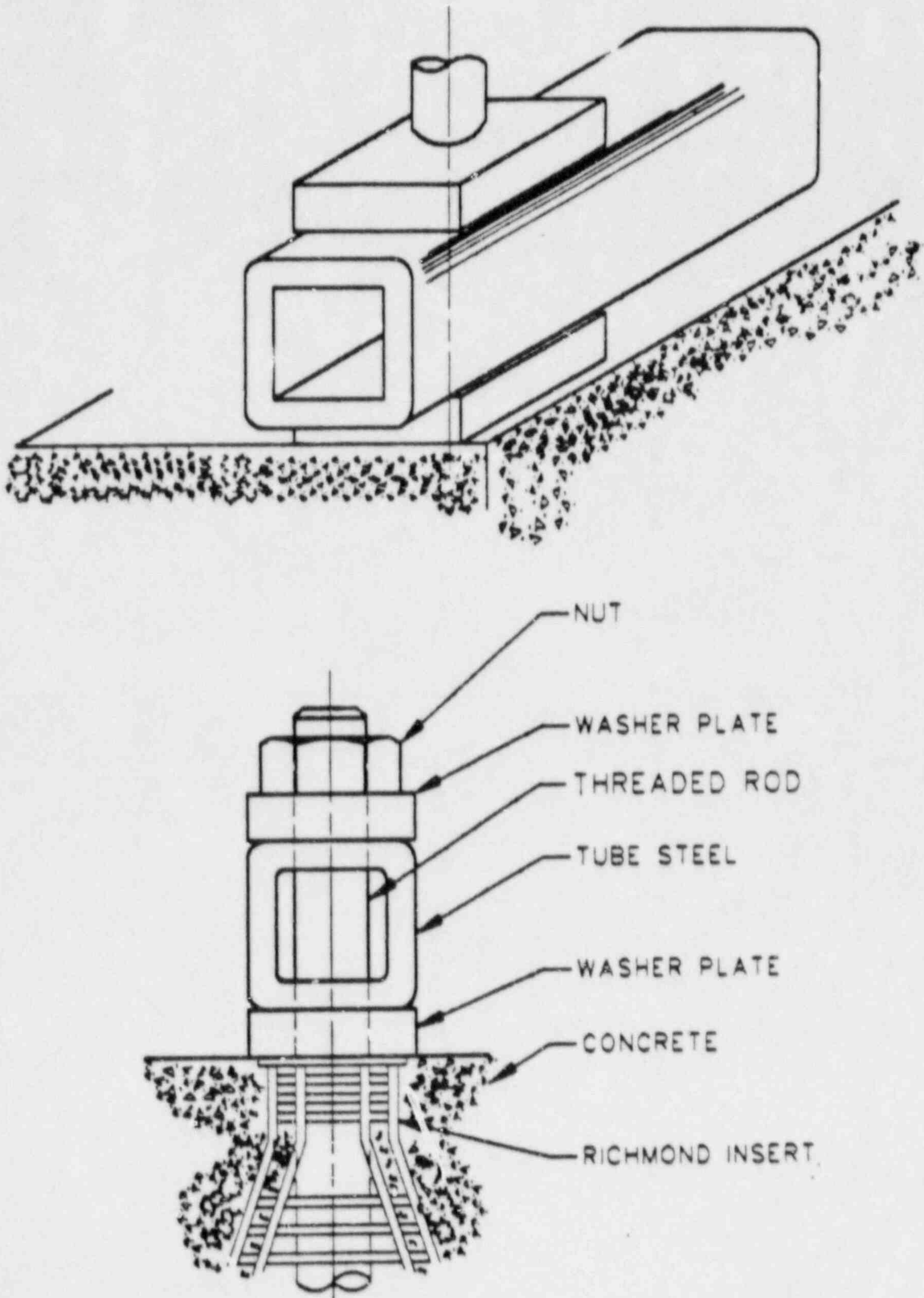


FIGURE A.1-1
TYPICAL RICHMOND INSERT / TUBE STEEL CONNECTION

SUBAPPENDIX A2

LOCAL STRESS - PIPING

1.0 Definition of the Issue

The issue was (References 4.1 through 4.4) that local stresses in piping, due to the relative displacements between the pipe and supports, were not properly addressed at CPSES in the items listed below:

1.1 Zero Gap Restraints

Zero gap restraints are box frame pipe supports with the specified gap on the pipe support drawing less than the predicted radial thermal expansion of the pipe. Therefore, these support types restrain the radial thermal expansion of the pipe. The loads due to the restrained pipe expansion, combined with the mechanical loads, have the potential to overstress the frame, welds, and pipe. In addition, zero gap restraints used in conjunction with struts or snubbers are potentially unstable.

1.2 Integral Welded Attachments (IWAs)

Integral welded pipe support attachments (IWAs), such as trunnions and lugs, induce local stresses in the pipe wall. Anchor supports with opposing trunnions attached to different support structures may restrain the radial thermal pipe expansion and induce additional load in the pipe, trunnions, and support structures.

The load from restrained radial thermal pipe expansion, when combined with the mechanical loads, has the potential to overstress the pipe, trunnion, welds, support structure, and support structure anchorage.

2.0 Issue Resolution

The issue of local stress on piping was resolved as follows:

2.1 Zero Gap Restraints

Frame-type pipe supports, designed to restrain the lateral movement of the pipe through point, line, or surface contact, induce local stresses in the pipe wall due to the bearing contact force. The issue of local pipe stress due to bearing contact was resolved as follows:

2.1.1 Zero clearance box frames are eliminated or modified to provide sufficient gaps to allow for the thermal expansion of the pipe in accordance with CPPP-7, Attachment 4-11. The modification of zero gap restraints on struts or snubbers, to provide stability, is discussed in Subappendix A4.

2.1.2 Guidelines were provided in CPPP-7, Attachments 4-6B and 4-6C, to assess the local longitudinal line/point contact and circumferential bearing stresses in piping restrained by pipe support frames.

2.2 Integral Welded Attachments

CPPP-7, Attachment 4-6A provided simplified analysis methods for the evaluation of pipe local stress at trunnions and lugs, with and without pipe reinforcing pads. The local pipe stress for trunnions on elbows is evaluated in accordance with PM-162. Local pipe stresses at IWAs that did not meet the geometric limitations of the simplified methods (such as multiple trunnions attached at the same location, or pipe-through trunnions) were qualified based on finite element analysis techniques.

In accordance with CPPP-7, Section 4.6.4.1, supports with opposing trunnions attached to different support structures were specially analyzed to predict the additional load induced on the pipe, trunnion, support structure, welds, and support structure anchorage due to the restrained thermal expansion of the pipe. This load was added to the thermal load due to the longitudinal thermal expansion of the pipe to determine the thermal design load for the pipe local stress evaluation and the design of the trunnion, support structure, welds, and support structure anchorage. The trunnion was then analyzed in accordance with CPPP-7, Attachment 4-6A as discussed above.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action to resolve the local pipe stress issues with zero clearance box frames was to eliminate the support or modify the support to provide proper gaps between the pipe and support during the design validation. The corrective action to resolve the stability issue for zero gap restraints is discussed in Subappendix A4. The corrective action to resolve the local pipe stress issue with frames and IWAs was to provide analysis methodologies and acceptance criteria consistent with licensing commitments in CPPP-7, Attachments 4-6A, B, and C during the design validation. All local pipe stress design validation analyses were performed in accordance with these attachments.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Finding of Fact and Conclusions of Law (Welsh/Doyle Allegations), Section IV, August 22, 1983.

4.2 CASE's Answer to Applicant's Statement of Material Facts as to which there is no Genuine Issue Regarding Consideration of Local Displacements and Stresses, August 24, 1984.

4.3 CASE's Answer to Applicant's Reply to CASE's Answer to Applicant's Motion for Summary Disposition Regarding Local Displacements and Stresses, October 4, 1984.

4.4 CYGNA Pipe Support Review Issues List, Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987.

SUBAPPENDIX A3

WALL-TO-WALL AND FLOOR-TO-CEILING SUPPORTS

1.0 Definition of the Issue

The issue (References 4.1 and 4.2) was that when a pipe support is attached from floor-to-ceiling or wall-to-wall, the support members effectively act as building structural members. Loadings due to the thermal expansion of the frame, relative displacements between building attachment points from seismic building movements, time-dependent displacements such as concrete creep, and the cumulative effects of these could be significant. Since these loads and displacements were not considered in the design, the potential existed for support members to become overstressed.

2.0 Issue Resolution

2.1 Floor-to-Ceiling and Wall-to-Wall (F-C/W-W) Supports

The large F-C/W-W frames were qualified for loading combinations that include frame thermal expansion, differential building displacements due to seismic movements, long-term concrete creep, and live loads. Relative building displacements, long-term creep, and live load effects were demonstrated to be insignificant for corner supports. The loading combinations and the allowable stresses are delineated in Attachment 4-19 of CPPP-7.

2.1.1 Large Frames Outside the Service Water Tunnel

All large F-C/W-W frames, except those in the service water tunnel, are being modified by adding slip joints.

2.1.2 Large Frames in the Service Water Tunnel

The large F-C/W-W frames in the service water tunnel were assessed for stresses caused by floor live load, differential floor/wall displacements due to long-term concrete creep, thermal expansion, and seismic excitation as specified in Section 2.1. Supports assessed as being inadequate are being modified (Reference 4.3).

2.2 Corner Supports

A generic study of these supports was performed utilizing the assessment methods in Section 2.1. The supports were then reviewed based on the study results, and the designs were validated.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- All the pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).

- The corrective action to resolve the issue with the proper evaluation of floor-to-ceiling and wall-to-wall and corner supports was accomplished through the implementation of the criteria of CPPP-7, Attachment 4-19 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section VI, August 22, 1983

4.2 CASE's Partial Answer to Applicant's Statement of Material Facts, in the Form of Affidavit of CASE Witness, Mark Walsh, August 27, 1984

4.3 SWEC-PSAS Report No. 15454.05-N(C)-013, Qualification of Wall-to-Wall/Floor-to-Floor Supports, April 1987

4.4 SWEC-PSAS Report No. 15454.05-N(C)-012, Revision 1, Qualification of Corner Supports, June 2, 1987

SUBAPPENDIX A4

PIPE SUPPORT/SYSTEM STABILITY

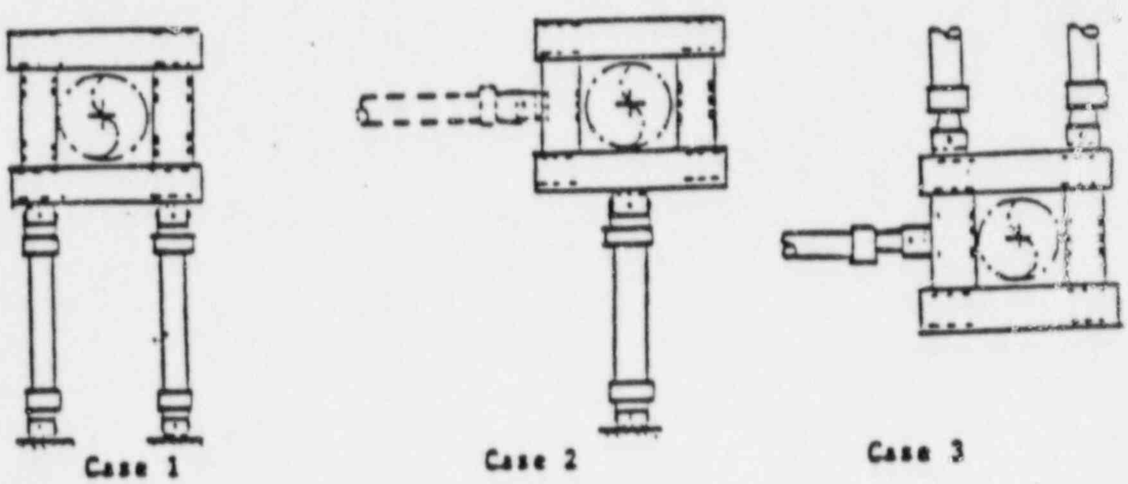
1.0 Definition of the Issue

The issue (References 4.1 through 4.5) was that certain pipe support configurations installed at CPSES were potentially unstable or their buckling capacity was not properly evaluated. An unstable support is defined as a support that can shift or move to an unqualified position. An unqualified position is a position other than that assumed in the piping stress analysis. A related issue was that the stability of the overall piping systems must be assured.

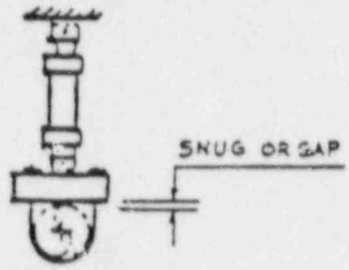
1.1 Potentially Unstable Support Configurations

The following are configurations whose buckling capacity was not properly assessed, or which were potentially unstable because they had the potential to move axially along the pipe and/or rotate around the pipe, creating a three-pin linkage system.

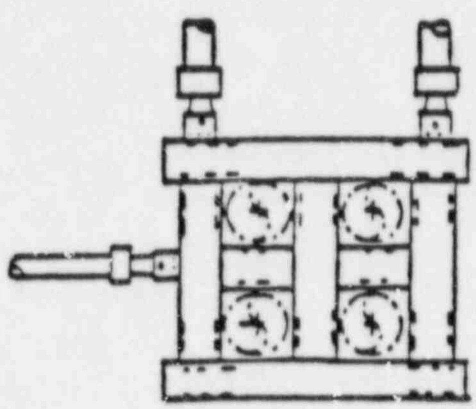
1.1.1 Zero-Clearance Box Frames Supported by Single and/or Multiple Struts or Snubbers



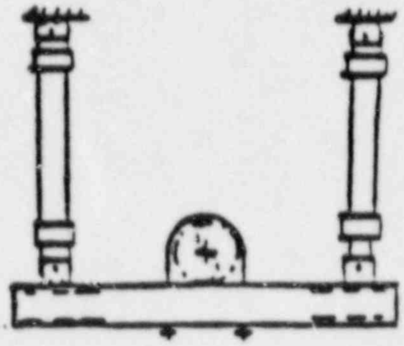
1.1.2 Uncinched U-Bolts on Single Strut or Snubber



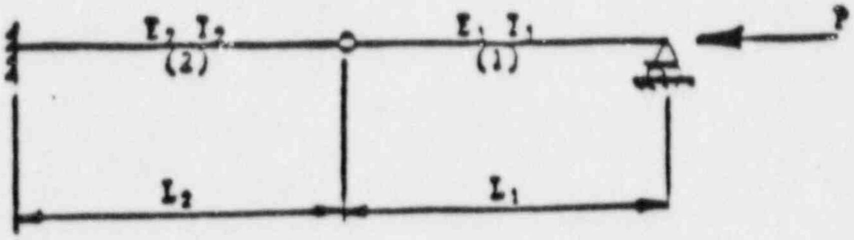
1.1.3 Multi-Strutted Frame Gang Supports

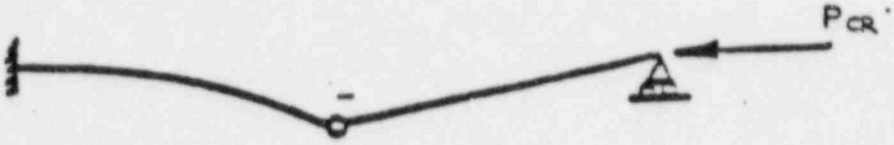


1.1.4 Trapeze Supports With U-Bolts



1.1.5 Column-Strut Stability





1.2 System Stability

The stability of the overall piping system is dependent upon the stability of each individual support. The issue was that if there were unstable supports in a piping system, then the overall system would be unstable.

2.0 Issue Resolution

2.1 Potentially Unstable Support Configurations

A stable support is a support that cannot shift or move to an unqualified position. Unqualified position means a position that exceeds the specified tolerances from the position assumed in the pipe stress analysis.

The stability of supports was assured by qualifying column-strut supports and by modifying potentially unstable configurations in accordance with CPPP-7, Section 4.2.4 and Attachment 4.9, as follows:

2.1.1 Zero-Clearance Box Frame Supported by Single or Multiple Struts or Snubbers

These support types were either eliminated or modified, such as by removing the existing box frame and replacing it with a standard pipe clamp or rigid frame.

2.1.2 Uncinched U-Bolts on Single Strut or Snubber

All supports of this nature were eliminated or are being modified by replacing the U-bolt assembly with a design consistent with the required support function.

2.1.3 Multi-Strutted Gang Support Frames

These supports were redesigned as rigid frames.

2.1.4 Trapeze Supports With U-Bolts

All supports of this nature were eliminated or are being modified as described in Subappendix A12, Axial, Rotational, and Trapeze-Type Restraints.

2.1.5 Column-Strut Stability

A procedure to evaluate the critical buckling load of a column-supported strut was developed and is included in CPPP-7, Attachment 4-9.

2.2 System Stability

The stability of the overall piping system was assured by the following:

1) Each installed support was individually qualified to be stable (in accordance with the definition in Section 2.1).

2) The system integrity was analyzed and qualified to the ASME Section III, Division 1 Code allowables for deadweight, thermal, and applicable occasional loads (fluid transients) and seismic excitations in three orthogonal directions.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).

- The corrective action to resolve the issue of pipe support and system stability was accomplished through the analysis methods and support modifications specified in CPPP-7, Section 4.2.4 and Attachment 4-9 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section III, August 22, 1983

4.2 CASE's Motions and Answer to TU Electric's Motions for Summary Disposition Regarding Stability of Pipe Supports, October 15, 1984

4.3 Testimony of N. H. Williams in Response to CASE Question of February 22, 1984, to CYGNA Energy Services

4.4 Letter to Mr. J. B. George of TU Electric from N. H. Williams of CYGNA in reference to stability of pipe supports, April 30, 1985

4.5 CYGNA Pipe Support Review Issues List, Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987.

SUBAPPENDIX A5

PIPE SUPPORT GENERIC STIFFNESS

1.0 Definition of the Issue

1.1 Generic Stiffness Methodology

The issue (References 4.1 through 4.6) was that there is no assurance that the assumed set of generic stiffness values used in the piping stress analyses were sufficiently representative of the stiffnesses of the installed supports. Therefore, the results of the pipe stress analyses may not be valid.

Supports were designed to allowable stresses and to a deflection limit of 1/16 in. for Level B (upset condition) loads. No check was performed on the support stiffness, since it was assumed that the 1/16-in. deflection limit would ensure that the actual support stiffness was acceptably close to the assumed values used in the piping stress analyses.

1.2 Pipe Support Stiffness Evaluation

It was also noted that the flexibilities of all pipe support components, such as U-bolts and base plates, should have been included in the support stiffness calculation.

1.3 Effect of Oversize Holes on Pipe Support Stiffness Evaluation

The bolt hole sizes for 1 in. diameter bolts were 1/16 in. larger than allowed by the ASME Section III Code of record. The issue was that these oversized holes were ignored in the pipe support deflection check and therefore could have an unconservative impact on the seismic analysis of the piping system.

2.0 Issue Resolution

2.1 Generic Stiffness Methodology

Pipe support stiffnesses were represented in the pipe stress analysis in accordance with CPPP-7, Section 3.10.8.

The following approach was followed to develop a generic stiffness methodology for CPSES.

2.1.1 Determination of Generic Values

The following three types of supports were selected from the CPSES pipe supports installed in the plant:

1) Rigid supports, including frames and struts

2) Anchors

3) Snubbers

For rigid supports, generic values were analytically developed (Reference 4.7) for groups of pipe sizes. For snubbers, generic values were based on snubber sizes.

The generic values for anchors were developed in terms of nondimensional values, which are independent of pipe sizes. The nondimensional stiffness values of all sample anchors for all pipe sizes can thus be used together in developing histograms.

2.1.2 Pipe Support Stiffness Histograms

For all the supports evaluated, stiffness values were calculated.

Histograms of the calculated stiffnesses (Reference 4.8) were developed and representative values (median values) determined.

2.1.3 Minimum Acceptable Stiffness for Use of the General Value

To assure that the use of generic values produce valid pipe stress analyses, a minimum stiffness value was established. The minimum stiffness was determined with consideration of its effect on thermal, static, and dynamic responses (Reference 4.7). This approach utilized simplified piping models and fundamental engineering principles.

2.1.4 Screening Procedure

Before the beginning of pipe stress analyses, each pipe support was assessed to determine if its stiffness falls above the minimum stiffness; if so, it was assigned the generic stiffness. When a pipe support's stiffness had been determined to fall below the minimum value, the calculated stiffness value was used in the pipe stress analysis in lieu of the generic value. A set of CPSES generic stiffness values and acceptable minimum values have been incorporated in the design criteria, CPPP-7, Section 3.10.8.

2.2 Pipe Support Stiffness Evaluation

In accordance with CPPP-7, Section 4.3.2.2, the stiffness of each component in the support assembly, such as vendor-supplied components, structural members, and base plates was assessed in the evaluation of the support stiffness.

To facilitate the support stiffness evaluation, the stiffnesses of commonly used supports and subassemblies have been provided in graphic and tabular forms and incorporated in Attachment 4-18 of CPPP-7.

2.3 Effect of Oversize Bolt Holes on Pipe Support Stiffness Evaluation

As discussed in Subappendix A13, Bolt Hole Gaps, CPSES anchor-bolt hole sizes were in compliance with ASME 1985 Summer Addenda NF-4721(a) and are not oversized. Therefore, consistent with industry practice, the effects of bolt hole gaps were not included in the support stiffness assessments.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).

- The corrective action to resolve the issues regarding pipe support generic stiffness was accomplished by implementing the procedures provided in CPPP-7, Sections 3.10.8 and 4.3.2 and Attachment 4-18 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations) Section IX, August 22, 1983

4.2 Affidavit of CASE Witnesses J. Doyle and M. Walsh, CASE's Partial Answer to Applicants' Statement of Material Facts as to which there is no Genuine Issue Regarding Applicants' Use of Generic Stiffnesses Instead of Actual Stiffnesses in Piping Analysis, August 24, 1984, and August 27, 1984

4.3 CYGNA Phase 3 Final Report, TR-84042-01, Revision 1, Appendix J, Note 8, November 20, 1984

4.4 N. H. Williams (CYGNA) letter to V. Noonan (USNRC), Open Items Associated with Walsh/Doyle Allegations, CYGNA Letter No. 84042 022 dated January 18, 1985

4.5 Testimony of N. H. Williams in response to CASE questions of February 22, 1984, to CYGNA Energy Services

4.6 CYGNA Pipe Support Review Issues List Revision 4, CYGNA Letter No. 84056.120 dated September 18, 1987

4.7 SWEC-PSAS Report No. 15454-N(C)-003, Generic Pipe Support Stiffness Values for Piping Analysis, September 1986

4.8 Pipe Support Generic Stiffness Study, CPPA-48,974, TU Electric, February 13, 1986

SUBAPPENDIX A6

UNCINCHED U-BOLT ACTING AS A TWO-WAY RESTRAINT

1.0 Definition of the Issue

The issue (References 4.1 and 4.2) was that certain uncinched U-bolts attached to rigid frames were modeled and analyzed as one-way restraints (i.e., as providing restraint in the direction parallel to the axis of the threaded portion of the U-bolt) but will actually behave as two-way restraints (i.e., as stated above and laterally). This was viewed as having a two-fold effect:

1.1 Modeling

Failure to include the two-way restraining action of the U-bolts may invalidate the results of pipe stress analyses that utilized U-bolts modeled as one-way restraints.

1.2 Uncinched U-Bolt Qualification Guideline

Such U-bolts may not meet the manufacturer's recommended interaction limits when the lateral loads are applied.

2.0 Issue Resolution

2.1 Modeling

2.1.1 For pipe sizes equal to or greater than 8 in. NPS, uncinched U-bolts were replaced in the model with a component commensurate with the support function.

2.1.2 In the piping analysis, uncinched U-bolt supports for pipe sizes 6 in. and smaller that are attached to rigid frames were modeled as two-way restraints.

2.2 Uncinched U-Bolt Qualification Guideline

2.2.1 STRUDL models of U-bolts were developed to derive the stiffness value and resultant loading (moment, shear, and tension) at the attachment to the frame. For static (i.e., signed) loads, a friction coefficient of 0.3 was considered to act in the axial direction of the pipe. Resolution of the friction issue is discussed in Subappendix A7.

2.2.2 Based on the above STRUDL analyses, allowable U-bolt load ratings were developed.

2.2.3 The uncinched U-bolt qualification procedure was incorporated in Section 4.2.5.2 and Attachment 4-3 of CPPP-7.

2.2.4 Stiffness values for uncinched U-bolts, modeled as two-way restraints were developed and issued in CPPP-7, Section 4.3.2.2 and Attachment 4-18.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action to resolve the concern of U-bolts acting as two-way restraints was accomplished by implementing the criteria of CPPP-7, Sections 4.2.5.2 and 4.3.2.2, and Attachments 4-3 and 4-18 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law, (Walsh/Doyle Allegations) Section II, August 22, 1983

4.2 CASE's Answer to Applicant's Motion for Summary Disposition of CASE's Allegations Regarding U-Bolts Acting as Two-Way Restraints, August 20, 1984

SUBAPPENDIX A7

FRICTION FORCES

1.0 Definition of the Issue

The issue (References 4.1 through 4.4) was that friction loads were not considered in the original pipe support designs when the predicted pipe movement was less than 1/16 in.

2.0 Issue Resolution

Friction loads were considered in the validation of pipe supports at CPSES. Section 4.7.3 and Attachment 4-7 of CPPP-7 required that friction be considered in all load cases for noncyclic loads (i.e., static and/or steady state loads) regardless of the magnitude of pipe movement.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action to resolve the issue of friction forces was accomplished through the implementation of the criteria provided in CPPP-7, Attachment 4-7 during the design valiation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section XVI, August 22, 1983.

4.2 CASE's Answer to Applicants' Motion for Summary Disposition Regarding Consideration of Friction Forces in the Design of Pipe Supports with Small Thermal Movements, August 6, 1984.

4.3 CASE's Answer to Applicants' Reply to CASE's Answer to Applicants' Motion for Summary Disposition Regarding Consideration of Friction Forces, October 1, 1984.

4.4 CYGNA Pipe Support Review Issues List, Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987

SUBAPPENDIX A8

AWS VERSUS ASME CODE PROVISIONS

1.0 Definition of the Issue

The issue (References 4.1 through 4.4) was that certain aspects of weld design, welding practices, and the effects of punching shear (local stress) on structural members were not adequately addressed. The items discussed are grouped into the following four groups:

1.1 Skewed T-Joint Welds

The issue was that the effective throats of skewed T-joint welds were incorrectly calculated in the original design. The AWS angle limitation between the joined parts was violated in the evaluations of skewed T-joint welds at CPSES.

1.2 Effective Throat of Flare Bevel Welds

The issue was that since the ASME Code does not adequately address the determination of the effective throat for flare bevel welds, there is no assurance that the evaluations of these welds were properly performed.

1.3 Welding Practices

The issue was that since the ASME Code does not adequately address various welding practice related items such as preheat requirements, cap welding, weave welding, downhill welding, drag and work angles (which limit the space allowed for welders to function), and lap joint requirements, that these welding processes may not have been properly addressed in the existing welding procedures.

1.4 Punching Shear (Local Stress)

The issue was that punching shear has not been considered in the designs at CPSES since the ASME Code does not adequately address this subject. Local stresses, which can be significant, develop in the immediate vicinity of the joint between two members. Based on the relative sizes of items joined, one member tends to punch through the wall of the other.

2.0 Issue Resolution

2.1 Skewed T-Joint Welds

Pipe support welds at CPSES were installed in accordance with Weld Procedure BR-WPS-11032. Weld configurations contained in this procedure were qualified by testing in accordance with ASME Section III, Subsection NF requirements; therefore, the limitations of prequalified welds did not apply.

Guidelines for the design validation of the effective throat of skewed T-joint welds were incorporated in CPPP-7, Attachment 4-2. These requirements were consistent with AWS D1.1.

2.2 Effective Throat of Flare Bevel Welds

Resolution of the issue regarding the determination of the effective throat for flare bevel welds is addressed in Subappendix A10.

2.3 Welding Practices

Resolution of the issues regarding inadequate weld procedure-related items is addressed in Subappendix A27.

2.4 Punching Shear (Local Stress)

Resolution of the issue regarding the evaluation of local stresses in the walls of structural pipe support members is addressed in Subappendix A21.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- Pipe support modifications resulting from the resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action to resolve the issue of AWS versus ASME Code provisions was accomplished through the implementation of the criteria provided in Section 4.4 and Attachment 4-2 of CPPP-7 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle allegations), Section V, August 22, 1983.

4.2 CASE's Answer to Applicant's Statement of Material Facts as to which there is no Genuine Issue Regarding Certain Case Allegations Regarding AWS and ASME Code Provisions Related to Design Issues, August 4, 1984.

4.3 NRC Staff Response to Applicant's Motion for Summary Disposition on AWS and ASME Code Provisions on Weld Design, November 2, 1984.

4.4 Affidavit of David Terao on AWS and ASME Code Provisions on Weld Design, November 2, 1984.

SUBAPPENDIX A9

A500, GRADE B TUBE STEEL

1.0 Definition of the Issue

The original design of CPSES pipe supports used a design yield strength Sy of 42 ksi for A500, Grade B, tube steel (cold formed) in accordance with ASME Code Case N-71-9. Later versions of ASME Code Cases N-71-10 through N71-14 revised the yield strength from 42 ksi to 36 ksi. Therefore, the issue (References 4.1 through 4.4) was that all designs for tube steel supports at CPSES should be revised to incorporate the lower design yield strength.

2.0 Issue Resolution

2.1 Basis of ASME Code Case Revision

The basis of the ASME Section III NF Code Committee revision of ASME Code Case N-71-9 (42 ksi) to N-71-10 (36 ksi) is the concern that the yield strength in the heat-affected zone at weldments could be slightly reduced. Since test data were not available at the time to quantify the reduction, the ASME Section III Code allowable for A500 Grade B (cold-formed tube steel) was reduced to that of A501 (hot-formed). The Code Committee's action was considered a conservative measure.

The Code Committee has evaluated test data on this issue. The test data demonstrate that the yield strength in the heat-affected zone of A500 Grade B tube steel is not reduced below 46 ksi.

ASME Code Case N-71-15, which specifies Sy = 46 ksi for A500 Grade B7 tube steel in rectangular shapes, was issued in December 1986.

2.2 SWEC-PSAS Validation

The design of pipe supports using A500, Grade B tube steel at CPSES were validated using a yield strength of 36 ksi in accordance with CPPP-7, Section 4.7.2.1.

Pipe supports where the calculated stress exceeded 36 ksi but did not exceed 42 ksi were not modified. The yield stress of 42 ksi is based on ASME Section III Code Case N-71-9 which is consistent with CPSES licensing commitments and is acceptable and conservative in light of ASME Section III Code Case N-71-15 which specifies the allowable yield strength of A500 Grade B tube steel as 46 ksi.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

* Pipe support modifications resulting from resolution of issues in Subappendix A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).

* The corrective action to resolve the A500, Grade B tube steel issue was accomplished through the implementation of criteria provided in CPPP-7, Section 4.7.2.1, during the design validation.

* The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 Affidavit of W. P. Chen on Revised A500 Steel Yield Values, May 29, 1984

4.2 Testimony of N. H. Williams in Response to CASE Questions of February 22, 1984, to CYGNA Energy Services

4.3 Meeting Between CASE and TU Electric with SWEC in Attendance, Large Bore Pipe Supports, March 12, 13, and 14, 1987

4.4 CYGNA Pipe Support Review Issues List, Revision 4, Transmittal Letter No. 84056.120 dated September 18, 1987

SUBAPPENDIX A10

TUBE STEEL SECTION PROPERTIES

1.0 Definition of the Issue

1.1 Section Properties

The section properties for A500 Grade B cold-formed tube steel used in the pipe support design at CPSES had been obtained from three authoritative source documents. Each source document listed small differences in section properties based on different nominal corner tangent radii (RT) as follows:

a. AISC Manual of Steel Construction, 7th Edition, RT ≅ 3t. (t = thickness of tube steel wall)

b. 1974 Welded Structural Tube Institute (WSTI) Manual of Cold-Formed Welded Structural Steel Tubing, RT ≅ 1t.

c. AISC Manual of Steel Construction, 8th Edition, RT ≅ 2t.

These small differences in nominal section properties led to the contention that tube steel milled prior to 1980 had different corner radii and that tube steel had been procured for use at CPSES both prior to and after 1980. Therefore, the issue was that the vintage of the tube steel must be established and the proper section properties used (References 4.1 and 4.2).

1.2 Effective Throat of Flare Bevel Welds

The 8th Edition of AISC states that the effective throat of flare bevel groove welds is t_e = 5/16 R unless it can be established that a larger effective throat can be obtained. The design of flare bevel welds at CPSES used two different effective throats of t_e = 0.645t and t_e = t.

Because of the differences in assumed corner radii of tube steel, the effective throat evaluation of flare bevel welds was questioned.

1.3 Bolt Hole Effects

The issue was that the effect of bolt holes on section properties had not been considered in the design.

2.0 Issue Resolution

2.1 Section Properties

SWEC reviewed the material manufacturer's dimensional standards for A500, Grade B tube steel supplied to CPSES.

The review was performed for ASTM A500 (standard specification for cold-formed welded and seamless structural tubing in rounds and shapes), which included a 12-year span starting from issue date 1974 through 1986. Since the standard mill tolerances did not change during this period of time, it was concluded that the fabrication tolerances and section properties of tube steel members in CPSES have been maintained to a consistent standard.

SWEC-PSAS also confirmed that Welded Steel Tube Institute (WSTI) amended its 1974 issue to agree with the 8th Edition of the AISC. This amendment is the latest revision to date. These section properties are based on a nominal corner tangent radius of 2t and are considered representative of cold-formed tube steel.

SWEC-PSAS resolutions are summarized as follows:

- The use of section properties in AISC Manual of Steel Construction, 8th Edition is appropriate, since it represents the actual cold-formed tube steel used at CPSES.
- The 8th Edition of AISC is used by SWEC-PSAS in the selection of section properties for structural tube steel.
- SWEC-PSAS surveyed tube steel corner dimensions on installed supports at CPSES (Reference 4.3) and confirmed that the installed supports have a nominal 2t corner radius.
- Section 4.3.2.1 of CPPP-7 specifies that structural tube steel section properties are selected from the 8th Edition of the AISC steel manual.

2.2 Effective Throat of Flare Bevel Welds

SWEC-PSAS performed a survey of tube steel dimensions on installed ASME Section III, Subsection NF pipe supports at CPSES and weld tests of worst-case configurations to determine the appropriate effective throat to be used for flare bevel welds (Reference 4.3). Based on the results of this survey, it was concluded that an effective throat of $t_e = t - 1/16$ in. is justified for all tube sizes except TS 2 x 2. For TS 2 x 2 sections, an effective throat $t_e = t - 1/8$ in. is appropriate.

Existing welds on TS 2 x 2 sections are qualified to the t_e = t - 1/8 in. criteria, unless it is verified that the weld has a larger effective throat by performing a field inspection of the weld in accordance with the methods described in SWEC-PSAS Project Memorandum No. 140 (PM-140).

Specification No. 2323-MS-100 was revised on March 2, 1987 to assure that an effective throat of t_e = t - 1/16 in. is achieved for welds on TS 2 x 2 tube steel for any subsequent work.

Section 4.4 and Attachment 4-2 of CPPP-7, as amended by SWEC-PSAS PM-140, specify the effective throats of flare bevel welds.

2.3 Bolt Hole Effects

The section properties for tube steel are reduced for the effects of bolt holes as required by CPPP-7, Section 4.3.2.1 which is in accordance with the requirements of ASME Section III, Appendix XVII requirements.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- Pipe support modifications resulting from resolution of issues in Subappendix A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action for tube steel section properties and bolt hole effects was provided in Section 4.3.2.1 of CPPP-7. The corrective action for the effective throats of flare bevel welds was accomplished through the implementation of the criteria provided in Attachment 4-2 of CPPP-7 and SWEC-PSAS PM-140 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section XVIII, August 22, 1983

4.2 CASE's Answer to Applicants' Statements of Material Facts as to Which There Is No Genuine Issue Regarding CASE's Allegations Regarding Section Property Values, August 12, 1984

4.3 SWEC-PSAS Report No. 15454-N(C)-0C4, Survey of Structural Tube Steel Dimensions to Verify the Effective Throat of Flare Bevel Welds, March 1987

SUBAPPENDIX A11

U-BOLT CINCHING

1.0 Definition of the Issue

The following issues (References 4.1 through 4.6) were raised regarding the use of cinched U-bolt supports with single struts or snubbers.

1.1 Evaluation of the Cinched U-Bolt Assembly

The stresses in the run pipe, the U-bolt, and the support cross-piece due to the combined effect of preload (i.e., cinching), pipe thermal and pressure expansion, and external loadings were not considered in the design of the cinched U-bolt supports.

1.2 Use of SA-36 and A307 Material for Cinched U-Bolts.

1.2.1 Preload Maintenance

SA-36 material is similar to A307 material, which is prohibited in the AISC Code, 7th Edition, Table 1.5.2.1, as bolting material in friction connections. Maintenance of joint preload is the underlying issue.

1.2.2 Fatigue

ASME Section III, Appendix XVII, Table XVII-3230-1, Footnote 4, and AISC 7th Edition, Appendix B, Table B2, Footnote 4, recommend that A307 bolts not be used in connections subject to stress reversal. Fatigue of the A307 material is the issue. Both these issues regarding the use of A307 material were extended to the SA-36 U-bolt used in cinched U-bolt supports.

1.3 Preload-Torque Relationship

The established preload-torque relationship was questioned, especially in light of the potential for galling under U-bolt nuts while tightening.

1.4 Stability of Cinched U-Bolt Supports

The stability of the cinched U-bolt pipe support assembly is dependent on attaining and maintaining the required preload. In light of the uncertainty in the preload-torque relationship, as discussed in Section 1.3, and the issue regarding the fatigue life and preload maintenance ability of A307 material, as discussed in Section 1.2, the stability of cinched U-bolt supports with struts and snubbers was questioned.

2.0 Issue Resolution

Due to the extensive engineering effort required to validate cinched U-bolt type supports with struts or snubbers, and the uncertainty in the ability to attain and maintain required preload levels, all cinched U-bolt supports with struts or snubbers are deleted or modified to other stable support designs consistent with the required support functions.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action to resolve the issues of 1) the proper evaluation of the pipe and cinched U-bolt assembly, 2) the use of SA-36 material in cinched U-bolts, 3) the preload-torque relationship, and 4) stability, is being accomplished through the elimination or modification of cinched U-bolt supports with struts or snubbers in accordance with the criteria provided in CPPP-7, Section 4.2.5.1 used during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Finding of Fact and Conclusions of Law, (Walsh/Doyle Allegations) Section IV, August 22, 1983

4.2 ASLB Memorandum and Order at 27, 28, 33-41, December 28, 1983, and reconsidered in Memorandum and Order at 25-6A, 20-4C, February 8, 1984

4.3 Westinghouse Report No. WCAP-10620, U-bolt Support/Pipe Test, July 1984

4.4 Westinghouse Report No. WCAP-10627, U-bolt Support Assembly Finite Element Analysis, July 26, 1984

4.5 CASE Answer to Applicant's Statement of Material Facts as to Which There is No Genuine Issue Regarding to Consideration of Cinched U-bolts, Affidavit of CASE Witness J. Doyle, October 8, 1984

4.6 CYGNA Pipe Support Review Issues List (RIL), Revision 4, Transmittal Letter No. 84056.120 dated September 18, 1987

SUBAPPENDIX A12

AXIAL/ROTATIONAL RESTRAINTS

1.0 Definition of the Issue

Three groups of axial and/or trapeze-type supports listed below use welded lug or trunnion attachments to transfer loads to frames or component hardware.

a. Single or dual trunnions with component supports

b. Non-trunnion component supports

- Trapeze supports with U-bolts
- Riser clamps with dual components
- Riser clamps with single components

c. Frame supports with lugs

The issues (References 4.1 and 4.2) regarding these specific types of supports are summarized as follows:

1.1 Rotational Load

The issue was that rotational restraint effects must be treated as a primary load for the support design.

1.2 Eccentric Loading

The issue was that eccentric loading, which can result from effects such as differential snubber lockup and support steel stiffness variations, must be considered in the design process.

1.3 Snubber Lockup

The issue was that snubber end clearance effects may cause significant increase in loads or invalidate linear analysis results.

1.4 Lug/Frame Design Load

The issue was that multiple lug configurations must consider a conservative loading distribution for lug and frame design.

1.5 Clearances

The issue was that insufficient clearances or eccentricities may exert rotational restraint on the pipe.

2.0 Issue Resolution

2.1 Rotational Load

The eccentric line of action of single component riser clamps and single axial trunnion, and the rotational resistance to the pipe of dual trunnion-type supports, were modeled in the pipe stress analysis. The pipe supports were design validated considering the resulting load as a primary load.

2.2 Eccentric Loading

The effect of differential snubber lockup in the dual trunnion support was addressed by increasing the design load on each trunnion snubber and its supporting structure by 20 percent. The variation in support steel stiffnesses for dual component riser clamps was addressed by limiting the acceptable variation in stiffness between the supporting structures for each component and increasing the component design load from 50 percent to 75 percent of the total support design load.

Four lugs are typically used for nonintegral axial clamp supports. Each lug was validated to 50 percent of the total load for dual component supports modeled as a single component.

Dual component riser clamps with variations in support stiffnesses exceeding the acceptable value were modeled in the stress analysis as eccentric (one-sided) translational restraints, and the support is being modified by the removal of the component on the softer side. For such eccentrically modeled supports, the load for each lug is based on statics with the assumption that all of the moment is reacted at the lugs, i.e., the clamp-to-pipe connection does not resist the moment.

Trapeze supports with cinched U-bolts are being eliminated or modified to provide a stable support configuration consistent with support function as discussed in CPPP-7, Attachment 4-8.

2.3 Snubber Lockup

To assure valid stress analysis results, snubber pairs used in dual component applications (dual trunnions and riser clamps) are matched as defined in Reference 4.3.

2.4 Lug/Frame Design Load

Lugs for rigid frame-type axial restraints were each validated for the total load if only two lugs are used, or 50 percent of the total load if four lugs are used.

Analysis of load distribution at lug/frame interfaces was based on CPPP-7, Attachment 4-8, which maximized the critical stress in the frame.

2.5 Clearances

The clearances between the pipe and the frame and the lugs and riser clamps and frame are controlled in accordance with CPPP-7, Attachment 4-11 to assure proper function of the pipe support. Pipe support eccentricities are discussed in Section 2.2 above.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action to resolve the issue of axial/rotational restraints was accomplished through the implementation of the criteria in CPPP-7, Section 3.10.6.2 and Attachment 4-8 of CPPP-7.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section XII, August 22, 1983

4.2 Affidavit of Case Witness Mark Walsh - CASE's Partial Answer to Applicant's Statement of Material Facts as to Which There was No Genuine Issue Regarding Allegations Concerning Consideration of Force Distribution in Axial Restraints, August 27, 1984

4.3 Nuclear Standard, Mechanical and Hydraulic Snubbers for Nuclear Application, NE-E7-9T, September 1984, U.S. Department of Energy, Nuclear Energy Program

SUBAPPENDIX A13

BOLT HOLE GAP

1.0 Definition of the Issue

Bolt hole gap, as used herein, refers to the radial clearance between an anchor bolt and the bolt hole edge in pipe support member/base plates. Issues regarding the effect of bolt hole gaps are as follows (References 4.1 to 4.4):

1.1 Oversized Holes

The issue was that bolt holes in support base plates are oversized. Bearing connections are not allowed if the bolt hole is greater than the standard size hole specified by the AISC Code.

1.2 Shear Distribution

The issue was that it is impossible to predict how many bolts are involved in the transfer of shear. Inelastic action that distributes the shear load to all anchor bolts is appropriate for static loads only.

1.3 Effect on Support Stiffness

The issue was that the presence of gaps in joints under dynamic conditions adversely affects the stiffness of the pipe support and its seismic response. The usual procedure is to assume that two bolts react to the load regardless of the number of bolts in the pattern.

2.0 Issue Resolution

2.1 Oversized Holes

Hole sizes allowed by the ASME Section III Code, paragraph NF-4721, were compared to existing hole sizes at CPSES as shown below.

ASME Code Table NF-4721(a)-1 specifies the allowable bolt hole sizes for bearing-type connections as follows:

Bolt Size	Hole Size
Equal to or less than 1 in.	Bolt diameter +1/16 in.
Between 1 and 2 in.	Bolt diameter +1/8 in.

The allowable bolt hole sizes of the installed CPSES base plates were as follows:

Bolt Size	Hole Size
Equal to or less than 3/4 in.	Bolt diameter +1/16 in.
1 in. to 1 1/2 in.	Bolt diameter +1/8 in.

Therefore, it was concluded that only the bolt holes for 1-in. diameter bolts at CPSES have an allowable size larger than the code allowable (by 1/16 in.). The 1985 Summer addenda of the ASME Section III Code, paragraph NF-4721(a) clarified that for anchor bolts, the hole size may be increased by 1/16 in. over the values specified in Table NF-4721(a)-1.

ASME Section III, 1985 Summer Addenda NF-4721(a) was added to the CPSES Code of Record in CPPP-7, Section 2.2, and Specification No. [illegible] (Reference 4.5).

2.2 Shear Distribution

Design of base plate connections at CPSES is based on standard steel design practices where equal shear load sharing among bolts is used. This practice is described in References 4.6 and 4.7, which compare the ultimate shear load sharing in plate connections to the equal distribution assumed at design levels.

Support designs at CPSES were examined and it was concluded that the Richmond insert to tube steel connection may not be covered by these normal practices. Therefore, Richmond insert to tube steel connection designs are reviewed in accordance with SWEC-PSAS Project Memorandum No. 141 (PM-141) to confirm that unequal shear load sharing is not an issue.

2.3 Effect on Support Stiffness

The effect of bolt hole gap on support stiffness is discussed in Appendix A5.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action to resolve the bolt hole gap issue was accomplished through the implementation of the criteria provided in CPPP-7, Attachments 4-4 and 4-5, SWEC-PSAS PM-141, and Specification No. MS-46A during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section XXI, August 22, 1983

4.2 CASE's Answer to the Applicants' Statement of Material Facts in the Form of Affidavit of CASE Witness M. Walsh, August 12, 1984

4.3 CYGNA's response to CASE Question No. Doyle 16

4.4 CASE's 4th Round Answer to Applicants' Reply to CASE's Answer to Applicants' Motion for Summary Disposition Regarding the Effects of Gaps, December 19, 1984

4.5 Comanche Peak Nuclear Safety Class Pipe Hangers and Supports Specification No. 2323-MS-46A, Revision 7, July 6, 1987

4.6 B. Kuzmanovic and N. Williams, Steel Design for Structural Engineer, 2nd Edition, 1983, Prentice Hall, Inc., page 321

4.7 C. Salmon and J. Johnson, Steel Structures Design and Behavior, 1971, Intext Educational Publishers

SUBAPPENDIX A14

OBE/SSE DAMPING

1.0 Definition of the Issues

The issue (References 4.1 to 4.4) was that the improper damping values were used in the stress analysis at CPSES.

1.1 NRC Regulatory Guide 1.61 Damping

The issue was that piping systems containing active components (e.g., valves) used the damping for piping which was higher than the damping prescribed by NRC Regulatory Guide 1.61 (Reference 4.5) for active valves.

Damping values higher than the allowables in NRC Regulatory Guide 1.61 were used in the pipe stress analysis at CPSES.

1.2 Damping for Mixed Size Piping

The issue was that in certain pipe stress analysis packages which are comprised of piping of different sizes, the damping values for the 12-in. or greater piping were used even though the pipe stress analysis package contained piping smaller than 12 in.

2.0 Issue Resolution

2.1 NRC Regulatory Guide 1.61 Damping

CPPP-7 Section 3.4.5.4.1 specified the use of NRC-recommended damping values for piping addressed in NRC Regulatory Guide 1.61. In fact, the NRC has recently approved the higher damping values for piping systems contained in ASME Code Case N-411 (Reference 4.6). Therefore, the lower damping for active components in NRC Regulatory Guide 1.61 is not applicable to the CPSES piping system analysis.

2.2 Damping for Mixed Size Piping

CPPP-7 specified that mixed-size piping systems (containing pipes above and below 12-in. NPS) are conservatively evaluated with the lower damping values of NRC Regulatory Guide 1.61.

Use of the damping values specified in ASME Code Case N-411 that are applicable to all pipe sizes was approved for implementation at CPSES by the NRC Staff. CPPP-7 authorized the use of Code Case N-411 for all systems, including mixed-size CPSES piping systems, except where stress analysis is performed using the Independent Support Motion Method.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- All the pipe support modifications resulting from resolution of issues in Subappendix A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).

- The corrective action to resolve OBE/SSE damping issue was accomplished through the implementation of the criteria provided in CPPP-7, Section 3.4.5.4.1 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section XXII, August 22, 1983

4.2 CASE's Answer to Applicant's Motion for Summary Disposition Regarding Alleged Errors Made in Determining Damping Factors for OBE and SSE Loading Conditions, August 6, 1984

4.3 CASE's Answer to Applicant's Reply to CASE's Answer to Applicant's Motion Regarding Alleged Errors Made in Determining Damping Factors for OBE and SSE Loading Conditions, October 2, 1984

4.4 CYGNA Pipe Stress Review Issues List, Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987

4.5 USNRC Regulatory Guide 1.61, Damping Values for Seismic Design of Nuclear Power Plants, October 1973

4.6 NRC Letter from V. S. Noonan to W. G. Counsil dated March 13, 1986, Evaluation of Request for Use of ASME Code Cases N-397 and N-411

SUBAPPENDIX A15

SUPPORT MASS IN PIPING ANALYSIS

1.0 Definition of the Issue

The issue was that the mass contribution of the support to the piping system is significant and it cannot be omitted from the analysis (Reference 4.1).

The support mass contribution to the piping model was not always considered in the CPSES pipe stress analysis, because it was considered small relative to the total mass of the piping system.

2.0 Issue Resolution

The support mass, eccentric and noneccentric, was accounted for in pipe stress analyses in accordance with CPPP-7, Section 3.10.4. A detailed procedure for pipe support mass determination and inclusion in the piping system analysis was included in Attachment 3-4 of CPPP-7, with additional guidance on the modeling of eccentric mass included in Attachment 3-11.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- All the pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action to resolve the support mass in piping analysis issue was accomplished through the implementation of the criteria provided in CPPP-7, Attachments 3-4 and 3-11 during the design validation.
- The preventive action for this issue is specified in Appendix C.

4.0 References

4.1 CASE'S Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section XIV, August 22, 1983

SUBAPPENDIX A16

PROGRAMMATIC ASPECTS AND QA INCLUDING ITERATIVE DESIGN

1.0 Definition of the Issue

The following miscellaneous issues with programmatic aspects and QA were identified (References 4.1 and 4.2).

1.1 Fragmented Responsibility and Interface Control

The issue was that inadequate interface control and fragmented responsibilities between analysis, design, and construction phases of piping and support design phases resulted in numerous inadequacies and inconsistencies.

1.2 Iterative Design

The issue was that the identification and correction of design errors was delayed until the end of the iterative design process.

1.3 Quality Assurance and Personnel

The issue was that calculations did not follow project guidelines for quality assurance. No standards were specified for the qualification of personnel at different levels.

1.4 Timeliness

The issue was that problems which were generic in nature were not resolved promptly, resulting in numerous deficiencies of a similar nature.

1.5 Construction and Field Changes

The issue was that procedures for construction and installation were inadequate and were not kept up to date. Field changes were not approved, and resulted in calculations justifying as-built conditions.

1.6 Procedures

The issue was that frequent changes and lack of adequate control of procedures resulted in many violations of the procedures.

1.7 Calculation Errors

The issue was that in random checks of calculations, numerous errors were found.

1.8 Miscellaneous

The issue was that various other issues were raised regarding the updating of criteria and the adequacy of various practices used in design/qualification activities.

2.0 Issue Resolution

SWEC-PSAS's Management Plan for Project Quality, CPPP-1 (Reference 4.3), outlines SWEC-PSAS's approach to resolving the various programmatic issues through issuance of Project Procedures, which implement SWEC corporate procedures (Engineering Assurance Procedures, and Quality Standards). CPPP-1 addresses each of the 18 criteria of 10CFR50, Appendix B. The individual issues listed in Section 1.0 are resolved as follows:

2.1 Fragmented Responsibility and Interface Control

The issue of fragmented responsibility between piping analysis and support design was resolved by the integrated design process in the SWEC-PSAS validation program.

All ASME Section III Code Class 2 and 3 piping systems and all ASME Section III Code Class 1, 2, and 3 supports were validated by SWEC-PSAS in accordance with CPPP-7 which provides consistent criteria for both pipe stress analysis and pipe support design. Each pipe stress analysis package was reviewed in accordance with Section 7.3 of CPPP-6, as a system, by pipe stress and pipe support engineers to assure that the interactions between the pipe stress and the pipe support efforts are properly accounted for in the SWEC-PSAS portion of the Corrective Action Program (CAP).

As part of the integrated design process, interfaces between analysis, design, and construction are controlled in accordance with CPPP-6. Personnel performing the validation effort are trained by project management in the use of the applicable project procedures.

2.2 Iterative Design

Design criteria changes were issued during the pipe stress and pipe support validation by means of controlled documents (project memoranda) and revisions to CPPP-7. Prompt review was required for any design criteria changes containing the potential for support modification.

As-built verification of piping and pipe supports is being performed as part of the PCHVP. All modifications are provided to TU Construction via procedurally controlled design change documentation prepared by SWEC-PSAS.

2.3 Quality Assurance and Personnel

SWEC-PSAS's Management Plan for Project Quality (CPPP-1) identifies the procedures to be followed during the generation and review of project calculations. These procedures appropriately emphasize review of calculations for technical adequacy of the resulting designs (calculation conclusions). The emphasis on review for technical adequacy assures that any inconsistencies/documentation discrepancies will not affect the overall conclusion of the calculations. All identified occurrences of inconsistencies and documentation discrepancies are promptly resolved.

Engineering personnel are assigned to tasks after an evaluation of their ability to perform that task. This evaluation is initiated by verification of the employee's academic and professional credentials and employment history in conjunction with the normal employment interviews. Personnel are then assigned to work at an appropriate level under a supervisor. The supervisor is responsible for evaluating and training the employee. This process assures that appropriately qualified personnel are assigned to all engineering tasks.

Personnel involved in the validation effort were trained in the use of the applicable project procedures.

2.4 Timeliness

Early in the validation process, all CPRT and external issues were identified and SWEC-PSAS resolutions to these issues were developed.

During the design validation, any additional issues identified were addressed in a timely manner and appropriate corrective and preventive actions identified and implemented.

2.5 Construction and Field Changes

Field changes were controlled by SWEC-PSAS project procedures which required that new designs, modifications, or reconciliations with as-built conditions be documented and approved by qualified responsible engineers. Walkdowns in accordance with SWEC-PSAS procedures, as well as inspection under the PCHVP, assured that the as-built condition of piping and pipe supports was properly reflected in the design validation.

2.6 Procedures

Controlled copies of CPPP-6 and CPPP-7 (and revisions/changes thereto) were issued to the pipe stress and pipe support supervisory personnel assigned to the SWEC-PSAS CPSES effort.

The issuance and modification of these procedures are controlled in accordance with CPPP-14 (Reference 4.4).

Revisions to these procedures were followed by detailed training of pipe stress and support personnel.

2.7 Calculation Errors

As addressed under paragraph 2.3 above, the SWEC QA Program assures the technical adequacy of the engineering product. SWEC-PSAS requires all employees to develop technically correct and precise calculations Whenever documentation discrepanices are observed, they are promptly corrected.

2.8 Miscellaneous

The various project procedures used in the validation effort along with the corporate engineering and quality assurance procedures were sufficient to address any issues related to the validation of pipe stress and pipe supports at CPSES. This conclusion was also reached by the third party reviewers (see Section 5.1.1).

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).

- The corrective action to control discipline interfaces and to provide consistent design criteria between pipe stress analysis and pipe support design was accomplished through the issue and control of CPPP-1, CPPP-6, CPPP-7, and other project procedures during the design validation. Many audits were conducted to assure that SWEC-PSAS personnel followed the procedures (see Section 5.3).

- The preventive action for this issue is specified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), August 22, 1983

4.2 Comanche Peak Response Team, Design Adequacy Program, Discipline Specific Results Report, Piping and Supports, DAP-RR-P-001, Revision 1, August 27, 1987

4.3 SWEC-PSAS Project Procedure CPPP-1, Revision 7, Management Plan for Project Quality (Piping System Qualification/Requalification), March 25, 1987

4.4 SWEC-PSAS Project Procedure CPPP-14, Revision 3, Procedure for the Preparation and Control of Project Procedures, September 19, 1986

SUBAPPENDIX A17

MASS POINT SPACING

1.0 Definition of the Issue

The issue (Reference 4.1) was that the project procedures which established requirements for minimum mass point spacing were not followed and that the computer program used improperly lumped concentrated masses.

2.0 Issue Resolution

Modeling guidelines for locating the mass points in the computerized pipe stress analysis were included in Section 3.10.6.1 and Attachment 3-7 of CPPP-7. To assure adherence to these requirements, mass point spacing was included as a review item in the pipe stress analysis checklist in CPPP-6, Attachment 9-9.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- All the pipe support modifications resulting from resolution of issues in Subappendix A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action to resolve the issue of mass point spacing was accomplished through the implementation of the criteria provided in CPPP-7, Section 3.10.6.1 and Attachment 3-7 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CYGNA Pipe Stress Review Issues List, Revision 4, and Transmittal Letter No. 84056.119, dated September 16, 1987

SUBAPPENDIX A18

HIGH FREQUENCY MASS PARTICIPATION

1.0 Definition of the Issue

The issue (References 4.1 and 4.2) was that the 33-Hz cutoff frequency criteria used in the CPSES pipe stress seismic analysis may not be adequate. The pipe stress analysis did not comply with the CPSES FSAR requirement that the inclusion of high frequency modes beyond the cutoff frequency in the response spectrum analysis do not result in more than a 10-percent increase in the system response.

2.0 Issue Resolution

Two analysis options were developed and utilized to address the high-frequency mass participation issue.

- Perform seismic amplified response spectrum (ARS) modal analysis with 50-Hz cutoff frequency, including a high-frequency missing mass correction option, by using NUPIPE-SW (V04/L02) or later issue.

- Perform an equivalent static analysis by using the zero-peri acceleration (ZPA) values in all three directions. Combine these results by the square root of the sum of the squares (SRSS) method with the results of the seismic analysis with a 50-Hz cutoff frequency that did not include the high-frequency missing mass correction. Additional studies (Reference 4.3) verified the adequacy of this methodology for CPSES piping systems whose ZPA is less than 50 Hz.

The high-frequency mass participation criteria was specified in Section 3.10.6.8 of CPPP-7.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.

- All the pipe support modifications resulting from resolution of issues in Subappendix A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).

- The corrective action to resolve the high frequency mass participation issue was accomplished through the implementation of the criteria provided in CPPP-7, Section 3.10.6.8 and the use of NUPIPE-SW(V04/L02) during design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 Question 2, CYGNA Communications Reports, J.O.No. 83090 dated October 5, 1983

4.2 CYGNA Pipe Stress Review Issues List, Revision 4, CYGNA Letter No. 84056.119 dated September 16, 1987

4.3 SWEC-PSAS Letter No. CH-1CPO-1456 dated February 6, 1987, from A. Chan to L. Nace, Attachment A, Justification for Terminating Comanche Peak Piping Response Spectrum Analysis at 50 Hz Instead of at the Frequency Corresponding to the Zero Period Acceleration

SUBAPPENDIX A19

FLUID TRANSIENTS

1.0 Definition of the Issue

Fluid transients are occasional mechanical loads that should be considered in stress evaluation of ASME Section III Code Class 2 and 3 piping. The previous analysis prepared for CPSES considered fluid transients on several piping systems. The issue was that the adequacy of the analysis and the completeness of the identification of these fluid transients was questioned (Reference 4.1).

2.0 Issue Resolution

The following process was followed to assure that fluid transients were properly addressed in the SWEC-PSAS validation of the pipe stress analysis.

- Specific fluid transients were identified and summarized in Attachment 1 of CPPP-10. These transients were identified by following the guidelines given in NUREG-0582, past experience with other PWRs, and by assessing an overall review of the CPSES system flow diagrams. Additionally, system engineers reviewed the piping system operating components which could produce significant fluid transients, such as rapid valve opening or closing actions of control valves, relief valve discharge, pump startup or trip, and turbine trip.

- The piping systems identified in Attachment 1-1 of CPPP-10 were analyzed for the effects of fluid transients in accordance with the requirements of CPPP-7, Section 3.4.5.5 and Attachment 3-1. These analysis methods resolve CPRT and external fluid transient issues.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).

- The corrective action to resolve the fluid transient issue was accomplished through the implementation of the criteria provided in CPPP-7, Attachment 3-1 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 TES draft Letter No. 6216-7 dated February 21, 1985, from D. F. Landers to V. S. Noonan, Director, Comanche Peak Project, U.S. Nuclear Regulatory Commission, which transmitted Technical Report No. TR-6216B, Preliminary Consulting Report on Comanche Peak Steam Electric Station - Piping and Support Design

SUBAPPENDIX A20

SEISMIC EXCITATION OF PIPE SUPPORT MASS

1.0 Definition of the Issue

The issue was that the effect of seismic acceleration of the support mass (i.e., self-weight excitation) was not included in the design of the CPSES pipe support structures (References 4.1 and 4.2).

2.0 Issue Resolution

SWEC-PSAS resolved these issues by the following methodology:

- Seismic acceleration of pipe support mass was evaluated for all pipe supports with frames on seismic systems.
- The procedure to include the effects of pipe support self-weight excitation in the pipe support evaluation was incorporated in CPPP-7 as Attachment 4-21.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action to resolve the seismic excitation of pipe support mass issue was accomplished through the implementation of the criteria provided in CPPP-7, Attachment 4-21 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), August 22, 1983, Section X

4.2 NRC Inspection Report 50-445/82-26 and 50-446/82-14, February 14, 1983 (NRC Staff Exhibit 207, pages 34, 35, and 36)

SUBAPPENDIX A21

LOCAL STRESS IN PIPE SUPPORT MEMBERS

1.0 Definition of the Issue

The issues (References 4.1 through 4.6) regarding the evaluation of local stress in pipe support members are as follows:

1.1 Local Stress in Tube Steel Members

The issue was that local stress in tube steel members, induced by attached support components, such as beam brackets, lugs, or other tube steel members, was not considered in the design.

1.2 Other Support Configurations Requiring Local Stress Evaluations

The issue was that several other support types and support details were identified as requiring evaluations for local stresses:

- Cinched U-bolt supports with struts and snubbers
- Piping anchors
- Zero gap box frames
- Wide flange webs at connections

1.3 Short Beam Stresses

The issue was that short structural members were incorrectly analyzed in full flexure. It was noted that more localized stress distribution due to plate behavior would result.

2.0 Issue Resolution

Attachment 4-13 of CPPP-7 specified the requirements to evaluate local stresses in pipe support members.

2.1 Local Stress in Tube Steel Members

A procedure to evaluate local stress in tube steel members based on the methods of AWS Code D1.1 Section 10.5, including yield line analysis, was developed and incorporated in Attachment 4-13 of CPPP-7.

2.2 Other Support Configurations Requiring Local Stress Evaluations

Resolutions for the issue regarding the need for local stress evaluations on other support configurations is as listed below:

- Cinched U-bolt supports on struts and snubbers are being eliminated or modified as discussed in Subappendix A11.

- Resolution of the issue regarding the local stress evaluation for piping anchors is addressed in Subappendix A2

- Zero gap box frames are being eliminated or modified as discussed in Subappendix A2

- Requirements for the evaluation of local stresses in wide flange member webs at connections, consistent with the AISC Code requirements, were developed and incorporated into Attachment 4-13 of CPPP-7

2.3 Short Beam Stresses

Attachment 4-13 of CPPP-7 requires that short beam support members be analyzed for local stress effect.

3.0 <u>Corrective and Preventive Action</u>

- No additional issues were discovered during the review and resolution of the issue.

- Pipe support modifications resulting from resolution of issues in Subappendix A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).

- The corrective action to resolve the issue of local stress in pipe support members was accomplished through the implementation of the criteria provided in CPPP-7, Attachment 4-13 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 <u>References</u>

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section IX, August 22, 1983

4.2 CASE's Answer to Applicants' Statement of Material Facts as to Which There is No Geniune Issue Regarding Consideration of Local Displacements and Stresses, August 27, 1984.

4.3 CASE's Answer to Applicant's Reply to CASE's Answer to Applicants' Motion for Summary Disposition Regarding Local Displacements and Stresses, October 9, 1984.

4.4 NRC Staff Response to Applicant's Motion for Summary Disposition on AWS and ASME Code Provisions on Weld Design, November 2, 1984

4.5 CASE's Answer to Applicant's Motion for Summary Disposition of Certain CASE Allegations Regarding AWS and ASME Code Provisions Related to Design Issues, August 6, 1984

4.6 Transcript of Proceedings Before the United States Nuclear Regulatory Commission, Washington, DC, in the Matter of Meeting to Conduct Feedback Discussions with Messrs. Walsh and Doyle Re Concerns About the Comanche Peak Plant Held March 23, 1986

SUBAPPENDIX A22

SAFETY FACTORS

1.0 Definition of the Issue

The issue (References 4.1 and 4.2) was that the industry practice of neglecting to factor small potential loads into design calculations is not supported by adequate CPSES factors of safety. The issue also was that CPSES safety factors had already been eroded by poor and insufficient design practices.

2.0 Issue Resolution

CPRT and external issues have been resolved and incorporated into the technical and design control procedures. Therefore, the inherent design margin (safety factor) accumulated from the built-in conservatisms in codes, inputs, and regulatory positions is applicable.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action to resolve the issue of safety factors has been implemented in the SWEC-PSAS Corrective Action Program (CAP) through the resolution of all applicable CPRT and external issues which have been incorporated into the technical and design control procedures.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section I, August 22, 1983

4.2 CASE's Partial Answer to TU Electric's Statement of Material Facts as to Which There is No Genuine Issue Regarding Safety Factors, August 27, 1984

SUBAPPENDIX A23

SA-36 AND A307 STEEL

1.0 Definition of the Issue

The following issues were identified (References 4.1 through 4.3) regarding the use of SA-36 and A307 material in pipe supports at CPSES.

1.1 Design Allowables Derived from Tests

The issue was that the material allowables used in the design of cinched U-bolts, U-bolts as two-way restraints, and SA-36 threaded rod used with Richmond inserts for pipe supports at CPSES were derived from tests and not from the ASME Section III Code minimum yield stress, since questions arose as to whether the material tested in the following tests represented the actual material used onsite.

1.1.1 Cinched U-Bolt Tests Conducted by Westinghouse

1.1.2 U-Bolts as Two-Way Restraints Tests Conducted by ITT Grinnell

1.1.3 Richmond Insert Tests Conducted by TU Electric

1.2 Friction Connections

The issue was that AISC Code 7th Edition Table 1.5.2.1 prohibits the use of A307 as bolting material in friction connections. Attainment and maintenance of joint preload is the underlying issue. SA-36 and A307 materials are similar. ASME Section III Code Inquiry NI86-030 (Reference 4.4) clarifies that cinched U-bolts are not friction connections. However, since the U-bolt design relies on friction and preload to provide stability, the AISC prohibition needs to be addressed.

1.3 Fatigue

The issue was that SA-36 material used in cinched U-bolts, U-bolts as two-way restraints, and as rod, threaded into Richmond inserts, are subject to load cycling, which must be considered in the qualification. ASME Section III, Appendix XVII, Table XVII-3230-1, footnote 4; and AISC 7th edition, Appendix B, Table B2, footnote 4, state "Where stress reversal is involved, use of A307 bolts is not recommended." Fatigue of the A307 material is the issue. Since SA-36 material is similar to A307, this issue was extended to SA-36 U-bolts and threaded rods used with Richmond inserts.

1.4 Allowable Stresses in Bolting Material

The issue was that the allowable stresses used in the design of bolting material exceed the material yield strength under the faulted condition (Level D) service limit. This does not conform to the guidance of NRC Regulatory Guide 1.124, Reference 4.5, which limits the load increases to 1.5 times the normal operating (Level A) service limit, because of the potential for nonductile behavior.

1.5 Use of Low-Strength Nuts with High-Strength Bolts

The issue was that low-strength nuts, A563 Grade A, were used with high-strength bolting, instead of the code compatible A194 Grade B nut. The issue was that the resultant connection capacity should have been reduced in the analysis.

2.0 Issue Resolution

2.1 Design Allowables Derived from Tests

In accordance with CPPP-7, Section 4.2.5.1, cinched U-bolts with struts or snubbers are being eliminated or modified.

Design allowables for linear components, such as SA-36 U-bolts and SA-36 threaded rod used with Richmond inserts, were derived by SWEC-PSAS from the ASME Section III Code minimum yield strength specified in Section 2.2 of CPPP-7 and not from tests.

2.2 Friction Connections

In accordance with CPPP-7, Section 4.2.5.1, cinched U-bolts with struts or snubbers are being eliminated or modified.

U-bolts used as two-way restraints do not rely on preload for load transfer. Richmond insert connections were designed as bearing connections and do not rely on friction (preload) for load transfer capability.

2.3 Fatigue

U-bolts used as two-way restraints and SA-36 threaded rod used with Richmond inserts were subject to reversing stress fields due to seismic and fluid transient loads.

The SA-36 U-bolts used as two-way restraints as well as the threaded rod used with Richmond insert tube steel joints were designed as ASME Section III, linear NF support components in accordance with ASME Section III, Appendix XVII, and AISC, respectively. ASME Section III Code Appendix XVII Table XVII-3230-1 and AISC Code 7th Edition, Appendix B, Table B2, footnote 4 define the lower bound value for consideration of stress cycles as 20,000. SWEC-PSAS demonstrated that the number of equivalent stress cycles for these components was less than 7,000. Therefore, fatigue was not relevant as defined in these codes.

2.4 Allowable Stresses in Bolting Material

Bolting material was designed in accordance with ASME Section III, Paragraph NF-3225 Summer 1983 addenda, which limited the stresses at temperature at the faulted condition (Level D) to yield. The use of this later code paragraph assures ductile behavior and thus conforms to the guidance of NRC Regulatory Guide 1.124.

2.5 Use of Low-Strength Nuts with High-Strength Bolting

In accordance with CPPP-7, Attachment 4-5, the tensile allowable load for high-strength bolts using low-strength nuts was reduced to 60 percent of the normal high-strength bolt allowable, to account for the reduced proof load stress of the A563 Grade A nut.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- Pipe support modifications resulting from resolution of issues in Subappendix A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action to resolve the SA-36 and A307 steel issue was accomplished through the implementation of the criteria provided in CPPP-7, Sections 2.2 and 4.2.5.1, and Attachment 4-5 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations, Section III), August 22, 1983.

4.2 CASE's Fourth Motion for Summary Disposition to Disqualify the Use of A307 and SA-36 Threaded Parts, January 14, 1985.

4.3 CASE's Partial Answer to Applicants' Statement of Material Facts Relating to Richmond Inserts as to Which There are No Material Facts, September 10, 1984

4.4 ASME III Code Inquiry NI86-030 "Section III, Division 1, NF-3324.6 (a)(3)(b) Friction Type Joints, NF-3324.6(a)(4) Slip Resistance, Friction Type Joints, NF-3225.4, Friction Type Joints, 1983 Edition with the Winter 1985 Addenda," June 25, 1986

4.5 NRC Regulatory Guide 1.124, Service Limits and Loading Combinations for Class 1 Linear Type Component Supports, Revision 1, January 1978

SUBAPPENDIX A24

U-BOLT TWISTING

1.0 Definition of the Issue

This issue (References 4.1 through 4.3) was that out-of-plane rotation of the crosspiece of a trapeze cinched U-bolt support may result when the struts are in compression. This rotation would induce twisting on the U-bolt, for which it was not designed.

2.0 Issue Resolution

Due to the extensive engineering effort required to demonstrate the acceptability of this type of support, cinched U-bolt trapeze supports with struts or snubbers are being eliminated or modified. Modification options are discussed in Subappendix A12, Axial/Rotational and Trapeze Restraints.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action for the twisting of U-bolts on trapeze supports with struts or snubbers is being accomplished through the elimination or modification of this support type in accordance with CPPP-7, Section 4.2.5.1 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section III, August 22, 1983

4.2 CASE's Motions and Answer to Applicants' Motions for Summary Disposition Regarding Stability of Pipe Supports, October 15, 1984

4.3 CYGNA Pipe Support Review Issues List, Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987

SUBAPPENDIX A25

FISHER/CROSBY VALVE MODELING/QUALIFICATION

1.0 Definition of the Issue

The issues (References 4.1 through 4.4) related to Fisher and Crosby valve modeling and qualification were as follows:

1.1 Crosby Valves

The issue was that the main steam (MS) safety relief valves (SRV) which have a double-ported outlet configuration used an unconservative assumption of a 55/45 split in the flow distribution in lieu of the 60/40 split flow distribution, as suggested by Crosby Valve. There are five such valves located along the MS line that discharges into vent stacks.

1.2 Fisher Valves

The issue was that the Fisher valve operators may not be qualified to withstand the loads imposed on them by the snubbers that support the valve operator.

The Fisher valve is a control valve that is used to control main steam (MS) flow by relieving steam to the atmosphere.

1.3 Flexible Valves

The issue was that the modeling of "flexible" valves (frequency less than 33 cycles per second) was inadequate. It was found that valves noted in Reference 4.4 (excluding Fisher valves) were the only "flexible" valves within the original scope of work. It was determined that the valve accelerations for those valves were acceptable; however, the modeling of the Fisher valve yoke, which is laterally supported at the end, was not addressed. If the yoke is modeled much stiffer than it actually is, it may have an effect on the analysis results.

1.4 Valve Accelerations and Loads

The issue was that the validity of a sampling process to assure the acceptability of valve accelerations and valve flange loads has not been demonstrated.

2.0 Issue Resolution

2.1 Crosby Valves

- SWEC-PSAS discussed the flow distribution of doubled-ported SRV with Crosby (Reference 4.5), and Crosby verified that the SRV has an equal

(50/50) flow distribution ratio (instead of 60/40, as was thought). For conservatism, a 55/45 SRV flow distribution ratio was used to calculate the blowdown force.

- SWEC-PSAS evaluated the multiple SRV loading combination issue and concurred that all five valves opening simultaneously must be considered for piping and pipe support design. Since valves may open in a set or random sequence, those cases were also considered. The validation process identified the design basis for multiple SRV openings, including five simultaneous valves opening, for stress analysis evaluation. The cases evaluated covered all possible circumstances based on the system design, including the worst load condition.

2.2 Fisher Valves

The SWEC-PSAS validation of the Fisher relief valve branch connection piping model included the effects of the snubber supports at the valve. In accordance with Section 7.4.3 of CPPP-6 both valve accelerations and support loads on the valves were transmitted to the equipment qualification organization (Impell Corporation) for validation, except for Westinghouse-supplied valves, which were transmitted to Westinghouse for validation.

2.3 Flexible Valves

The yokes of flexible valves were modeled to properly predict the yoke frequency. CPPP-7, Section 3.10.6.5 specified the proper valve yoke modeling of flexible valves.

2.4 Valve Accelerations and Loads

All valves were validated for applicable accelerations and valve nozzle loadings in accordance with CPPP-7, Section 3.10.5.2. Also, since all valves were validated, the concern regarding sampling has been satisfied.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendix A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action to resolve the issue of valve modeling and qualification was accomplished through the implementation of the criteria provided in CPPP-6, Section 7.4.3 and CPPP-7, Sections 3.10.5.2 and 3.10.6.5 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 Tel-con dated October 21, 1976, between Crosby Valve and Gibbs & Hill, J. R. Zahorsky and M. H. Giden, regarding Contract No. 2323A, Double-Ported Safety Valves

4.2 Telex from Crosby Valve to Gibbs & Hill regarding Contract No. 2323A, Main Steam Safety Valves, J. R. Zahorsky to Dr. Kim, October 12, 1976

4.3 CYGNA Pipe Stress Review Issues List, Revision 4, and Transmittal Letter No. 84056.119 dated September 16, 1987.

4.4 Communications Report between Krishnan/Ray (Gibbs & Hill) and Minichiello (CYGNA), June 18, 1984.

4.5 Tel-con dated February 21, 1986, between R. Martin and J. R. Zahorsky of Crosby Valve and W. Wang, A. J. Cokonis, and W. H. Green of SWEC, regarding Crosby double-ported relief valve discharge loads.

SUBAPPENDIX A26

PIPING MODELING

1.0 Definition of the Issue

The issue was that incorrect inputs were used in the pipe stress analysis as follows (Reference 4.1):

- Incorrect pipe wall thickness was used to calculate an allowable nozzle load (Reference 4.1, Issue 2).
- Improper stress intensification factors were used (Reference 4.1, Issue 10).
- Fluid content and insulation weights were not included for valves and flanges (Reference 4.1, Issue 4).
- Valve acceleration and flange loads were not always checked in the piping analysis (Reference 4.1, Issue 21).
- Two piping segments were input into the stress analysis with the incorrect wall thickness (Reference 4.1, Issue 12).

2.0 Issue Resolution

All pipe stress analysis packages were validated in accordance with Project Procedures CPPP-6 and CPPP-7, which provided direction for the proper modeling of piping systems. SWEC Engineering Assurance Procedure EAP 5.3 provided guidance on the preparation and review of calculations, including the need to assure that proper input is used. Checklists were included in project procedures to provide additional assurance that correct piping models were created and that proper review of the input and output was performed.

In addition, personnel were trained in the implementation of the procedures. This training was further enhanced by daily contact with the experienced on-project technical supervision. The SWEC Engineering Assurance Division performed audits of project activities to verify that procedural requirements were met and that calculations were technically acceptable. The combination of the procedures, the procedural control, and the audit program provided assurance that the inputs were correct and the calculations were complete and technically acceptable.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).

- The corrective action to resolve the issues related to piping modeling was accomplished through the implementation of the criteria provided in Section 3.0 of CPPP-7 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CYGNA Pipe Stress Review Issues List, Revision 4, and Transmittal Letter No. 84056.119 dated September 16, 1987.

SUBAPPENDIX A27

WELDING

1.0 Definition of the Issue

The following welding-related issues were identified (Reference 4.1):

1.1 Undersized Fillet Welds

The issue was that the sizes of two fillet welds were found to be less than the minimum requirements of Table XVII-2452.1-1 in Appendix XVII of the ASME Code Section III.

1.2 Penetration Weld Subsurface Cracking

The issue was that there is a potential for subsurface cracking on welds with deep penetrations. The shrinkage due to weld cooling may be resisted where the joined surfaces approach being parallel. Under these conditions, subsurface cracking can occur without the crack propagating to the surface. Upon loading, this subsurface crack may propagate through the weld causing joint failure.

1.3 Eccentricity of Three-Sided Welds (Unsymmetrical Welds)

The issue was that analyses of three-sided welds have not consistently considered the eccentricity between the center of gravity of the member and the weld.

1.4 Linear Versus Plate and Shell Weld Design for Base Plates

The issue was that the practice of qualifying base plate welds using linear analyses (as opposed to plate and shell analyses) was questioned.

1.5 Combination Welded/Bolted Connections

The issue was that no evidence was found to support the fact that combination welded/bolted connections are designed in accordance with Appendix XVII, subparagraph XVII-2442, Section III of the ASME Code.

1.6 Crosspiece Cover Plate Welds

The issue was that it was observed that shear flow has not always been considered in the analysis of welds attaching cover plates to crosspiece members.

1.7 One-Third Increase of Weld Allowable Stress for Emergency and Faulted Conditions

The issue was that the practice of increasing weld allowable stresses by one-third for emergency and faulted conditions was questioned.

1.8 Welding Practices

The issue was whether welding procedures qualified by test in accordance with the ASME Code are adequate in light of AWS requirements for prequalified welds. This issue involves the following inadequate welding practices: cap welding, weave welding, lap joint requirements, downhill welding, and preheat requirements.

2.0 Issue Resolution

2.1 Undersized Fillet Welds

ASME Code Case N-413 eliminated the minimum weld size requirements of Table XVII-2452.1-1 in the ASME Section III Code. Attachment 4-2 of CPPP-7 incorporates ASME Code Case N-413.

2.2 Penetration Weld Subsurface Cracking

As part of the resolution of this issue, SWEC-PSAS reviewed Reference 4.3, which states that the tendency to develop subsurface weld cracks stems from the "... misuse of a welding process that can achieve deep penetration or poor joint design. A few preventive measures can ensure elimination of both of these factors. Limiting the penetration and the volume of weld metal deposited per pass, through speed and amperage control, and using reasonable depth of fusion are both steps in the right direction."

All CPSES pipe support welds are fabricated in accordance with CPSES Weld Procedure WPS-11032.

SWEC-PSAS reviewed WPS-11032 and concluded that it is a qualified procedure in accordance with ASME Section IX which adequately controls the joint design, travel speed, electrode size, and amperage and that the SMAW process is not a deep penetration process.

Therefore, all pipe support welds fabricated in accordance with CPSES Weld Procedure WPS-11032 are in compliance with the ASME Code.

2.3 Eccentricity of Three-Sided Welds (Unsymmetrical Welds)

In accordance with CPPP-7, Attachment 4-2, paragraph 3, the eccentricity between the center of gravity of the member and the weld has been considered.

2.4 Linear Versus Plate and Shell Weld Design for Base Plates

ASME Section III, Subsection NF-1230 allows the use of either plate-and-shell or linear-type support analysis for the design of welds connecting linear and plate and shell elements. In accordance with CPPP-7, Attachment 4-2, these welds were validated using the linear-type support analysis.

2.5 Combination Welded/Bolted Connections

Welds used in combination welded/bolted connections were designed in accordance with CPPP-7, Attachment 4-2, paragraph 3.1.3 for the entire shear force, which complies with ASME Section III, paragraph XVII-2442.

2.6 Crosspiece Cover Plate Welds

In accordance with CPPP-7, Attachment 4-2, paragraph 3.1.5, members which use cover plates for strength purposes had the plate-to-member attachment weld validated for shear flow.

2.7 One-Third Increase in Allowable Weld Stress for Emergency and Faulted Conditions

2.7.1 A one-third increase in allowable weld stress for emergency and faulted conditions is acceptable. ASME Code, Section III Subsection NF, paragraph NF 3231.1(b), Design of Linear-Type Supports by Analysis for Class 1 Component Supports, and Appendix XVII-2110(a), Linear Elastic Analysis, specify an allowable stress increase for emergency and faulted conditions. The emergency condition is stated as having a one-third allowable increase. Both paragraph NF 3231.1(b) and Appendix XVII-21100 refer to ASME Section III, Subsection NF for the faulted condition, where the factor is always greater than one-third.

2.7.2 AISC has allowed the one-third increase since the 7th edition.

2.7.3 Correspondence from K. Ennis, Assistant Secretary of ASME, to W. M. Eifert of SWEC, dated September 25, 1985, confirms this position (Reference 4.2).

2.8 Welding Practices

SWEC-PSAS reviewed WPS-11032 and concluded that it is a qualified procedure in accordance with ASME Section IX, and thus, the limitations of AWS for prequalified weld configurations do not apply.

Therefore, all pipe support welds fabricated in accordance with weld procedure WPS-11032 are in compliance with the ASME Code.

Furthermore, the Atomic Safety and Licensing Board (ASLB), using an NRC staff comparison of ASME versus AWS and their own review of existing welding procedures, concluded (on June 29, 1984, Reference 4.4) that compliance with the ASME code has been adequate to assure the acceptability of the CPSES welding procedures.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- All the pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action to resolve pipe support welding concerns was accomplished through the implementation of the criteria provided in Attachment 4-2 of CPPP-7 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CYGNA Pipe Support Review Issues List Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987.

4.2 Letter from K. Ennis, Assistant Secretary of ASME, to W. M. Eifert of SWEC dated September 25, 1985.

4.3 Design of Welded Structures, Omer W. Blodgett, 1966.

4.4 ASLB Memorandum and Order LBP-84-25 (Written - Filing Decisions, No. 1: Some AWS/ASME Issues), June 29, 1984.

SUBAPPENDIX A28

ANCHOR BOLTS/EMBEDMENT PLATES

1.0 Definition of the Issue

Issues were raised (Reference 4.1) involving embedment plate, anchor bolt, and base plate designs at CPSES. They are as follows:

1.1 Embedment Plates and Through-Bolts

The issue was that there was no evidence that the spacing between attachments to embedment plates was checked at CPSES and that for existing designs, moment connections to the embedments require stiffeners, but no procedure for the design of a stiffener was provided.

Also, there was no written evidence documenting that as-built loads from pipe supports that use through-bolts were transmitted to the Civil/Structural Group for acceptance.

In addition, several instances were observed of Hilti Kwik-bolts installed close to through-bolt base plates that were not shown on the support drawing.

1.2 Base Plate Edge Distance

The issue was that anchor bolt edge distance tolerances could result in a 15-percent increase in base plate stresses for base plate designs with struts, springs, or snubbers with a 5-degree offset.

1.3 Hilti Kwik-Bolt Embedment Length

The issue was that there was a discrepancy identified between the bolt embedment lengths on support drawings and the lengths used in calculations.

1.4 Concrete Edge Distance Violation

The issue was that instances were observed where pipe sleeve penetrations exist close to support base plates but were not shown on support drawings.

2.0 Issue Resolution

These issues were addressed as described below:

The SWEC Civil/Structural Corrective Action Program (SWEC-C/S-CAP) developed uniform design criteria for all concrete anchorages (References 4.2 and 4.3), including the evaluation of spacing between different discipline commodities. The design criteria were incorporated into CPPP-7, Attachments 4-4, 4-5, and 4-25 via SWEC-PSAS Project Memorandum PM-210. Pipe support anchorage validation was performed in accordance with these attachments. Specific resolutions of these issues are as follows:

2.1 Embedment Plates and Through-Bolts

SWEC Civil/Structural is responsible for structural attachment load evaluations. CPPP-6 controlled the transmittal of pipe support attachment loads on embedded plates, through-bolts, and base plates to SWEC Civil/Structural discipline. SWEC Civil/Structural will identify base plates installed close to through-bolts to SWEC-PSAS for validation. SWEC Civil/Structural design validation of embedded plates and structures is described in the Civil/Structural PSR (Reference 4.3).

2.2 Base Plate Edge Distance

An analysis was performed by SWEC-PSAS to determine the effects of edge distance tolerances on the bolt loads and plate stresses, and it was concluded that the edge distance tolerance was acceptable.

Furthermore, the PCHVP will validate the as-built base plate bolt hole edge distances.

2.3 Hilti Kwik-Bolt Embedment Length

Embedment lengths shown on the drawings were used in calculations to validate pipe support anchorage designs in accordance with Attachment 4-4 of CPPP-7.

2.4 Concrete Edge Distance Violation

During PCHVP, SWEC Civil/Structural will identify base plates which are installed close to pipe sleeve penetrations and transmit this information to SWEC-PSAS for validation. Base plate validation is performed in accordance with CPPP-7.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix P2, SDAR-CP-86-36).
- The corrective action to resolve the anchorage issues has been accomplished by the incorporation of the DBD (Reference 4.2) into CPPP-7 for the validation of embedments in concrete and the PCHVP for the identification of anchorage spacing violations.

- The preventive action for this issue is identified in Appendix C

4.0 References

4.1 CYGNA Pipe Support Review Issues List, Revision 4, and Transmittal Letter No. 84056.120, dated September 18, 1987.

4.2 TU Electric, CPSES Units 1 and 2, Design Basis Document DBD-CS-015, Revision 4, June 10, 1987

4.3 TU Electric, CPSES Unit 1 and Common, Civil/Structural Project Status Report, Revision 0, October 1987

SUBAPPENDIX A29

STRUT/SNUBBER ANGULARITY

1.0 Definition of the Issue

1.1 The issue (Reference 4.1) was that the loading component ("kick" load) resulting from the angular swing of the strut/snubber from its nominal position, due to construction tolerances and pipe movements, was not assessed in designs.

1.2 The NRC Inspection and Enforcement Bulletin IEB-79-14 program requires all as-built angular tolerances over ± 2 deg to be measured and assessed (Reference 4.2). The issue was that the construction angular tolerance for the installed CPSES struts/snubbers was ± 5 degrees.

2.0 Issue Resolution

2.1 The angular swing of struts/snubbers due to construction tolerances and pipe movements from applicable thermal, seismic, and/or fluid transients were assessed. The effect of the swing angle load component (maximum swing angle of ± 5 deg) was considered in the support design. If the ± 5-deg tolerance was exceeded, the proper function and load rating of strut/snubber assemblies were ensured in addition to the component load consideration. These requirements were included in Sections 4.2 and 4.2.6 of CPPP-7.

2.2 All installed struts/snubbers were measured and those that exceeded ± 2-deg tolerance were assessed in the validation program.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).

- The corrective action to resolve the issue of strut/snubber angularity was accomplished through the implementation of the criteria provided in Sections 4.2 and 4.2.6 of CPPP-7 during the design validation and is physically validated in the Post Construction Hardware Validation Program (PCHVP) through the implementation of Field Verification Method CPE-SWEC-FVM-PS-081 (Reference 4.3).

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 Transcript of Proceedings of Feedback Discussion Between USNRC and Walsh and Doyle on the Concerns About the CPSES, March 23, 1985

4.2 NUREG-0797, Supplementary No. 11, Safety Evaluation Report Related to the Operation of CPSES Units 1 and 2, USNRC, Docket Nos. 50-445 and 50-446, May 1985

4.3 SWEC-PSAS Comanche Peak Field Verification Method, Hardware Validation and Supplemental Inspection Programs CPE-SWEC-FVM-PS-081, Revision 0, July 29, 1987

SUBAPPENDIX A30

COMPONENT QUALIFICATION

1.0 Definition of the Issue

Issues related to the qualification of member components in CPSES pipe supports were identified as follows (Reference 4.1):

1.1 Dynamic Pipe Movements in Support Design

The issue was that all dynamic piping movements were not included in the support design when checking frame gaps, swing angles, or spring travel. Existing designs addressed only the seismic effects. This is applicable to frame gaps in the unrestrained direction, strut/snubber swing angles, and both spring and snubber travel.

1.2 Incorrect Standard Component Allowables

The issue was that incorrect U-bolt allowables were used in the design of support RH-1-064-011-S22R.

1.3 Untightened Locknut On Struts

The issue was that the upper locknut on one strut was not tightened, which could lead to rotation of the strut and a subsequent load redistribution.

1.4 Inverted Snubbers

The issue was that four supports were identified in which the snubbers were installed 180 degrees from the configuration shown on the support drawings.

2.0 Issue Resolution

2.1 Dynamic Pipe Movements in Support Design

Predicted pipe movements for all design conditions for pipe supports were evaluated in the design validation in accordance with CPPP-7, Section 4.2.

2.2 Incorrect Standard Component Allowables

RH-1-064-011-S22R was a cinched U-bolt support with a strut. This support is being modified in accordance with CPPP-7, Section 4.2.5.1.

Component standard-type pipe supports were validated in accordance with CPPP-7, Section 4.1, by comparison to vendor-supplied load capacity data sheets (LCD) or certified design report summaries (CDRS).

2.3 Untightened Locknuts on Struts

The Post-Construction Hardware Validation Program (PCHVP) is being performed to validate the proper hardware installation including locknuts through inspections performed in accordance with Field Verification Method CPE-SWEC-FVM-PS-081 (Reference 4.2).

2.4 Inverted Snubbers

The Post-Construction Hardware Validation Program (PCHVP) is being performed to validate the proper hardware installation including snubbers through inspections performed in accordance with Field Verification Method CPE-SWEC-FVM-PS-081.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).

- The corrective action to resolve the locknut and snubber installation issues is being accomplished through the implementation of pipe support hardware inspections and rework. The corrective action to resolve the component allowable and dynamic pipe movement issue was accomplished through the implementation of the criteria provided in Sections 4.1 and 4.2 of CPPP-7 during the design validation. The corrective action to resolve the design of Support RH-1-064-011-S22R was accomplished through the implementation of the criteria provided in CPPP-7, Section 4.2.5.1.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CYGNA Pipe Support Review Issues List, Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987

4.2 SWEC-PSAS Comanche Peak Field Verification Method, Hardware Validation and Supplemental Inspection Program CPE-SWEC-FVM-PS-081, Revision 0, July 29, 1987

SUBAPPENDIX A31

STRUCTURAL MODELING FOR FRAME ANALYSIS

1.0 Definition of the Issue

Issues were raised (Reference 4.1) relating to the structural modeling for frame supports:

1.1 Torsion Evaluation

The issue was that for wide flange members, the torsional deflections were underestimated and members were not checked for local stresses at points of torsional loading.

1.2 Boundary Conditions for Richmond Insert/Tube Steel Connections

The issue was that modeling of member end restraints at Richmond insert/tube steel connections was inconsistent. Three different member end conditions varying from fully fixed to fully free were assumed. Each assumption may be conservative for one member and unconservative for another.

1.3 Support Boundary Conditions

The issue was that supports were identified in which the assumed boundary conditions were questionable.

2.0 Issue Resolution

2.1 Torsion Evaluation

In accordance with Section 4.3.2.1 of CPPP-7 member properties used in the pipe support validation, including values for torsional resistance, were taken from AISC Manual of Steel Construction, 8th Edition. Tables 4.7.2-3 through 4.7.2-7 of CPPP-7 provided equations for evaluating member stresses, including local effects due to torsional loading.

2.2 Boundary Conditions for Richmond Insert Tube Steel Connections

Consistent modeling techniques were used for Richmond insert tube steel connection validation as specified in CPPP-7, Attachment 4-5 to assure that member end restraints were properly modeled.

2.3 Support Boundary Conditions

Attachment of the pipe support to the building structure was reflected in the frame analysis by the proper modeling of the connection stiffness in accordance with CPPP-7, Attachment 4-18.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).

- The corrective action to resolve this issue was accomplished through the implementation of the criteria provided in CPPP-7, Section 4.3.2.1, Tables 4.7.2-3 and 4.7.2-7, and Attachments 4-5 and 4-18 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Sections VII and XII, August 22, 1983.

SUBAPPENDIX A32

COMPUTER PROGRAM VERIFICATION AND USE

1.0 Definition of the Issue

The issue (References 4.1 and 4.2) was whether there was adequate quality assurance for the verification and use of appropriate versions of the following computer programs:

- ADLPIPE Version 2C (dated April 1977) - Piping Analysis
- FUB-II - Base Plate Qualification - ITT Grinnell
- Corner and Lada Base Plate Qualification Program

2.0 Issue Resolution

The computer programs for which specific issues were raised were not used in the pipe stress and pipe support validation effort.

The computer programs that were used for piping and pipe support validation were identified in CPPP-7, Section 5.0.

The computer programs used in the validation effort were verified in accordance with SWEC QA program requirements for verification, technical adequacy, and appropriate version. The computer program verification was documented, and identified the various project applications.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under the provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).

- The corrective action to resolve the concern regarding computer program verification was accomplished through the implementation of the SWEC Quality Assurance Program.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CYGNA Design Control Review Issues List, Revision 1, June 21, 1985

4.2 NRC Inspection Report No. 50-445/83-12:50-446/83-07 Inspection Conducted by J. I. Tapia and W. Paul Chen, May 13, 1983

SUBAPPENDIX A33

HYDROTEST

1.0 Definition of the Issue

The issues (References 4.1 and 4.2) was that hydrostatic test loading conditions were not properly considered for ASME Section III Code Class 2 and 3 piping analysis and pipe support designs.

2.0 Issue Resolution

The hydrotest loads for piping and supports were evaluated for 1.5 times the design pressure, in accordance with the ASME Section III Code of Record, except for the ASME Section III Class 2 and 3 piping, which was evaluated for 1.25 times the design pressure consistent with the actual hydrostatic test conditions. The lower design pressure for Classes 2 and 3 piping is in accordance with a later code version which is acceptable, since the project met the requirements of ASME Section III Code paragraph NA-1140, which allows the use of later Code provisions where appropriate. Evaluation of piping and supports for hydrotest loading was performed as specified in CPPP-7, Sections 3.6.2.4 and 4.7.2.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action to resolve the hydrotest issue was accomplished through the implementation of the criteria provided in CPPP-7, Sections 3.6.2.4 and 4.7.2, during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section XIII, August 22, 1983

4.2 CYGNA Pipe Support Review Issues List, Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987

SUBAPPENDIX A34

SEISMIC/NONSEISMIC INTERFACE

1.0 Definition of the Issue

The following issues (Reference 4.1) were raised relating to the design of isolation anchors:

1.1 Seismic Category I Piping Attached to Nonseismic Piping

The issue was that the seismic effects of nonseismic piping attached to safety-related piping were not adequately considered.

1.2 Piping Routed Between Seismic Category I and Nonseismic Buildings

1.2.1 The issue was that safety-related piping was not seismically isolated when it was routed between seismic Category I and nonseismic buildings.

1.2.2 The issue was that postulated failure of the turbine building due to an earthquake, which is a nonseismic building, was not considered in the design of safety-related piping which is routed between the turbine building and seismic Category I buildings.

2.0 Issue Resolution

2.1 Seismic Category I Piping Attached to Nonseismic Piping

In accordance with CPPP-7, Attachment 4-10, Sections 1.4, 1.5, and 1.6 the following two methods were used for the design validation of safety-related piping attached to nonseismic piping:

2.1.1 A plastic hinge was assumed to occur on the nonseismic piping immediately adjoining the anchor. The anchor was analyzed for plastic moments.

2.1.2 One or more restraints and the piping supported by these restraints on the nonseismic side were seismically analyzed. In addition, the effect of the remaining portion of nonseismic piping was accounted for by the assumption of a plastic hinge.

2.2 Piping Routed Between Seismic Category I and Nonseismic Buildings

SWEC-PSAS Project Memorandum No. PM-203 clarified the requirements of CPPP-7, Attachment 4-10, and limits the use of Option 2.1.2 to piping in seismically analyzed buildings. Therefore, the interface between seismic Category I piping and nonseismic piping occurring at the boundary between seismic Category I and nonseismic buildings (e.g., the main steam line) was modeled by a plastic hinge as discussed in Item 2.1.2.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under the provisions of 10CFR50.55(e) (See Subappendix B2, SDAR-CP-86-36).

- The corrective action to resolve the seismic/nonseismic interface issue was accomplished through the implementation of criteria provided in CPPP-7, Attachment 4-10 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CYGNA Pipe Support Review Issues List, Revision 4 and Transmittal Letter No. 84056.120, dated September 18, 1987.

SUBAPPENDIX A35

OTHER ISSUES

1.0 Definition of the Issue

Subappendixes A1 through A34 have addressed the CPRT and external issues (excluding the SSER and CPRT-QOC issues addressed in Subappendixes A36 through A39). These 34 subappendixes represent the consolidation of all but 51 of the 972 piping-related Discrepancy Issue Reports (DIRs), generated by TENERA, L. P. to track closure of issues as part of their third party review. The remaining 51 DIRs (Reference 4.1, Attachment B) are unrelated to the 34 primary issue topics discussed in the previous 34 subappendixes. The issues raised by these 51 DIRs must be resolved by the SWEC-PSAS validation effort.

2.0 Issue Resolution

SWEC-PSAS resolved the issue identified in each of the 51 DIRs described above by referencing the applicable design or administrative procedure that resolved each issue. These 51 DIRs are considered closed by SWEC-PSAS and TENERA, L. P.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36).
- The corrective action to resolve this issue was accomplished through the implementation of the criteria provided in CPPP-6 and CPPP-7.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CPRT Design Adequacy Program Descipline Specific Results Report: Piping and Supports, DAP-RR-P-001, Revision 1, August 27, 1987

SUBAPPENDIX A36

SSER-8 REVIEW

1.0 Definition of the Issue

SSER-8 describes the NRC Staff evaluation and resolution of technical issues relating to the civil, structural, and miscellaneous issues of CPSES (Reference 4.1).

The issue was whether the concrete design strength of CPSES safety-related concrete installed between January 1976 and February 1977 was 4,000 psi or greater.

2.0 Issue Resolution

The results of the concrete strength tests, performed between January 1976 and February 1977, were reviewed by the SWEC Civil/Structural Group (Reference 4.2). As a result of the consistency between the cylinder data and the Schmidt-Hammer data, SWEC Civil/Structural concluded that there is no evidence of systematic falsification of cylinder data or improper testing; therefore, it was further concluded that the 4000 psi design strength of the safety-related concrete placed during that period was substantiated (Reference 4.3).

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- This issue has been determined to be not reportable in accordance with 10CFR50.55(e).
- No corrective action on the design basis is required due to this issue.
- Current construction and QC concrete testing procedures are adequate. No additional preventive action is required due to this issue.

4.0 References

4.1 NUREG-0797, Supplement No. 8, Sections 3.1.3 and 4.1.2, Safety Evaluation Reported Related to the Operation of CPSES Units 1 and 2, Docket Nos. 50-445 and 50-446, USNRC, February 1985

4.2 TU Electric CPSES Unit 1 and Common, Civil/Structural, Project Status Report, Revision 0

4.3 CPRT Action Plan II.b Results Report, Concrete Compression Strength, Revision 1, February 28, 1986

SUBAPPENDIX A37

SSER-10 REVIEW

1.0 Definition of the Issue

SSER-10 describes the NRC Staff evaluation and resolution of technical issues relating to the mechanical and piping group (Reference 4.1). The four piping design related issues are:

1.1 Uncontrolled Weld Repairs by Plug Welding

The SSER indicated that a plan is required for sampling inspection of plug welds in CPSES for cable tray supports, pipe supports, and base plates. A bounding analysis is required to assess the ranging effects of uncontrolled plug welds on pipe supports, cable tray supports, and base plates to serve their intended functions. A report documenting the results of the assessment is required.

1.2 Installation of Main Steam Line Pipes - Unit 1, Loop 1

The SSER indicated that Tasks 4.5.1 through 4.5.8 in SSER-10, which include stress assessment and nondestructive examination of Loop 1 main steam (MS) and feedwater (FW) lines, must be performed. Results of analysis, examinations, and reviews are required to be documented in a report.

1.3 Isolation of Seismic Category I Piping from Nonseismic Piping

The SSER indicated that an analysis shall be performed and documentation shall show that piping systems such as MS, FW, and auxiliary steam lines routed from seismic Category I to nonseismic Category I buildings are in conformance with the licensing commitments.

1.4 As-Built Verification of Type 2 Skewed Welds on NF Supports

The SSER indicated that confirmation is required that the Type 2 skewed welds on pipe supports are not undersized. This may be accomplished through the verification of previous weld inspections or through reinspection.

2.0 Issue Resolution

2.1 Uncontrolled Weld Repairs by Plug Welding

SWEC-PSAS reviewed the Comanche Peak Response Team (CPRT) Action Plan V.d Results Report (Reference 4.2) and concluded that since the unauthorized repair of plug welds does not compromise the structural integrity of the components, there is no impact of plug weld repairs on the validation of pipe supports at CPSES.

2.2 Installation of Main Steam Line Pipes - Unit 1, Loop 1

The CPRT Action Plan V.e Results Report (Reference 4.3) was reviewed by SWEC-PSAS and, based on the main steam and feedwater pipe stress analysis, which incorporated bounding parameters, it was concluded that no deleterious effects resulted from the sequence of events associated with Unit 1, Loop 1, main steam and feedwater (FW) lines hydrostatic tests.

2.3 Isolation of Seismic Category I Piping from Nonseismic Piping

This topic is addressed in Subappendix A34.

2.4 As-Built Verification of Type 2 Skewed Welds on NF Supports

Pipe support welds at CPSES are inspected in accordance with Inspection Procedure QI-QAP-11.1-28 (Reference 4.4). However, since Type 2 skewed welds are typically found on the weld of the trunnion to the pipe, inspection procedures for Type 2 skewed welds were included in the piping weld inspection Procedure QI-QAP-11.1-26 (Reference 4.5). CPRT Action Plan V.a Results Report (Reference 4.6) confirmed that inspections were performed in accordance with QI-QAP-11.1-26, and that skewed welds are not undersized. Pipe support weld inspection Procedure QI-QAP-11.1-28 has since been revised to include inspection procedures for Type 2 skewed welds.

3.0 <u>Corrective and Preventive Action</u>

- No additional issue was discovered during the review and resolution of this issue.

- Pipe support modifications resulting from resolution of isolation of Seismic Category I piping from nonseismic piping has been determined reportable under the provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36). No modifications were required as a result of the resolution of the issues discussed in Sections 1.1, 1.2, and 1.4.

- The corrective action to resolve the issue of the isolation of Seismic Category I piping from nonseismic piping has been accomplished through the implementation of criteria provided in CPPP-7, Attachment 4-10, during the design validation.

  The corrective action to resolve the issue of the installation of main steam line piping was accomplished through implementation of CPSES Construction Procedure CP-CPM-1.2 (Reference 4.7) and SWEC-PSAS Procedure CPSP-30 (Reference 4.8), which requires engineering to evaluate the installed piping and pipe support configuration including the proper design of temporary supports prior to a piping system hydrostatic test to assure the integrity of the installed safety-related piping and pipe supports.

The corrective action for the issue of uncontrolled plug weld repair was accomplished through enhanced pipe support installation and inspection criteria.

The corrective action for the issue of verification of Type 2 skewed welds on NF supports was accomplished through the revision of Weld Inspection Procedure QI-QAP-11.1-28 to include inspection procedures for Type 2 skewed welds.

- The preventive action for this issue is specified in Appendix C.

4.0 References

4.1 NUREG-0797, Supplement No. 10, Safety Evaluation Report related to the operation of CPSES Units 1 and 2, USNRC, Docket Nos. 50-445 and 50-446, April 1985

4.2 CPRT Action Plan V.d Results Report, Plug Welds, Revision 1, December 18, 1986

4.3 CPRT Action Plan V.e Results Report, Installation of Main Steam Pipes, Revision 1, October 15, 1986

4.4 CPSES Quality Assurance Procedure QI-QAP-11.1-28, Fabrication and Installation Inspection of Safety Class Component Supports

4.5 CPSES Quality Assurance Procedure QI-QAP-11.1-26, Piping and Equipment Installation Inspection

4.6 CPRT Action Plan V.a Results Report, Inspection for Certain Types of Skewed Welds in NF Supports, Revision 1, October 22, 1986

4.7 CPSES Construction Procedure CP-CPM-1.2, Construction Activities for Systems and/or Areas Accepted and/or Controlled by TU Electric Plant Operations, Revision 5, March 4, 1987

4.8 SWEC-PSAS Project Procedure CPSP-30, Processing TU Electric Requests for Temporary Hangers, Revision 0, October 7, 1987

SUBAPPENDIX A38

SSER-11 REVIEW

1.0 Definition of the Issue

SSER-11 (Reference 4.1) describes the NRC Staff TRT position on the evaluation and resolution of technical questions and allegations relating to the QA/QC Group.

The issues identified by SSER-11 in the design process that are related to piping design are as follows:

1.1 As-Built Inspection Program (Allegations AQ-50, AQ-21, AQ-22, and AQ-119, Reference 4.1)

As-built issues were classified into hardware, procedural, as-built, and weld-related categories. Specifically, six pipe support construction issues in Unit 1 were listed as follows:

1.1.1 Excessive snubber spherical bearing clearance.

1.1.2 Missing strut and snubber load pin locking device.

1.1.3 Pipe clamp halves not parallel.

1.1.4 Snubber adapter plate bolts not fully engaged.

1.1.5 Hilti-Kwik bolts installed with less than minimum embedment.

1.1.6 Absence of locking devices for threaded fasteners on NF supports.

1.2 Isolation Anchors

The issue was that isolation anchors were not always used in the design of seismic-to-nonseismic piping. The isolation anchor must be designed to withstand the combined loading imposed by both seismic Category I and nonseismic piping (Allegation SRT-13, Reference 4.2).

1.3 Main Steam Loop Hydro

The issue was that the design of the main steam lines in Unit 1 did not take into account the stresses caused by repositioning of the line after flushing and by the settling of temporary supports (Reference 4.1).

1.4 Girth Welds

The issue was that radial shrinkage of girth welds in thin-walled stainless steel pipe was not always adequately analyzed (Allegations AQ-50, Ref. 4.1; and AW-52, AW-59, AW-62, Ref. 4.2).

2.0 Issue Resolution

2.1 As-Built Inspection Program

The issue of the as-built QC verification of supports at CPSES was also identified in Subappendixes A39 and B3. The resolution of this issue and the corrective and preventive actions associated with this issue are addressed in Subappendixes A39 and B3.

2.2 Isolation Anchors

The isolation anchor issue was also identified in SSER-10 (Reference 4.2) and is discussed in Subappendixes A34 and A37. The resolution of this issue and the corrective and preventive actions associated with this issue are addressed in Subappendixes A34 and A37.

2.3 Main Steam Loop Hydro

The Unit 1 main steam loop hydro issues were also identified in SSER-10 and are discussed in Subappendix A37. The resolution of this issue and the corrective and preventive actions associated with this issue are addressed in Subappendix A37.

2.4 Girth Welds

The effects of radial shrinkage of girth welds on the pipe stress analysis were analyzed in accordance with CPPP-7, Attachment 3-15.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- Pipe support modifications resulting from resolution of the issue of isolation anchors and girth weld shrinkage have been determined reportable under the provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-36). Pipe support modifications resulting from resolution of the issue of as-built verification of pipe supports have been determined reportable under the provisions of 10CFR50.55(e) (see Subappendix B3, SDAR-CP-86-63).

- The corrective action to resolve the girth weld issue was accomplished through the implementation of the criteria specified in Attachment 3-15 of CPPP-7 during the design validation.

- The corrective actions to resolve the issues of the as-built inspection program, the isolation anchors, and the main steam loop hydrostatic test are discussed in Subappendixes A39, A34, and A37, respectively.

- The preventive actions for these issues are specified in Attachment C.

4.0 References

4.1 NUREG-0797, Supplement No. 11, Safety Evaluation Report related to the operation of CPSES Units 1 and 2, USNRC, Docket Nos. 50-445 and 50-446, May 1985

4.2 NUREG-0797, Supplement No. 10, Safety Evaluation Report related to the operation of CPSES Units 1 and 2, USNRC, Docket Nos. 50-445 and 50-446, April 1985

SUBAPPENDIX A39

CPRT QUALITY OF CONSTRUCTION REVIEW ON PIPING AND PIPE SUPPORTS

1.0 Definition of the Issue

Evaluation Research Corporation (ERC) was contracted by CPRT to perform the Quality of Construction (QOC) sample inspection of the safety-related components installed in CPSES, including piping and pipe supports. This task was implemented in accordance with CPRT Action Plan VII.c, and the results were discussed in Section 5.2.5 of the CPRT Action Plan VII.c Results Report (Reference 4.1).

ERC inspection covered approximately 82,500 inspection points for piping and pipe supports. ERC evaluated the results and recommended corrective action on the adverse trends and construction deviations on the piping components, gaps, locking devices, pipe clamp spacers, pipe clamps, cotter keys, and angularity offsets.

The recommended corrective actions on the adverse trends and construction deviations of the pipe supports identified in the CPRT-QOC Results Report are summarized as follows:

	Construction Work Category	CPRT Action Plan VII.c Results Report Recommendations
1.1	Large Bore Piping Configuration	Reinspect flow elements to verify that they are oriented in the proper direction
1.2	Large Bore Piping Configuration	Verify existing piping clearance criteria and walkdown on all large bore piping with insulation installed
1.3	Large Bore Piping Configuration	Reinspect safety-related piping expansion joints
1.4	Pipe Welds and Materials	Reinspect butt welds in Schedule 80 or thinner stainless steel piping made prior to 1982 that are replacement welds and/or have received extensive repairs

	Construction Work Category	CPRT Action Plan VII.c Results Report Recommendations
1.5	Large Bore Pipe Supports Rigid	Walkdown of pipe supports containing vendor-supplied components and replacement of nonconforming parts subject to appropriate engineering disposition
1.6	Large Bore Pipe Supports Rigid	Inspect for proper gaps between pipe and pipe support and verify adequate clearance between pipe welds and pipe support
1.7	Large Bore Pipe Supports Rigid	Inspect and install suitable locking devices on all vendor-supplied components that do not have high-strength bolting; install locking devices on all high-strength bolting that is not torqued to an acceptable preload
1.8	Large Bore Pipe Supports Rigid	Walkdown reinspection of pipe clamps and replace nonconforming spacers or confirm they fall within the limits of bounding calculation
1.9	Large Bore Pipe Supports Rigid	Verify that jam nuts on all vendor-supplied components (sway struts, snubbers, and spring cans) are snug tight
1.10	Large Bore Pipe Supports Rigid	Walkdown of all pipe supports having pipe clamps to verify security of attachment to the pipe
1.11	Large Bore Pipe Supports Nonrigid	Reverify component adjustment during the startup and preoperational phases of the plant
1.12	Large Bore Pipe Supports Nonrigid	Walkdown of all vendor-supplied components to ensure that proper angularity exists
1.13	Large Bore Pipe Supports Nonrigid	Walkdown of all supports containing vendor-supplied components and inspect cotter keys and associated bolting

Construction Work Category	CPRT Action Plan VII.c Results Report Recommendations
1.14 Large Bore Pipe Supports Nonrigid	Inspect and install suitable locking devices on all vendor-supplied components that do not have high-strength bolting, install locking devices on all high-strength bolting that is not torqued to an acceptable preload

2.0 Issue Resolution

The Post-Construction Hardware Validation Program (PCHVP) (Reference 4.2) is the portion of TU Electric's Corrective Action Program (CAP) which validates the final acceptance attributes for safety-related hardware.

The input to the Post-Construction Hardware Validation Program (PCHVP) is contained in the installation specifications. Final acceptance inspection requirements identified in the validated installation specifications were used to develop the Post-Construction Hardware Validation Program (PCHVP) attribute matrix. This matrix is a complete set of final acceptance attributes identified for installed hardware. The Post-Construction Hardware Validation Program (PCHVP), by either physical validations or through an engineering evaluation methodology, assures that each of the attributes defined in the attribute matrix is validated.

SWEC-PSAS developed the Field Verification Method (FVM) CPE-SWEC-FVM-PS-081 (Reference 4.3) to coordinate the Unit 1 and Common piping and pipe support inspection validation activities.

Piping inspections are performed and documented by Quality Control (QC) personnel to assure that applicable inspection attributes are acceptable. The piping inspection attributes are as below:

- Equipment and piping configuration
- Piping wall thickness at shop/field bends
- Radial weld shrinkage at stainless steel piping joints
- Equipment anchoring
- Remote valve operators
- Branch connections
- All pressure boundary items installation/base metal defects
- Valve orientations
- Pipe/sleeve details
- Permanent pipe support installation (no temporary or voided supports)
- Verify location (span) dimensions/tolerances
- Applicable dielectric insulating sleeves over bolts/studs
- Linear dimensions of piping segments and in-line components

The hardware validation of pipe supports assures that the removable items on a pipe support are installed as required by the design documentation. The hardware validation is implemented by Quality Control (QC) personnel in compliance with the validated support drawing. Quality Control personnel verify and document that all applicable hardware attributes listed on the hardware validation checklists are acceptable. The following pipe support hardware validation checklists are used, as applicable:

Adjacent Weld Checklist
Bolted Connection Checklist
Hilti Bolt Checklist
Pipe Clamp Checklist
Richmond Insert Checklist
Snubber Checklist
Support Checklist
Sway Strut Checklist
Through Bolt/Embedded Bolt Checklist
U-Bolt/Bolted U-Guide Checklist
Variable/Constant Spring Checklist

In addition to the hardware validation pipe support inspections, Quality Control (QC) personnel also conduct inspections for pipe support configuration attributes as below:

Material acceptability
Support configuration compliance with validated design drawing, including dimensions
Support overhang length/tolerance
Support projection length/tolerance
Sway strut/snubber pin-to-pin dimension/tolerance
Alignment and circumferential deviation of shear lugs
Hilti bolt size/embedment
Weld length of structural member on base plate
Welded connection in accordance with validated drawing
Edge distance for structural members and base plates
Slope of bolted part with bolt head or nut
Shim size/weld

SWEC-PSAS developed the Field Verification Method (FVM) CPE-SWEC-FVM-PS-080 (Reference 4.4) to assure that sufficient clearance exists around the validated piping. Clearance is required to permit those anticipated piping displacements that could occur under plant operating conditions without any impediment to those displacements. An impediment is defined as any structure, pipe, conduit, cable tray, or equipment that encroaches on the envelope of anticipated pipe displacement.

This field verification effort is performed by the SWEC-PSAS engineering personnel. SWEC-PSAS has established clearance criteria and is responsible for training the clearance walkdown teams, evaluating clearance problems, and issuing design changes to correct any clearance violations.

The physical validation of mechanical piping attributes (e.g., flow element orientation and expansion joint installation) is performed by SWEC mechanical discipline PCHVP as discussed in the SWEC Mechanical Project Status Report (Reference 4.5).

These corrective actions also envelop the resolution of issues in Subappendixes A29, A30, A38, and B3. The quality of construction requirements for piping and pipe supports in the PCHVP were incorporated into the construction and QC inspection procedures to serve as the preventive action.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- The quality of construction of pipe support installation issue was determined to be reportable under the provisions of 10CFR50.55(e) (see Subappendix B3, SDAR-CP-86-63).
- The corrective action to resolve this issue is accomplished through the implementation of the Post-Construction Hardware Validation Program.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CPRT Action Plan VII.c Results Report, Construction Reinspection/Documentation Review Plan, Revision 0, June 11, 1987

4.2 TU Electric Engineering and Construction Procedure EC-9.04, Post Construction Hardware Validation Program, July 17, 1987

4.3 SWEC-PSAS Comanche Peak Field Verification Method, Hardware Validation and Supplemental Inspection Programs, CPE-SWEC-FVM-PS-081, Revision 0, July 29, 1987

4.4 SWEC-PSAS Comanche Peak Field Verification Method, Clearance Walkdown, CPE-SWEC-FVM-PS-080, Revision 0, July 28, 1987

4.5 TU Electric, CPSES Unit 1 and Common, Mechanical Project Status Report, Revision 0

APPENDIX B

INTRODUCTION

This appendix describes the details of resolutions of issues identified during the performance of the piping Corrective Action Program (CAP). Included in this appendix are the piping-related Significant Deficiency Analysis Reports (SDARs) initiated by TU Electric.

Each of the five issues listed below is described in an individual sub-appendix which includes discussions of resolution methodology and corrective and preventive actions.

Issue No.	Issue Title
B1	SDAR-CP-86-33, Stiffness Values for Class 1 Stress Analysis
B2	SDAR-CP-86-36, Large Bore Piping and Supports
B3	SDAR-CP-86-63, Pipe Support Installations
B4	SDAR-CP-86-67, Preoperational Vibration Test Criteria
B5	SDAR-CP-86-73, ASME Snubber Attachment Brackets

SUBAPPENDIX B1

SDAR-CP-86-33, STIFFNESS VALUES FOR CLASS 1 STRESS ANALYSIS

1.0 Definition of Issue

TU Electric identified a deficiency in the stiffness values of pipe supports for ASME Section III Class 1 piping stress analysis (Reference 4.1). The pipe support stiffness values used in the previous Westinghouse stress analysis of ASME Section III Code Class 1 piping in Unit 1 were based on input from the existing design. These pipe support stiffness values changed with implementation of the corrective actions from the pipe stress and pipe support validation program, thus rendering the previous results of ASME Section III Class 1 pipe stress analysis in Unit 1 inconsistent with the pipe stress and pipe support validation program.

Appropriate ASME Section III Code Class 1 pipe support stiffness values that incorporated corrective actions and modifications resulting from the pipe stress and pipe support validation program must be used in the validated ASME Section III Code Class 1 pipe stress analysis.

2.0 Issue Resolution

The calculations of the stiffness values for the pipe supports for the ASME Section III Code Class 1 pipe stress analysis packages were completed and these results were transmitted to Westinghouse in accordance with Section 7.5.7 of project procedure CPPP-6 (Reference 4.2) and SWEC-PSAS Project Memorandum PM-130 (Reference 4.3). Westinghouse reanalyzed these stress problems and issued revised support loads for pipe support validation.

TU Electric determined that this issue was reportable under the provisions of 10CFR50.55(e) and submitted reports (References 4.1 and 4.4) to the NRC Staff on May 28, 1986, and October 17, 1986. The large bore pipe support modifications and hardware validation status is being updated under 10CFR50.55(e) via SDAR-CP-86-36 (Subappendix B2).

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- This issue was determined to be reportable under the provisions of 10CFR50.55(e).
- The corrective action to resolve this issue was accomplished by the validation of the ASME Section III Code Class 1 pipe stress analysis by Westinghouse and by the SWEC-PSAS validation of the pipe supports in accordance with Sections 3.10.8 and 4.3.2.2, and Attachment 4-18 of CPPP-7.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 TU Electric Letter No. TXX-4831, W. G. Counsil to E. H. Johnson, Director, Division of Reactor Safety and Projects, U.S. Nuclear Regulatory Commission, Stiffness Values for Class 1 Pipe Stress Analysis, May 28, 1986 (SDAR-CP-86-33 - Interim Report).

4.2 SWEC-PSAS Project Procedure CPPP-6, Pipe Stress/Support Requalification Procedure - Unit 1, Revision 4, April 8, 1987.

4.3 SWEC-PSAS Project Memorandum PM-130, Transmittal of Requalification Results to Westinghouse, December 19, 1986.

4.4 TU Electric Letter No. TXX-6025, W. G. Counsil to E. H. Johnson, Director, Division of Reactor Safety and Projects, U.S. Nuclear Regulatory Commission, Stiffness Values for Class 1 Pipe Stress Analysis, October 17, 1986 (SDAR-CP-86-33 - Final Report).

SUBAPPENDIX B2

SDAR-CP-86-36, LARGE BORE PIPING AND SUPPORTS

1.0 Definition of Issue

Impact of CPRT and external issues tabulated in Subappendixes A1 through A35 on the adequacy of the piping and pipe support design and installation processes is significant.

2.0 Issue Resolution

SWEC-PSAS was contracted to validate the piping and pipe supports at CPSES. Modification of certain pipe supports provided expedient acceptance for the expanded requirements. Support modifications are categorized as follows:

2.1 Prudent - Supports in this category may have been technically acceptable; however, more time and expense would have been involved in the detailed analysis than that required to physically modify the support and qualify the modification.

2.2 Recent Industry Practice - Modifications implemented to eliminate snubbers to enhance plant maintainability, reduce inservice inspection, and minimize worker radiation exposure during operating plant conditions.

2.3 Adjustment - Minor modifications (such as retorquing or shimming) implemented to meet installation criteria contained in the resolution of the CPRT and external issues.

2.4 Cumulative effects - Modifications that are required due to the combined effect of previous issues.

The implementation of the physical modifications of pipe supports is being performed by TU Electric Construction and is being validated by the PCHVP.

TU Electric determined that this issue was reportable under the provisions of 10CFR50.55(e) and submitted the initial Significant Deviation Analysis Report No. SDAR-CP-86-36 (Reference 4.1) on June 9, 1986. Periodic status reports are being submitted to the NRC Staff.

3.0 Corrective and Preventive Action

- No additional issues have been discovered during the review and resolution of this issue.
- This issue was determined to be reportable under the provisions of 10CFR50.55(e).

- The corrective action to resolve this issue is accomplished through the piping and pipe supports CAP.

- The preventive actions for this issue are described in Appendix C.

4.0 References

4.1 TU Electric Letter No. TXX-4844 dated June 9, 1986, W. G. Counsil to E. H. Johnson, Director, Division of Reactor Safety and Projects, U.S. Nuclear Regulatory Commission, Pipe Supports, SDAR-CP-86-36 (Interim Report)

SUBAPPENDIX B3

SDAR-CP-86-63, PIPE SUPPORT INSTALLATIONS

1.0 Definition of the Issue

On September 4, 1986, a deficiency was identified involving a broken cotter pin on a snubber (Reference 4.1).

2.0 Issue Resolution

The piping CAP includes the PCHVP that will validate cotter pin installation in accordance with field verification method CPE-SWEC-FVM-PS-081 (Reference 4.2).

3.0 Corrective and Preventive Action

See Section 3.0 of Subappendix A39.

4.0 References

4.1 TU Electric Letter No. TXX-6027, W. G. Counsil to E. H. Johnson, Director, Division of Reactor Safety and Projects, U.S. Nuclear Regulatory Commission, Pipe Supports, SDAR-CP-86-63 (Interim Report), November 3, 1986

4.2 SWEC-PS, Comanche Peak Field Verification Method, Hardware Validation and Supplemental Inspection Programs, CPE-SWEC-FVM-PS-081, Revision 0, July 29, 1987

SUBAPPENDIX B4

SDAR-CP-86-67, PREOPERATIONAL VIBRATION TEST CRITERIA

1.0 Definition of the Issue

TU Electric identified a deficiency (Reference 4.1) in the preoperational vibration test criteria. The CPSES criteria document, Preoperational Vibration Test Program, Issue 1, June 1980, was reviewed, and it was found that the mathematical formulas used to determine stress endurance limits, allowable deflections, and flexibility characteristics of certain piping systems may not have been accurate. Vibration calculations and test results were evaluated to determine the validity of the original calculations.

The evaluation yielded the following results:

1. Two test data points (from a total of 21 system tests) were found to exceed the allowable deflection limits.

2. The measured direction of deflection movement was not clearly identified in all instances.

3. The test deflections were measured in only one direction in some cases.

2.0 Issue Resolution

As a result of the piping Corrective Action Program (CAP) and extensive modifications to the piping systems, TU Electric will repeat the preoperational vibration testing. SWEC-PSAS has established Project Procedure CPPP-25, Unit 1 Piping Vibration Test Procedure (Reference 4.2), for the management and assessment of piping system vibration as required by the CPSES FSAR Section 3.9.B.2. This preoperational vibration test procedure is based on information contained in NRC Regulatory Guide 1.68 (Reference 4.3) and Section 3.9 of NUREG-0800 (Reference 4.4). SWEC-PSAS will provide technical services to the testing program.

TU Electric determined that this issue is reportable under the provisions of 10CFR50.55(e) and submitted SDAR-CP-86-67 on February 19, 1987.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- This issue was determined to be reportable in accordance with the provisions of 10CFR50.55(e).

- The corrective actions to resolve this issue will be implemented by repeating the preoperational piping vibration testing by a new test procedure to resolve the concerns.

- Preventive action for this issue is identified in Appendix C.

4.0 References

4.1 TU Electric Letter No. TXX-6072 dated October 27, 1986, W. G. Counsil to U.S. Nuclear Regulatory Commission, Attention: Document Control Desk, SDAR-CP-86-67 Preoperational Vibration Test Criteria

4.2 SWEC-PSAS Project Procedure CPPP-25, Piping Vibration Test Procedure, Revision 0, December 8, 1986

4.3 USNRC Regulatory Guide 1.68, Initial Test Programs for Water-Cooled Nuclear Power Plants, Revision 2, January 1978

4.4 USNRC Standard Review Plan NUREG-0800, Section 3.9.2, Revision 2, July 1981

SUBAPPENDIX B5

SDAR-CP-86-73, ASME SNUBBER ATTACHMENT BRACKETS

1.0 Definition of the Issue

TU Electric identified a deficiency (Reference 4.1) involving restriction of the snubber swing angle by the snubber rear brackets. Rear brackets on safety-related snubbers have the potential to cause restricted movement and binding due to the use of the incorrect rear bracket.

2.0 Issue Resolution

A drawing review of ASME Section III, Code Class 1, 2, and 3 snubbers was conducted to verify the adequacy of swing clearances, and identified 1063 snubbers as having attachment brackets. As a result of field examination, the number of snubbers requiring evaluation has been reduced to 165.

2.1 These 165 supports were evaluated by comparing the field verified swing angle data with the predicted movements. The results are as follows:

- 83 supports were determined to have sufficient field verified swing angle to accommodate the predicted pipe movement.
- 15 supports were determined to be unnecessary in a previously initiated pipe support validation effort (and are being deleted).
- 33 supports are being modified as a result of the pipe support validation effort (but not as a result of this deficiency).
- 31 supports have been identified as having less clearance than required by analysis and are being modified to correct the situation.
- 3 supports have no safety-related function and do not impair the safety-related function of other components and therefore require no further evaluation for safety significance.

2.2 TU Electric determined that this issue was reportable under the provisions of 10CFR50.55(e) and submitted Significant Deficiency Analysis Report SDAR-CP-86-73 (Reference 4.1).

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- This issue was determined to be reportable under the provisions of 10CFR50.55(e).

- The corrective action to resolve the snubber rear bracket issue is being accomplished through the implementation of CPSES Construction Procedure CP-CPM-9.10A, paragraph 3.6 and CPSES Quality Control Procedure Nos. CP-QAP-12.1 and QI-QAP-11.1-28, which require a check for binding on the rear bracket. Additionally, a backfit inspection was implemented in accordance with Field Verification Method TNE-FVM-PS-038.

- The preventive actions are identified in Appendix C.

4.0 References

4.1 TU Electric Letter No. TXX-6104, W. G. Counsil to E. H. Johnson, Director, Division of Reactor Safety and Projects, U.S. Nuclear Regulatory Commission, Snubber Rear Brackets, SDAR-CP-86-73, November 19, 1986

APPENDIX C - PREVENTIVE ACTIONS

The preventive actions are embodied in the procedures developed and used for the Corrective Action Program. These procedures resolve all CPRT and external issues as well as all issues identified during the performance of the CAP. Implementation of the preventive actions will assure that the design and hardware for CPSES Unit 1 and Common can continue to comply with the licensing commitments throughout the life of the plant as described in Section 5.4. The particular preventive actions preclude the recurrence of the issues identified in Appendixes A and B as summarized below in Sections 1.0 and 2.0, respectively.

1.0 APPENDIX A ISSUES - PREVENTIVE ACTION

A1. Richmond Inserts

Attachment 4-5 of CPPP-7 (Reference C.1) provides requirements and instructions for the inclusion of bending stress in the analysis of bolting used in Richmond inserts with tube steel, the proper modeling of Richmond insert to tube steel connections, length limits of tube steel members used with two or more Richmond inserts, and evaluations of spacing between inserts. Attachment 4-13 of CPPP-7 provides procedures for the evaluation of local stresses due to nuts bearing on tube steel walls. SWEC-PSAS Project Memorandum PM-141 (Reference C.2) provides procedures to check the potential unequal shear loading when the tube steel connection is anchored by two or more Richmond inserts. Additionally, Quality Assurance Procedure QI-QAP-11.1-28 (Reference C.3) was revised to include inspection for proper thread engagement.

A2. Local Stress in Piping

Attachments 4-6A, 4-6B, and 4-6C of CPPP-7 provide requirements and instructions for the evaluation of local run pipe stresses due to integral welded attachments (4-6A), and support bearing loads (4-6B and 4-6C).

The use of zero-gap box frames, the evaluation of pipe support stiffnesses and the evaluation of local stresses in pipe support members are discussed in the preventive actions of Subappendixes A4, A5, and A21, respectively.

A3. Wall-to-Wall and Floor-to-Ceiling Supports

Attachment 4-19 of CPPP-7 provides procedures for the inclusion of the effects of differential seismic displacements and the long-term effects of concrete creep on supports which span wall-to-wall and floor-to-ceiling.

A4. Pipe Support/System Stability

Section 4.2.4 and Attachment 4-9 of CPPP-7 provide requirements for the modification of potentially unstable pipe support configurations.

A5. Pipe Support Generic Stiffness

Section 3.10.8 of CPPP-7 provides baseline stiffness values for rigid pipe supports, anchors, and snubbers. Section 4.3.2.2 of CPPP-7 outlines the approach to be used in determining pipe support stiffnesses and Attachment 4-18 is a tabular/graphic compilation of support component and standard support subassembly.

A6. Uncinched U-Bolt Acting as Two-Way Restraint

Section 4.2.5.2 and Attachment 4-3 of CPPP-7 provide requirements and instructions for the proper application and evaluation of uncinched U-bolts used as two-way restraints. Section 4.3.2.2 and Attachment 4-18 of CPPP-7 provide the stiffness values for uncinched U-bolts used as two-way restraints.

A7. Friction Forces

Section 4.7.3 of CPPP-7 requires that the effects of friction forces acting on pipe supports be included in the design for all noncyclic loads. Attachment 4-7 of CPPP-7 provides the methods of implementing this requirement.

A8. AWS Versus ASME Code Provisions

Section 4.4 and Attachment 4-2 of CPPP-7 provide guidance for the design/qualification of skewed joint welds.

The angular limits of skewed, T-joint welds requires no preventive action since CPSES weld procedures are qualified by testing, which overrides the AWS angle limitations.

A9. A500, Grade B Tube Steel

Section 4.7.2.1 of CPPP-7 specifies the design criterion of pipe supports using A500, Grade B tube steel.

A10. Tube Steel Section Properties

Section 4.3.2.1 of CPPP-7 requires the use of the 8th Edition of the AISC Manual of Steel Construction (Reference C.4) in the selection of section properties for support design/qualification to preclude the use of inappropriate section properties for tube steel.

Specification No. 2323-MS-100 (Reference C.5) has been revised to assure that an effective throat of $t_e = t-1/16$ in. is achieved for welds on all tube steel sizes for any new design in the future.

Section 4.4 and Attachment 4-2 of CPPP-7, Revision 3, as amended by SWEC-PSAS Project Memorandum PM-140 (Reference C.6), specifies effective throat dimensions for flare bevel welds which meet the criteria of AWS. The revised guidelines of PM-140 will be followed for any future weld evaluation to preclude the recurrence of inadequate effective throat size.

A11. U-Bolt Cinching

Section 4.2.5.1 of CPPP-7 deleted the use of cinched U-bolts/crosspiece supports with struts/snubbers.

A12. Axial/Rotational Restraints

Sections 3.10.6.2 and 4.6.3, and Attachments 3-11 and 4-8 of CPPP-7 establish the procedure for the analysis of axial and rotational restraints.

A13. Bolt Hole Gap

Attachments 4-4 and 4-5 of CPPP-7 and SWEC-PSAS Project Memorandum PM-141 provide procedures for the design and evaluation of base plate bolt holes. Specification No. MS-46A (Reference C.7) and Quality Assurance Procedure QI-QAP-11.1-28 specify the design requirements and QA inspection tolerance of the bolt hole diameters.

A14. OBE/SSE Damping

Section 3.0 of CPPP-7 requires the use of OBE/SSE damping values that are consistent with Regulatory Guide 1.61 (Reference C.8) as modified by ASME Code Case N-411.

A15. Support Mass in Piping Analysis

Section 3.10.4, Attachment 3-4, and Attachment 3-11 of CPPP-7 provide guidance for the determination of pipe support mass and require the inclusion of this mass in the piping stress analysis.

A16. Programmatic Aspects and Quality Assurance, Including Iterative Design

Project Procedures CPPP-1, (Reference C.9) CPPP-6, (Reference C.10) and CPPP-7 control the validation of the piping and pipe supports. This is an integrated effort within one organization and assures proper interface between piping analysis and pipe support design. Additionally, personnel involved in the validation process receive training in the proper application of the requirements.

Interface with Westinghouse for Class 1 stress analysis is discussed in Subappendix B.1.

A17. Mass Point Spacing

Section 3.10.6.1 and Attachment 3-7 of CPPP-7 provides guidelines for the proper location of mass points in pipe stress analyses.

A18. High-Frequency Mass Participation

Section 3.10.6.8 of CPPP-7 specifies the criteria to account for high frequency mass participation in stress analyses. Use of computer program NUPIPE-SW (V04/L02) has been revised to automatically account for high frequency mass corrections.

A19. Fluid Transients

Project Procedure CPPP-10 (Reference C.11) describes the procedure by which fluid transient events are identified for applicable systems for inclusion in the pipe stress analyses.

Section 3.4.5.5 and Attachment 3-1 of CPPP-7 provide requirements and instructions for the inclusion of these load conditions in the stress analyses.

A20. Seismic Excitation of Pipe Support Mass

Attachment 4-21 of CPPP-7 specifies the requirements for inclusion of the effects of pipe support self-weight excitation in the support evaluation.

A21. Local Stress in Pipe Support Members

Attachment 4-13 of CPPP-7 establishes the requirements to evaluate local stresses which may occur in pipe support members.

A22. Safety Factors

The technical and design control procedures assure that the piping systems are designed in accordance with the CPSES design criteria, and therefore, they will perform their safety-related function.

A23. SA-36 and A307 Steel

Section 2.0 of CPPP-7 lists the applicable governing codes to be used to assure that the proper allowable stresses (determined from the minimum material yield strengths) are used in the design. Section 4.2.5.1 of CPPP-7 deletes the use of cinched U-bolts/crosspiece supports with struts/snubbers. Attachment 4-5 of CPPP-7 establishes the requirement for the reduced allowables of high strength bolts used with A563 Grade A nuts.

A24. U-Bolt Twisting

Section 4.2.5.1 and Attachment 4-8 of CPPP-7 provides guidance for the modification of U-bolt trapeze supports. Cinched U-bolts used with struts or snubbers are deleted from CPSES.

A25. Fisher/Crosby Valve Modeling/Qualification

The validation process requires a conservative 55/45 flow distribution ratio on the outlet configuration.

Section 7.4.3 of CPPP-6 establishes the requirements for assuring that valves are properly qualified to the as-built loadings.

Section 3.10.6.5 of CPPP-7 addresses the proper valve yoke modeling of flexible valves.

A26. Piping Modeling

Section 3.0 of CPPP-7 provides direction and requirements for the proper modeling of piping systems.

A27. Welding

Section 4.4 and Attachment 4-2 of CPPP-7 provide requirements for the design and analysis of welded joints.

A28. Anchor Bolts/Embedment Plates

Attachment 4-4 of CPPP-7 provides guidance and requirements for the evaluation of anchor bolt embedded depths and edge distances.

Project Procedure CPPP-6 provides controls to assure that reaction loads on embedded plates, attachment spacing between embedded plates, and as-built loads for through-bolts are transmitted to responsible groups for evaluation.

A29. Strut/Snubber Angularity

Section 4.2.6 of CPPP-7 specifies requirements to assure that force components resulting from off-axis loading of struts and snubbers is included in the support design.

Specification No. 2323-MS-100, Construction Procedure CP-CPM-9.10A (Reference C.12), and Quality Assurance Procedure QI-QAP-11.1.28 have been revised to incorporate the resolutions of the items related to this issue.

A30. Component Qualification

Sections 3.4.5 and 4.2 of CPPP-7 delineate the requirements to assure that piping movements due to system design conditions are considered in the evaluations of frame gaps, swing angles, and spring and snubber travel.

Quality Assurance Procedures QI-QAP-11.1-28 and CP-QAP-12.1 (Reference C.13) have been revised to include inspections for the existence and tightness of all locking devices on pipe supports.

A31. Structural Modeling for Frame Analysis

Section 4.3.2.1 of CPPP-7 requires the use of AISC Manual of Steel Construction, 8th Edition for the selection of the member properties used in the analysis, including values for torsional resistance.

Attachment 4-5 of CPPP-7 provides the modeling technique used for the Richmond insert/tube steel connection.

Attachment 4-18 of CPPP-7 provides procedures for the proper modeling of the connection stiffness for use in the frame analysis.

A32. Computer Program Verification and Use

Section 5.0 of CPPP-7 identifies the computer programs acceptable for use in the validation of piping and pipe supports. This list assures that only those programs verified in accordance with SWEC standard QA program requirements for verification, technical adequacy, and appropriate version are used in the validation program.

A33. Hydrotest

Sections 3.6.2.4 and 4.7.2 of CPPP-7 provide guidance for the evaluation of piping and supports for hydrotest loading.

A34. Seismic/Nonseismic Interface

Attachment 4-10 of CPPP-7 provides requirements and instruction for the design of safety-related piping attached to nonseismic piping.

A35. Other Issues

CPPP-6 and CPPP-7 provide technical and administrative procedures to address the concerns described in the 51 DIRs referenced in Subappendix A35.

A36. SSER-8 Review

Resolution of this issue requires no preventive action, since design allowables for Richmond inserts and anchor bolts are based on the actual strength of concrete at CPSES.

A37. SSER-10 Review

No preventive action is required for the uncontrolled plug welding issue. As concluded by the CPRT Action Plan V.d Results Report (Reference C.14), the current procedures and practices for the repair of mislocated holes are adequate to preclude the recurrence of undocumented plug welds.

TU Electric Construction Procedure CP-CPM-1.2 (Reference C.15) and Project Procedure CPSP-30 (Reference C.16) provide procedures for the evaluation of the installed piping and pipe support configuration including the proper design of temporary supports prior to a piping system hydro to assure the integrity of the installed safety-related piping and pipe supports.

Project Procedure CPPP-28 (Reference C.17) and Attachment 4-10 to CPPP-7 provide direction and requirements for the identification and evaluation of interface anchors between seismic and nonseismic piping to assure isolation of Category I systems from non-Category I systems.

Quality Assurance Procedure QI-QAP-11.1-28 has been revised (Revision 30) to include acceptance criteria and measurement techniques for the inspection of Type 2 skewed welds.

A38. SSER-11 Review

Attachment 3-15 to CPPP-7 provides the procedure to analyze girth welds.

Quality Control Procedures QI-QAP-11.1-28 and CP-QAP-12.1 have been revised to assure that the items related to the QA Inspection Program have been addressed.

A39. CPRT Quality of Construction Review on Piping and Pipe Supports

TU Electric instituted the Post-Construction Hardware Validation Program (PCHVP) (Reference C.18) to validate that the as-built hardware complied with the design for Unit 1 and Common safety-related piping and pipe supports. The quality of construction requirements for pipe supports in the PCHVP were incorporated into Quality Assurance Procedures QI-QAP-1.11-28 and CP-QAP-12.1.

2.0 APPENDIX B ISSUES - PREVENTIVE ACTION

B1. SDAR-CP-86-33, Stiffness Values for Class 1 Stress Analysis

Project Procedure CPPP-6 requires that support stiffness values for pipe supports for Class 1 lines be computed and provided to Westinghouse for use in the stress analysis of Class 1 lines.

B2. SDAR-CP-86-36, Large Bore Piping and Supports

Design Basis Documents (DBD) (References C.19, C.20, and C.21) for large bore piping and the supports have been established. These documents delineate the applicable specifications, detailed technical procedures, and construction and QC inspection procedures, required to maintain the validated design.

B3. SDAR-CP-86-63, Pipe Support Installation

The as-built verification procedure, CPSP-12 (Reference C.22), and the Pipe Stress/Support Final Reconciliation Procedure, CPPP-23 (Reference C.23), combined with those Quality Assurance inspection procedures identified in the DBD-CS-067 (Reference C.18) provide assurance that pipe support installations will meet the requirements of the design.

B4. SDAR-CP-86-67, Preoperational Vibration Test Criteria

The results of the preoperational vibration testing will be reviewed by SWEC-PSAS to assure that the results satisfy the design criteria.

No further preventive action is required because preoperational vibration testing is a one-time event, which will not be repeated following the issuance of an operating license.

B5. SDAR-CP-86-73, ASME Snubber Attachment Brackets

Quality Assurance Procedure QI-QAP-11.1-28 has been revised to inspect for the incorrect use of the correct attachment brackets for snubbers.

REFERENCES:

C.1 SWEC-PSAS Project Procedure CPPP-7, Design Criteria for Pipe Stress and Pipe Supports, Revision 3, February 27, 1987

C.2 SWEC-PSAS Project Memorandum PM-141, Unequal Shear Loading Effect on Richmond Insert and Threaded Rods Used in Conjunction with Tube Steel, Revision 0, March 25, 1987

C.3 CPSES Quality Assurance Procedure QI-QAP-11.1-28, Fabrication and Installation Inspection of Safety Component Supports, Revision 35, January 8, 1987

C.4 AISC Manual of Steel Construction, 8th Edition, 1980

C.5 CPSES Piping Erection Specification No. 2323-MS-100, Revision 9, August 17, 1987

C.6 SWEC-PSAS Project Memorandum PM-140, Flare Bevel Groove Welds, Revision 1, May 1, 1987

C.7 CPSES Nuclear Safety Class Pipe Hangers and Supports Specification No. 2323-46A, Revision 7, May 7, 1987

C.8 NRC Regulatory Guide 1.61, Damping Values for Seismic Design of Nuclear Power Plants, October 1973

C.9 SWEC-PSAS Project Procedure CPPP-1, Management Plan for Project Quality (Piping System Qualification/Requalification), Revision 7, March 25, 1987

C.10 SWEC-PSAS Project Procedure CPPP-6, Pipe Stress/Support Requalification Procedure, Revision 4, April 8, 1987

C.11 SWEC-PSAS Project Procedure CPPP-10, Procedure for Review of Plant Operating Mode Conditions, Revision 1, April 1, 1986

C.12 CPSES Construction Procedure CP-CPM-9.10A, Installation of Vendor Supplied Component Supports Catalog Items, Revision 1, August 15, 1985

C.13 CPSES Quality Assurance Procedure CP-QAP-12.1, Mechanical Component Installation and N-5 Certification, Revision 18, January 12, 1987

C.14 CPRT Action Plan V.d Results Report, Revision 1, Plug Welds, December 18, 1986

C.15 CPSES Construction Procedure CP-CPM-1.2, Construction Activities for Systems and/or Areas Accepted and/or Controlled by TU Electric Plant Operations, Revision 5, March 4, 1987

C.16 SWEC-PSAS Project Site Engineering Procedure CPSP-30, Processing TU Electric Requests for Temporary Hangers, Revision 0, October 7, 1987

C.17 SWEC-PSAS Project Procedure CPPP-28, Procedure for Identification and Evaluation of Interfaces Between Seismic and Nonseismic Piping, Revision 0, February 20, 1987

C.18 TU Electric Engineering and Construction Procedure EC-9.04, Post Construction Hardware Validation Program, July 29, 1987

C.19 TU Electric Design Basis Document DBD-CS-065, ASME Class 1 Piping Analysis (Draft), August 14, 1987

C.20 TU Electric Design Basis Document DBD-CS-066, ASME Class 2 and 3 Piping Analysis, Revision 0, July 31, 1987

C.21 TU Electric Design Basis Document DBD-CS-067, ASME Class 1, 2, and 3 Pipe Support Design, Revision 0, July 31, 1987

C.22 SWEC-PSAS Project Site Engineering Procedure CPSP-12, As-Built Verification (Piping), Revision 0, November 12, 1986

C.23 SWEC-PSAS Project Procedure CPPP-23, Pipe Stress/Support Final Reconciliation Procedure, Revision 0, March 2, 1987

Errata
Large Bore Piping and Pipe Support
PSR

PSR Page	Item/Line No.	Correction
5-21	41	Delete "Piping Erection"
5-30	16-17	Change "have verified" to "verify" and "were" to "are" and "identified a trend" to "have identified a trend"
FIGURE 5-1	-	Change "SPEC. 2323-MS200A (Ref. 41)" to "SPEC. 2323-MS200 (Ref. 41)"
TABLE 5-7	1	Change "Piping Erection" to "Field Fabrication and Erection of Piping and Pipe Supports"
"	9	Change "CPSES Quality Assurance Procedure QI-QAP-11.1-26, Piping and Equipment Installation Inspection (Reference 42)" to "CPSES ASME Quality Procedure, AQP-11.2, Fabrication and Installation Inspection of Pipe and Equipment (Reference 60)"
TABLE 5-10	SWCL No. 1	Change "02/21/85" to "02/21/86"
"	Project No. 5	Change "CPO-746, 04/03/86" to "CPO-881, 04/16/86"

Errata
Large Bore Piping and Pipe Support
PSR

PSR Page	Item/Line No.	Correction
TABLE 5-10	SWCL No. 2	Change "CPI-3557, 08/12/86" to "CPO-1901, 07/18/86 and CPO-2002, 07/28/86"
"	Project No. 10	Add, under the Audit Response Transmittal column, "2CPO-1199, 10/09/86"
"	Project No. 14	Change "03/06/87" to "03/27/87" and under the Audit Response Transmittal column, change "EMD File 16.1.2 (016)" to "CPI-8657, 05/08/87"
"	Project No. 15	Change "03/27/87" to "03/31/87"
"	Project No. 16	Add, under the Audit Response Transmittal column, "2CPO-2579, 07/17/87"
"	Site No. 5	Change "06/22/87" to "06/20/87"
TABLE 5-11	TSWEC-7	Change "CPO-1900, 07/18/86" to "CPO-1922, 07/23/86"

Errata
Large Bore Piping and Pipe Support
PSR

PSR Page	Item/Line No.	Correction
TABLE 5-11	ATP-87-03	Change "06/05/87" to "06/23/87"
"	ATP-87-09	Change "CPO-7415, 08/07/87" to "CPO-6750, 06/23/87"
"	ATP-87-14	Change "CPO-7056, 06/30/87" to "CPO-6750, 06/23/87"
"	ATP-87-18	Change "CPO-7315, 07/24/87" to "CPO-7229, 07/17/87"
"	ATP-87-28	Change "07/01/87" to "06/29/87" and "07/10/87" to "07/14/87"
6-3	32	Change "Revision 0, November 21, 1986" to "Revision 1, October 23, 1987"
6-3 C-9	38 C.5	Change "Piping Erection" to "Field Fabrication and Erection of Piping and Pipe Supports"

Errata
Large Bore Piping and Pipe Support
PSR

PSR Page	Item/Line No.	Correction
6-3	42	Change "CPSES Quality Assurance Procedure QI-QAP-11.1-26, Piping and Equipment Installation Inspection, Revision 0" to "Deleted. Superseded by Reference 60."
6-4	49	Change "August 30, 1987" to "August 28, 1987"
6-5	60	Change "Revision 0, July 10, 1987" to "Revision 1, August 31, 1987"
6-5	62	Change "Reactor Coolant Loop Piping and Support Design" to "Reactor Coolant Loop Piping Stress Analysis and Support Design"
6-5	73	Change "October 15, 1987" to "October 15, 1986"
A4-5	4.4	Change "J. B. George" to "J. W. Beck"
A5-4	4.8	Change "Pipe Support Generic Stiffness Study" to "Pipe Support Stiffness Study"

Errata
Large Bore Piping and Pipe Support
PSR

PSR Page	Item/Line No.	Correction
A11-2	4.4	Change "U-bolt Support Assembly Finite Element Analysis" to "U-bolt Piping Support Assembly Finite Element Analysis"
A13-3	4.5	Change "July 6, 1987" to "May 12, 1987"
A20-1	4.2	Change "February 14, 1983" to "February 15, 1983"
A28-3	4.2	Change "Revision 4" to "Revision 1"
A37-3	4.8	Change "Processing TU Electric Requests for Temporary Hangers" to "Processing Requests for Temporary Hangers" and "October 7, 1987" to "October 1, 1987"
A39-5	4.2	Change "July 17, 1987" to "July 29, 1987"
B3-1	4.1	Change "Pipe Supports" to "Pipe Support Installations" and "November 3, 1986" to "October 16, 1986"

Errata
Large Bore Piping and Pipe Support
PSR

PSR Page	Item/Line No.	Correction
B5-2	4.1	Change "Snubber Rear Brackets" to "ASME Snubber Attachment Brackets"
C-9	C.3	Change "Fabrication and Installation Inspection of Safety Component Supports" to "Fabrication and Installation Inspection of Safety Class Component Supports" and "January 8, 1987" to "January 12, 1987"
C-9	C.7	Change "May 7, 1987" to "May 12, 1987"
C-10	C.19	Change "(Draft), August 14, 1987" to "Rev. 0, October 1, 1987"

COMANCHE PEAK STEAM ELECTRIC STATION

UNIT 1 and COMMON

CORRECTIVE ACTION PROGRAM

PROJECT STATUS REPORT

SMALL BORE PIPING AND PIPE SUPPORTS

TU ELECTRIC

Generating Division

02

Revision 0

TU ELECTRIC
COMANCHE PEAK STEAM ELECTRIC STATION
UNIT 1 AND COMMON

STONE & WEBSTER ENGINEERING CORPORATION

PROJECT STATUS REPORT

SMALL BORE PIPING AND PIPE SUPPORTS

R. P. Klause

R. P. Klause
Project Manager

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This Project Status Report (PSR) summarizes the systematic validation process for safety-related small bore piping (2 in. nominal pipe size and smaller) and pipe supports implemented by Stone & Webster Engineering Corporation - Pipe Stress Analysis and Support Project (SWEC-PSAS) at Comanche Peak Steam Electric Station (CPSES), Unit 1 and Common[1]. This Project Status Report (PSR) presents the results of the design validation and describes the Post-Construction Hardware Validation Program (PCHVP). SWEC-PSAS's activities were governed by the TU Electric Corrective Action Program (CAP) which required SWEC-PSAS to:

1. Establish a consistent set of CPSES safety-related piping and pipe support design criteria that complies with the CPSES licensing commitments.

2. Produce a set of design control procedures that assures compliance with the design criteria.

3. Evaluate systems, structures, and components, and direct the corrective actions recommended by the Comanche Peak Response Team (CPRT) and those determined by the Corrective Action Program (CAP) investigations to be necessary to demonstrate that systems, structures, and components are in conformance with the design.

4. Assure that the validation resolves the piping-related design and hardware issues identified by the Comanche Peak Response Team (CPRT), external sources[2], and the Corrective Action Program (CAP).

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[1]Common refers to areas in CPSES that contain both Unit 1 and Unit 2 systems, structures, and components

[2]External issues are issues identified by the following:

NRC Staff Special Review Team (SRT-NRC)
NRC Staff Special Inspection Team (SIT)
NRC Staff Construction Appraisal Team (CAT)
Citizens Association for Sound Energy (CASE)
Atomic Safety and Licensing Board (ASLB)
NRC Region IV Inspection Reports
NRC Staff Technical Review Team (TRT) [SSERs 7-11]
CYGNA Independent Assessment Program (IAP)

Comanche Peak Response Team (CPRT) issues are issues identified by the following:

CPRT Design Adequacy Program (DAP)
CPRT Quality of Construction Program (QOC)

5. Validate that the design of safety-related piping systems is in conformance with the licensing commitments and that the installed hardware is in conformance with the validated design.

6. Produce a set of consistent and validated design documentation.

A consistent set of design criteria for CPSES safety-related piping and pipe supports has been developed and used by SWEC-PSAS for the design validation process. This set of design criteria and methodologies is in conformance with the CPSES licensing commitments. It has been independently and extensively reviewed and was accepted by Comanche Peak Response Team (CPRT) and by CYGNA Energy Services (CYGNA).

SWEC-PSAS established design control procedures to implement the design criteria and methodologies described above, and to govern the work flow and technical interfaces with other disciplines, for both the design and hardware validation processes. These procedures specify the processes (such as the validation of piping system inputs, piping and pipe support checklists, documentation control, and final reconciliation) that have been implemented throughout the safety-related small bore piping and pipe supports Corrective Action Program (CAP).

SWEC-PSAS has performed analyses to validate the design of as-built CPSES Unit 1 and Common safety-related small bore piping and pipe supports.[3] The results are documented in 457 pipe stress analysis packages[4] that contain approximately 6,630 pipe supports. The as-built hardware for safety-related small bore piping and pipe supports is being validated to the design by the Post-Construction Hardware Validation Program (PCHVP).

Methodologies have been incorporated into the SWEC-PSAS design criteria and the Post-Construction Hardware Validation Program (PCHVP) implementation procedures which have resolved the piping-related design and hardware issues identified by the Comanche Peak Response Team (CPRT), external sources, and the Corrective Action Program (CAP). Consequently, the validated design of the CPSES safety-related small bore pipe and pipe supports has resolved these piping-related issues.

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[3]Analysis of the ASME Section III Code Class 1 small bore piping for the Corrective Action Program (CAP) was performed by Westinghouse, except one small bore pipe stress analysis package was performed by SWEC-PSAS. SWEC performed the analysis of the ASME Section III Code Class 1 pipe supports as well as the ASME Section III Code Class 2 and 3 piping and pipe supports.

[4]The term "pipe stress analysis package" is used in this Project Status Report to describe the engineering documentation required to validate the design adequacy of piping.

The Post-Construction Hardware Validation Program (PCHVP) assures that the safety-related small bore piping and pipe supports are installed in conformance with the validated design. SWEC-PSAS has reviewed and revised the CPSES piping-related installation specifications, construction procedures, and reviewed quality control inspection procedures to assure that the validated design requirements are implemented. The Post-Construction Hardware Validation Program (PCHVP) for safety-related small bore piping and pipe supports, including the inspections, engineering walkdowns and evaluations, implements the corrective actions recommended by the Comanche Peak Response Team (CPRT), as well as those required by Corrective Action Program (CAP) investigations.

SWEC-PSAS will provide TU Electric a complete set of validated design documentation for CPSES safety-related small bore piping and pipe supports, including the pipe stress and pipe support calculations, drawings, and interface discipline transmittals. This documentation, in conjunction with the updated specifications and procedures, can provide the basis for CPSES configuration control[5] to facilitate maintenance and operation throughout the life of the plant.

In-depth quality and technical audits have been performed by SWEC Quality Assurance, TU Electric Quality Assurance, and the independent Engineering Functional Evaluations (EFE). These audits, in addition to the third party overview performed by TENERA, L.P. (TERA) for Comanche Peak Response Team (CPRT), assured that the SWEC-PSAS procedures and the established design criteria complied with the licensing commitments.

The Unit 1 and Common safety-related small bore piping and pipe supports Corrective Action Program (CAP) validates that:

- The design of the small bore piping and pipe supports complies with the CPSES licensing commitments.
- The as-built safety-related small bore piping and supports comply with the validated design.
- The small bore piping and pipe supports comply with the CPSES licensing commitments and will perform their safety-related functions.

[5]Configuration control is a system to assure that the design and hardware remain in compliance with the licensing commitments throughout the life of the plant.

ABBREVIATIONS AND ACRONYMS

AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ARS	Amplified Response Spectra
ASLB	Atomic Safety and Licensing Board
ASME Section III	American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Section III, Division 1, Nuclear Power Plant Components
BRP	Piping Isometric Drawing
CAP	Corrective Action Program (TU Electric)
CASE	Citizens Association for Sound Energy
CAT	Construction Assessment Team (NRC)
CFR	Code of Federal Regulations
CMC	Component Modification Card
CPE	Comanche Peak Engineering (TU Electric)
CPPP	Comanche Peak Project Procedure
CPRT	Comanche Peak Response Team (TU Electric)
CPSES	Comanche Peak Steam Electric Station
CYGNA	CYGNA Energy Services
DAP	Design Adequacy Program (CPRT)
DBCP	Design Basis Consolidation Program (SWEC-PSAS)
DBD	Design Basis Document
DCA	Design Change Authorization
DIR	Discrepancy/Issue Resolution Report (CPRT-DAP)
DR	Deviation Report
DSAP	Discipline Specific Action Plan (CPRT)
DVP	Design Validation Package
DWG	Design Drawing
EA	Engineering Assurance (SWEC)
Ebasco	Ebasco Services Incorporated
EFE	Engineering Functional Evaluation
FSAR	Final Safety Analysis Report
FVM	Field Verification Method
GIR	Generic Issues Report
HELB	High-Energy Line Break
HVAC	Heating, Ventilation, and Air-Conditioning
IAP	Independent Assessment Program (CYGNA)
IEB	Inspection and Enforcement Bulletin (NRC)
Impell	Impell Corporation
ISAP	Issue-Specific Action Plan (CPRT)
IWA	Integral Welded Attachment
LOCA	Loss-of-Coolant Accident
MELC	Moderate Energy Line Crack
NCR	Nonconformance Report
NOV	Notice of Violation (NRC)
NRC	United States Nuclear Regulatory Commission

NRR	Office of Nuclear Reactor Regulation (NRC)
NSSS	Nuclear Steam Supply System (Westinghouse)
NUREG	NRC Document
NUREG/CR	NRC Document Developed by NRC Contractor
PCHVP	Post-Construction Hardware Validation Program
PM	Project Memorandum
PSAS	Pipe Stress Analysis and Support
PSR	Project Status Report
PWR	Pressurized Water Reactor
QA	Quality Assurance
QAAD	Quality Assurance Auditing Division (SWEC)
QC	Quality Control
QOC	Quality of Construction and QA/QC Adequacy Program (CPRT)
RIL	Review Issue List (CYGNA)
SDAR	Significant Deficiency Analysis Report (TU Electric)
SER	Safety Evaluation Report (NRC, NUREG-0797)
SIT	Special Inspection Team (NRC Staff)
SRT	Senior Review Team (CPRT)
SRT-NRC	Special Review Team (NRC)
SSE	Safe Shutdown Earthquake
SSER	Supplemental Safety Evaluation Report (NRC, NUREG-0797)
SWEC	Stone & Webster Engineering Corporation
SWEC-PSAS	Stone & Webster Engineering Corporation - Pipe Stress and Support Project
TAP	Technical Audit Program (TU Electric)
TERA	TENERA, L. P.
TET	Thermal Expansion Testing
TRT	Technical Review Team (NRC Staff, SSERs 7-11)
UT	Ultrasonic Testing
VMG	Vibration Monitoring Group
VPB	Vendor Program Branch (NRC)

1.0 INTRODUCTION

In October 1984, TU Electric established the Comanche Peak Response Team (CPRT) to evaluate issues that have been raised at CPSES and to prepare a plan for resolving those issues. The Comanche Peak Response Team (CPRT) program plan was developed and submitted to the NRC.

In mid-1986, TU Electric performed a qualitative and quantitative review of the preliminary results of the Comanche Peak Response Team (CPRT) (References 79 and 84). This review identified that the Comanche Peak Response Team (CPRT) issues were very broad in scope and included each discipline. TU Electric decided that the appropriate method to correct the issues raised and to identify and correct any other issues that potentially existed at CPSES would be through one integrated program rather than a separate program for each issue. TU Electric decided to initiate a comprehensive Corrective Action Program (CAP) (Reference 49) to validate the entirety of CPSES safety-related designs.[1,2] The scope of the Corrective Action Program (CAP) has the following objectives:

- Demonstrate that the design of safety-related systems, structures and components complies with licensing commitments.
- Demonstrate that the existing systems, structures and components are in compliance with the design; or develop modifications which will bring systems, structures, and components into compliance with design.
- Develop procedures, an organizational plan, and documentation to maintain compliance with licensing commitments throughout the life of CPSES.

The Corrective Action Program (CAP) is thus a comprehensive program to validate both the design and the hardware at CPSES, including resolution of specific Comanche Peak Response Team (CPRT) and external issues.

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[1]Portions of selected nonsafety-related systems, structures and components are included in the Corrective Action Program (CAP). These are Seismic Category II systems, structures and components, and Fire Protection Systems.

[2]Nuclear Steam Supply System (NSSS) design and vendor hardware design and their respective QA/QC programs are reviewed by the NRC independently of CPSES, and are not included in the Corrective Action Program (CAP) as noted in SSER 13; however, the design interface is validated by the CAP.

TU Electric contracted and provided overall management to Stone & Webster Engineering Corporation (SWEC), Ebasco Services Incorporated (Ebasco), and Impell Corporation (Impell) to implement the Corrective Action Program (CAP) and divided the CAP into eleven disciplines as follows:

Discipline	Responsible Contractor
Mechanical	SWEC
-Systems Interaction	Ebasco
-Fire Protection	Impell
Civil/Structural	SWEC
Electrical	SWEC
Instrumentation & Control	SWEC
Large Bore Piping and Pipe Supports	SWEC-PSAS
Cable Tray and Cable Tray Hangers	Ebasco/Impell
Conduit Supports Trains A,B, & C >2"	Ebasco
Conduit Supports Train C ≤ 2"	Impell
Small Bore Piping and Pipe Supports	SWEC-PSAS
Heating, Ventilating, and Air Conditioning (HVAC)	Ebasco
Equipment Qualification	Impell

A Design Basis Consolidation Program (DBCP) (Reference 30) was developed to define the methodology by which SWEC - Pipe Stress and Support Project (SWEC-PSAS) performed the design and hardware validation. The approach of this DBCP is consistent with other contractors' efforts and products.

The design validation portion of the Corrective Action Program (CAP) identified the design-related licensing commitments. The design criteria were developed from the licensing commitments and consolidated in the Design Basis Documents (DBDs) (References 1, 2, 3, 61, and 62). The DBDs identify the design criteria for the design validation effort. If the existing design did not satisfy the design criteria, it was modified to satisfy the criteria. The design validation effort for each of the eleven Corrective Action Program (CAP) disciplines is documented in Design Validation Packages (DVPs). The Design Validation Packages (DVPs) provide the documented assurance (e.g., calculations and drawings) that the validated design meets the licensing commitments, including resolution of all Comanche Peak Response Team (CPRT) and external issues.

The design validation effort revised the installation specifications to reflect the validated design requirements. The validated installation specifications also contain the inspection requirements necessary to assure that the as-built hardware complies with the validated design.

The hardware validation portion of the Corrective Action Program (CAP) is implemented by the Post-Construction Hardware Validation Program (PCHVP), which demonstrates that existing systems, structures, and components are in compliance with the installation specifications (validated design), including the modifications that are necessary to bring the hardware into compliance with the validated design.

The results of the performance of the Corrective Action Program (CAP) for each discipline are described in a Project Status Report (PSR). This Project Status Report (PSR) describes the results for the Small Bore Piping and Pipe Supports - Corrective Action Program (CAP).

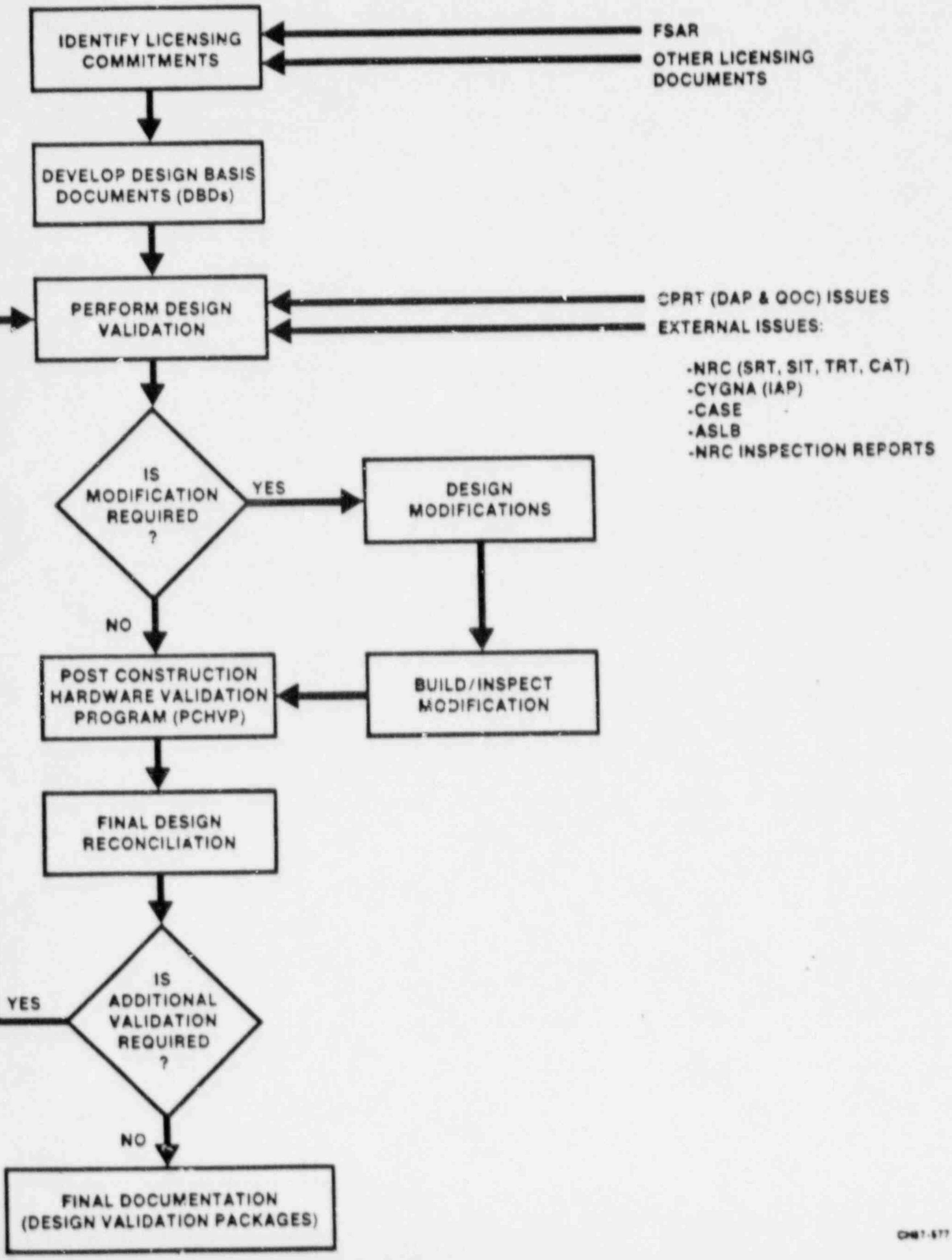
SWEC-PSAS has performed a comprehensive design validation of safety-related small bore piping and pipe supports for Comanche Peak Steam Electric Station (CPSES) in order to demonstrate that the design of piping systems and supports complies with licensing commitments, and is performing the Post-Construction Hardware Validation Program (PCHVP) to demonstrate that the as-built piping and pipe supports comply with the validated design. SWEC-PSAS was initially contracted by TU Electric in 1985 to validate small bore piping and pipe supports at CPSES. When the TU Electric Corrective Action Program was created in 1986, it incorporated and expanded the existing SWEC-PSAS program. The validation process is conducted in accordance with the Piping - Design Basis Consolidation Program (Piping-DBCP), which controls implementation of the piping portion of the TU Electric Corrective Action Program (CAP). The Small Bore Piping and Pipe Supports - Corrective Action Program (CAP) encompassed the Comanche Peak Response Team Action Plan DSAP IX, Piping and Pipe Supports Discipline Specific Action Plan (CPRT-DSAP IX) (Reference 4). The Small Bore Piping and Pipe Supports - Corrective Action Program (CAP), shown schematically in Figure 1-1, was developed by SWEC-PSAS to implement the corrective actions for the small bore piping and pipe supports discipline following the directions specified in the TU Electric's Corrective Action Program (CAP). The design bases of the Small Bore Piping and Pipe Supports - Corrective Action Program (CAP) are contained within a consolidated set of CPSES Design Basis Documents (DBDs) for safety-related piping and pipe supports.

Validation of the CPSES small bore piping and pipe supports is accomplished by pipe stress and pipe support analyses and implementation of required field modifications. The results and the methodology used in implementing both the design and hardware-related validations for Unit 1 and Common small bore piping and pipe supports are presented in this Project Status Report (PSR).

This Small Bore Piping and Pipe Supports Project Status Report (PSR) represents a road map of the validation effort from the early stages of design criteria development through the establishment and implementation of the detailed design and design control procedures. The report traces the updating of design/installation specifications, construction and Quality Control (QC) procedures, the implementation of the Post-Construction Hardware Validation Program (PCHVP) to validate the as-built piping and pipe support design, and the completion of the Unit 1 and Common small bore pipe stress analysis packages and pipe support calculations.

FIGURE 1-1

SMALL BORE PIPING AND PIPE SUPPORT CORRECTIVE ACTION PROGRAM (CAP)



2.0 PURPOSE

The purpose of this Proj . Status Report (PSR) is to demonstrate that the safety-related small bore piping and pipe supports in Unit 1 and Common are in conformance with the CPSES licensing commitments, satisfy the design criteria, and will satisfactorily perform their safety-related functions.

3.0 SCOPE

The scope of the Corrective Action Program (CAP) implemented for CPSES Unit 1 and Common small bore piping and pipe supports as summarized in this Project Status Report (PSR) includes:

1. Seismic Category I[1]

   - ASME Section III Code Class 1, 2, and 3 piping and pipe supports.

2. Seismic Category II[2]

   - Piping and supports required to be included as extensions of a Seismic Category I Pipe Stress Analysis Package.
   - Piping and supports of high and moderate energy lines which are computer analyzed (for break and crack postulation purposes).
   - Other piping and supports as defined in the CPSES FSAR (Reference 26), the failure of which could cause damage to Seismic Category I structures, systems, or components.

The CPSES Piping and Pipe Supports Corrective Action Program (CAP) is shown schematically in Figure 1-1 and discussed below. The program requires:

1. Establishment of small bore piping and pipe support design criteria which comply with licensing commitments.

2. Development of the Design Basis Documents (DBDs) for CPSES small bore piping and pipe supports, which contain the design criteria. These

[1]Structures, systems, and components that are designed and constructed to withstand the effects of the Safe Shutdown Earthquake (SSE) and remain functional are designated as Seismic Category I in accordance with the requirements of NRC Regulatory Guide 1.29 (Reference 78). All ASME Section III Code Class 1, 2, and 3 piping and pipe supports in CPSES are Seismic Category I.

[2]Those portions of structures, systems, or components whose continued function is not required, but whose failure could reduce the functioning of any Seismic Category I system or component required to satisfy the requirements of Regulatory Guide 1.29 to an unacceptable safety level or could result in incapacitating injury to occupants of the control room, are designated Seismic Category II and are designed and constructed so that the Safe Shutdown Earthquake (SSE) would not cause such failure.

Design Basis Documents (DBDs) provide the basis for corrective and preventive actions through the life of the plant. These documents also identify the updated design/installation specifications, Quality Control (QC)/Construction procedures, and technical and design control procedures used in the validation process.

3. Implementation of design and hardware validations, consisting of analysis, identification and implementation of necessary modifications, and field verifications as identified in the Post-Construction Hardware Validation Program (PCHVP). The as-built design of all small bore piping and pipe supports is validated by Quality Control (QC) inspections, engineering walkdowns, and engineering evaluations. Analysis results are documented in Small Bore Piping Design Validation Packages (DVPs).

4. Resolution of the design and hardware-related issues of CPSES small bore piping and pipe supports and implementation of a corrective action plan for closure of these issues. These issues include external issues, Comanche Peak Response Team (CPRT) issues, and issues identified during the performance of the Corrective Action Program (CAP) (See Section 4.0).

5. The validated design documentation forms the basis for configuration control of CPSES small bore piping and pipe supports. The validated design documentation and updated procedures/specifications will be provided to TU Electric to facilitate operation, maintenance, and future modifications following issuance of an operating license.

Within Section 5.1, Section 5.1.1 describes the methodology by which the CPSES licensing commitments were identified, the design criteria were established, and the procedures were developed. These technical and design control procedures, in conjunction with the CPSES quality assurance procedures and design and installation specifications that were updated to meet the corrective actions for small bore piping and supports, are consolidated in the CPSES Design Basis Documents (DBDs).

Section 5.1.2 describes the design validation process, including the calculation input/output reviews and interface requirements with other disciplines, and the preoperational testing program.

Section 5.1.3 describes the Post-Construction Hardware Validation Program (PCHVP) process and the procedures for field verifications (inspections, engineering walkdowns, and engineering evaluations) required to be implemented to validate that the as-built small bore piping and pipe supports are in compliance with the design documentation.

Section 5.2 presents a summary of the design validation and Post-Construction Hardware Validation Program (PCHVP) results, including the hardware modifications resulting from the Corrective Action Program (CAP).

Section 5.3 describes the quality assurance program implemented for the validation process, including the SWEC Engineering Assurance audits, the Engineering Functional Evaluation (EFE) audits, and the TU Electric Technical Auditing Program audits.

Section 5.4 describes the SWEC-PSAS inputs to the TU Electric preventive actions including the training of TU Electric Comanche Peak Engineering (CPE) personnel and the transfer of a complete set of the validated design documentation and procedures to CPE. These procedures can provide the basis for CPSES configuration control throughout the life of the plant.

The design of the Unit 1 and Common small bore piping and pipe supports has been validated as follows:

Description	Number of Small Bore Pipe Stress Analysis Packages	Number of Pipe Supports
Unit 1 and Common - ASME Section III Code Class 2 and 3 (Seismic Category I)	455 (SWEC-PSAS)	6,626 (SWEC-PSAS)
Unit 1 and Common - ASME Section III Code Class 1 (Seismic Category I)	1 (Westinghouse) 1 (SWEC-PSAS)	3 (SWEC-PSAS) 7 (SWEC-PSAS)
TOTAL	457	6,636

Appendix A of this Project Status Report (PSR) describes the details of Corrective Action Program (CAP) resolution of the Comanche Peak Response Team (CPRT) and external issues.

Appendix B of this Project Status Report (PSR) describes the details of resolutions of issues identified during the performance of small bore piping and pipe supports Corrective Action Program (CAP). These issues are Significant Deficiency Analysis Reports (SDARs) (10CFR50.55(e)) (Reference 58) initiated by TU Electric.

Appendix C of this Project Status Report (PSR) describes the preventive action taken resulting from the implementation of the small bore piping and pipe supports Corrective Action Program (CAP).

4.0 SPECIFIC ISSUES

The small bore piping and pipe supports Corrective Action Program (CAP) resolved all the Comanche Peak Response Team (CPRT) issues, external issues, and issues identified during the performance of CAP. This section presents a listing of piping-related issues addressed in this Project Status Report (PSR). Technical review and resolution of external and Comanche Peak Response Team (CPRT) issues are described in Appendix A, including responses to the NRC staff evaluations within the CPSES Supplements to the Safety Evaluation Report (SER) (Reference 28). Resolutions and corrective action taken for issues identified during the performance of the Corrective Action Program (CAP) are described in Appendix B.

External issues were originally identified in the Large Bore Piping and Pipe Supports Generic Issues Report (GIR) (References 5 and 35). This Generic Issues Report (GIR) was transmitted to NRC, Citizens Association for Sound Energy (CASE), and CYGNA Energy Services (CYGNA). Comanche Peak Response Team (CPRT) contracted TENERA, L.P. (TERA) to perform the Third Party overview (Reference 79) for the completeness and adequacy of these issues/resolutions, and the overview of corrective actions implemented by SWEC-PSAS to resolve these issues. The results of these Third Party overviews are presented by TENERA, L.P. (TERA) in the Discipline Specific Results Report (Reference 46).

Comanche Peak Response Team (CPRT) and external issues are listed below (issue number corresponds to subappendix number in Appendix A):

Issue No.	Issue Title
A1	Richmond Inserts
A2	Local Stress in Piping
A3	Wall-to-Wall and Floor-to-Ceiling Supports
A4	Pipe Support/System Stability
A5	Pipe Support Generic Stiffness
A6	Uncinched U-Bolt Acting as a Two-Way Restraint
A7	Friction Forces
A8	AWS Versus ASME Code Provisions
A9	A500, Grade B, Tube Steel
A10	Tube Steel Section Properties
A11	U-Bolt Cinching
A12	Axial/Rotational Restraints
A13	Bolt Hole Gap
A14	OBE/SSE - Damping
A15	Support Mass in Piping Analysis
A16	Programmatic Aspects and QA Including Iterative Design
A17	Mass Point Spacing
A18	High-Frequency Mass Participation
A19	Fluid Transients
A20	Seismic Excitation of Pipe Support Mass
A21	Local Stress in Pipe Support Members

A22	Safety Factors
A23	SA-36 and A307 Steel
A24	U-Bolt Twisting
A25	Fischer/Crosby Valve Modeling/Qualification
A26	Piping Modeling
A27	Welding
A28	Anchor Bolts/Embedment Plates
A29	Strut/Snubber Angularity
A30	Component Qualification
A31	Structural Modeling for Frame Analysis
A32	Computer Program Verification and Use
A33	Hydrotest
A34	Seismic/Nonseismic Interface
A35	Other Issues
A36	SSER-8 Review
A37	SSER-10 Review
A38	SSER-11 Review
A39	CPRT Quality of Construction Review on Piping and Pipe Supports

Issues identified during the performance of the Corrective Action Program (CAP) are listed below (issue number corresponds to subappendix number in Appendix B):

Issue No.	Issue Title
B1	SDAR-CP-86-33, Stiffness Values for Class 1 Stress Analysis
B2	SDAR-CP-86-72, Small Bore Piping and Pipe Supports
B3	SDAR-CP-86-63, Pipe Support Installations
B4	SDAR-CP-86-67, Preoperational Vibration Test Criteria
B5	SDAR-CP-86-73, ASME Snubber Attachment Brackets

5.0 CORRECTIVE ACTION PROGRAM METHODOLOGY AND RESULTS

5.1 METHODOLOGY AND WORK PERFORMED

5.1.1 Licensing Commitments, Design Criteria, and Procedures

SWEC-PSAS reviewed the piping-related CPSES licensing documentation (such as the FSAR, NRC Regulatory Guides, NRC Inspection and Enforcement Bulletins, ASME Section III Code, and NRC/TU Electric correspondences) and identified licensing commitments related to the small bore piping and pipe supports. SWEC-PSAS established design criteria to assure compliance with the licensing commitments. The design criteria are documented in the Design Basis Documents (DBDs). SWEC-PSAS then developed design procedures which encompass the following:

- Design criteria
- Resolution of Comanche Peak Response Team (CPRT) and external issues
- SWEC's experience gained through the design of piping and pipe supports for several recently licensed and operating United States nuclear power plants
- Regulatory and Professional Society Guidance, such as applicable codes and standards; Welding Research Council Bulletin 300, Technical Positions on Criteria Establishment (Reference 13); and Sections 3.6, 3.7, and 3.9 of NUREG-0800 (Reference 7).

SWEC-PSAS Procedures CPPP-7 (Reference 8) and CPPP-6 (Reference 9) are the primary technical and design control procedures, respectively, for the small bore piping and pipe supports Corrective Action Program (CAP). CPPP-6 is supplemented by SWEC-PSAS Procedure CPPP-15 (Reference 80). CPPP-15 identifies three items unique to the small bore pipe stress analysis validation process:

- Identification of small bore pipe stress analysis package boundaries were validated by SWEC-PSAS Procedure CPSP-16 (Reference 82)
- Equivalent-static analysis was performed for small bore pipe stress analysis packages which have no supports (see Section 5.1.2.2)
- The review jointly performed by the pipe stress and pipe support engineers is not applicable to small bore pipe stress analysis packages which have no supports (see Section 5.1.2.2)

Engineering methodology, based on SWEC-PSAS experience, has been incorporated within the SWEC-PSAS procedures. A list of typical technical and design control practices that are specified within the SWEC-PSAS procedures is presented in Table 5-8.

The governing procedures implementing the Corrective Action Program (CAP) of small bore piping and pipe supports are shown in Figure 5-1. These procedures assure compliance with the design criteria and the resolution of the Comanche

Peak Response Team (CPRT) and external issues. Resolutions of these piping-related issues, whenever applicable, have been implemented for both the small bore and large bore piping and pipe supports Corrective Action Program (CAP).

To assure that the licensing commitments related to small bore piping and pipe supports have been identified, appropriate design criteria established, and procedures developed which comply with the design criteria, several audits and overviews were conducted by the SWEC Corporate Quality Assurance Program and the Comanche Peak Response Team (CPRT). SWEC Quality Assurance audits were performed as described in Section 5.3. The Comanche Peak Response Team (CPRT) overview of large bore piping and pipe supports was performed by TENERA, L.P. (TERA). The TENERA, L.P. (TERA) conclusions for large bore piping and pipe supports are discussed in detail in the TERA Discipline Specific Results Report: Piping and Supports (T&P-RR-P-001), Revision 1. In this report, TENERA, L.P. (TERA) states on page 1-2:

> "SWEC procedures were reviewed for compliance with applicable CPSES FSAR and licensing criteria. Licensing commitments applicable to CPSES were used to establish a listing of criteria which were then used to check SWEC procedures. The procedures were determined to be in compliance either with the existing criteria or criteria changes that were accepted by the NRC for submittals as FSAR amendments (see NRC letter to TUGCO dated November 4, 1986, Reference 7.4.)"

The small bore piping and pipe supports Corrective Action Program (CAP) used the same technical and design control procedures as used in the large bore piping and pipe supports CAP.

The TU Electric Technical Audit Program (TAP) is performing an overview of the SWEC-PSAS Corrective Action Program (CAP) implementation and is auditing the CAP to assure that the design criteria are reconciled with the licensing commitments. In addition, CYGNA Energy Services (CYGNA) has reviewed and accepted SWEC-PSAS's resolution of piping and pipe supports issues that were identified by the Independent Assessment Program (IAP) of CYGNA.

5.1.1.1 Verification and Validation of Design Methodology

SWEC-PSAS performed two separate walkdowns of samples of Unit 1 and Common as-built piping systems to verify and refine the design methodology used for the design validation process. These walkdowns were performed by experienced SWEC-PSAS personnel and are described below.

The first walkdown, called the Small Bore Walkdown, was conducted in accordance with SWEC-PSAS Procedure CPPP-5 (Reference 14). The results of this walkdown are documented in References 15 and 83. The small bore piping walkdown was performed to determine whether the existing design documentation was adequate to initiate the pipe stress analyses. As a result of this walkdown, the existing design documentation was determined to be adequate to initiate pipe stress analyses.

The second walkdown, called the Engineering Walkdown, was performed in accordance with SWEC-PSAS Procedure CPPP-8 (Reference 10) to determine:

- Whether there were any additional technical issues related to the functional behavior of the piping system that should be evaluated during the Corrective Action Program (CAP).

- Whether additional design inputs (or refinements thereof), guidelines, or procedures were necessary to complete the small bore piping and pipe support validation effort.

The engineering walkdown was performed by 10 teams composed of both SWEC-PSAS pipe stress and pipe support engineers and encompassed 70 Unit 1 and Common large bore pipe stress analysis packages, including approximately 2,400 pipe supports. The results of this walkdown are documented in Reference 11. This walkdown identified the need for additional refinements that were then incorporated into the technical procedure, CPPP-7, and design control procedure, CPPP-6 (such as the requirement to validate the valve stem extension depicted on the as-built drawing, which was incorporated into CPPP-6, see also Table 5-8), which have also been implemented in the small bore piping and pipe supports Corrective Action Program (CAP).

The engineering walkdown resulted in assurance that no additional technical issues existed, and that the SWEC-PSAS procedures, with the refinements incorporated, were satisfactory to perform the validation of the small bore piping and pipe supports.

Evaluation of Deviation Reports from CPRT - Quality of Construction (QOC) Program

SWEC-PSAS reviewed Deviation Reports (DRs) related to the piping system validation program generated by the Quality of Construction (QOC) program of the Comanche Peak Response Team (CPRT), as discussed in Subappendix A39. This review was performed in accordance with SWEC-PSAS Procedure CPPP-18 (Reference 17). The purposes of the review were to determine 1) whether any changes were required to the inputs or the procedures that control the inputs to the SWEC-PSAS Piping and Pipe Supports Corrective Action Program (CAP) as a result of specific deviations or trends identified during the review, and 2) whether any additional programs, procedures, or changes to existing programs or procedures were required to enhance the inputs to the SWEC-PSAS Piping and Pipe Supports CAP. The review concluded (Reference 18) that no changes to the Piping and Pipe Supports CAP (which includes the PCHVP) in the form of programs or procedures were required to account for the Deviation Reports (DRs) identified by the Quality of Construction program (QOC). However, certain inspection attributes for piping and pipe supports were added to the piping and pipe supports Post-Construction Hardware Validation Program (PCHVP) inspection attributes matrix as a result of the Deviation Report (DR) reviews. Corrective action for the hardware-related concerns identified by the Quality of Construction program (QOC) or SWEC-PSAS, such as missing washers, spacers, and locking devices, is implemented through the TU Electric Post-Construction Hardware Validation Program (PCHVP) as described in Section 5.1.3.

5.1.1.2 Resolution of Piping-Related Design Issues

SWEC-PSAS evaluated the issues described in Section 4.0 and Appendixes A and B, and developed technical and design control procedures to resolve the issues. Resolutions of all issues in Appendix A were reviewed by TU Electric Comanche Peak Engineering (CPE), and the resolutions of issues in Subappendixes A1 through A35 were reviewed by TENERA, L.P. (TERA). The resolutions of the issues in Appendix B were reviewed by Comanche Peak Engineering (CPE) and the TU Electric Technical Audit Program (TAP). These resolutions were incorporated into the updated design and installation specifications, as well as the CPSES quality control and construction procedures.

The issue resolution and implementation processes were as follows:

1. For each issue that affected the small bore piping and pipe supports validation effort, SWEC-PSAS reviewed the associated documentation to gain an understanding of the background. SWEC-PSAS then defined its understanding of the issue.

2. With the issue thus defined, SWEC-PSAS developed and executed an action plan to resolve the issue.

3. The resolutions were implemented in appropriate SWEC-PSAS project procedures used for the CPSES Corrective Action Program (CAP). Compliance with these procedures is assured by the SWEC Corporate Quality Assurance program.

Third Party Overview Results

The methodology to resolve Comanche Peak Response Team (CPRT) and external issues was documented in SWEC-PSAS's Evaluation and Resolution of Generic Technical Issues Report dated June 27, 1986. Final revision to this Generic Issues Report (GIR) dated July 24, 1987, updates the resolution sections to encompass current revisions of SWEC-PSAS's procedures and memoranda, and its contents have been incorporated into Appendix A of this report.

TENERA, L.P. (TERA), the lead contractor for the Comanche Peak Response Team (CPRT) Design Adequacy Program (DAP), conducted the third party overview of the large bore piping and pipe supports to assure that all CPRT and external issues are clearly identified and resolved in accordance with the CPRT Discipline Specific Action Plan IX (DSAP-IX). The scope of third party overview included the completeness of issue identification, adequacy of issue resolution, and technical procedures implemented by SWEC-PSAS. During performance of Design Adequacy Program (DAP) overview, TENERA, L.P. (TERA) identified and documented issues in Discrepancy Issue Reports (DIRs). SWEC-PSAS has responded to and closed all of the 972 Discrepancy Issue Reports (DIRs) received from TENERA, L.P. (TERA).

TENERA, L.P. (TERA) has completed the third party overview of the large bore piping and pipe supports and presented the results in the Discipline Specific Action Plan Results Report for Piping and Pipe Supports. As described on page 2-1 of Reference 46, three areas of overview identified in the Discipline Specific Action Plan IX (DSAP-IX) are discussed as follows:

1. Issues

"The Third Party identified, reviewed, and tracked external source identified issues which were raised regarding pipe analysis and pipe support design. This effort also included consideration of TRT Issues ISAP V.c (Reference 7.5), which addresses design considerations for piping between seismic Category I and nonseismic Category I buildings. The criteria and methodology used by the Project (SWEC) for analysis of these systems were reviewed by the Third Party. This review provides reasonable assurance that the external source issues have been identified and that criteria and methodology used by the Project address all identified issues."

2. Commitment Verification

"The Third Party verified that commitments which establish piping and support-related design criteria and standards are adequately addressed in procedures and other Project documents. The commitment sources included the FSAR, design specifications, and the ASME Codes of Record for piping (Reference 7.6) and piping supports (Reference 7.7). For each criterion source and standard identified, the appropriate criteria and commitments were summarized. These criteria were used in the development of checklists for the review of specific program areas. This review ensures that Project procedures are consistent with applicable criteria and commitments.

Where criteria changes have been submitted by the project to resolve differences between the approved FSAR and Project procedures (documented on C-DIRs) closure is based on the assumption that the NRC will approve the amendments."

3. Procedure Review

"The Third Party reviewed procedures (including appropriate SWEC Project Management memoranda) developed by the Project (SWEC) for the performance of the SWEC scope involving large bore piping analysis and support design to verify, by evaluation of the supporting analyses, that they are adequate to achieve their intended purpose. This review verifies that the project procedures resolve the external source issues."

TENERA, L.P.'s (TERA) conclusion on the Third Party review of large bore piping and pipe supports is cited in their Discipline Specific Action Plan Results Report No. DAP-RR-P-001 on page 1-2.

"For each of the thirty-two issues, the resolution methodology has been reviewed by the Third Party and found to be responsive to the concern and in compliance with applicable FSAR and licensing criteria. The Third

Party has concluded that the overall objectives of the review have been met, and considers all piping-related external source issues applicable to the large bore piping scope to be closed with respect to the methodology being applied to the requalification effort assuming the NRC approves the FSAR amendments."

Small bore piping and pipe supports Corrective Action Program (CAP) used the same technical and design control procedures as used in large bore piping and pipe supports CAP.

CYGNA Independent Assessment Program

CYGNA Energy Services (CYGNA), a consulting firm, was originally contracted by TU Electric to perform a project review identified as the Independent Assessment Program (IAP). As a result of this review, CYGNA Energy Services (CYGNA) identified issues which they summarized in the CYGNA Pipe Stress Review Issues List, Revision 4 (Piping-RIL) (Reference 86) and the Pipe Support Review Issues List, Revision 4 (Supports-RIL) (Reference 16).

CYGNA Energy Services (CYGNA) and SWEC held public meetings on November 13 and 14, 1986, at SWEC's Cherry Hill office and December 15 and 16, 1986, at CPSES site to discuss the issue resolutions contained in the CYGNA Review Issue List (RIL) in conjunction with SWEC Project Procedures CPPP-7 and CPPP-6. CYGNA Energy Services (CYGNA) then performed audits on the basis of SWEC-PSAS design criteria between November 1986 and May 1987.

At the public meeting in Glen Rose, Texas, on May 19, 1987, CYGNA Energy Services (CYGNA) announced that all pipe stress and pipe support issues were closed. All issues relating to embedment plate design, anchorage allowables, spacing, and edge distances were transferred to the Civil/Structural Review Issues List, Revision 0, dated July 12, 1987 (Reference 19), and their resolution is reported in the Civil/Structural Project Status Report (PSR) (Reference 63).

5.1.2 Design Validation Process

The SWEC-PSAS design validation program assures that the design conforms to the licensing commitments. The program can be visualized as a three-step process. The first step, described in Section 5.1.2.1, is to establish the input and the analytical models of the pipe stress analysis packages, to identify and implement the necessary pipe support optimizations and modifications in the analyses, and to produce a set of pipe stress analysis results (e.g., pipe stresses, support loads, and equipment nozzle loads). The first-step results, described in Section 5.1.2.2, provide the pipe support design loads and determine that the computerized pipe stress analysis results are within the ASME Section III Code allowables. The second step includes the detailed evaluation and design of pipe supports (described in Section 5.1.2.3), the local stresses in piping (integral welded attachments), equipment nozzle and containment penetration loads, valve accelerations, pipe break locations, and floor-to-ceiling/wall-to-wall supports, as specified in SWEC-PSAS Procedures CPPP-15, CPPP-6 and CPPP-7. Discrepancies identified in this step are resolved either by support modifications or by additional analyses. The third step, or final reconciliation, described in Section 5.1.2.7, is the final process to consolidate analysis, hardware modifications, and inspection documentation from Step 2 into the piping design documentation. The technical interfaces and flow charts for the small bore piping and pipe supports Corrective Action Program (CAP) are shown schematically in Figures 5-2, 5-3, and 5-4.

5.1.2.1 Piping System Input Validation

The design validation process of piping and supports requires a large quantity of input information, as identified in Table 5-1. The SWEC-Mechanical Group and the SWEC-Civil/Structural Group validate the piping system input. The piping system input validation by SWEC and the design inputs developed by SWEC-PSAS are described below.

SWEC-Mechanical Group

The SWEC-Mechanical Group reviewed CPSES system design and operating conditions, which describe the temperatures and pressures of piping systems. These design and operating conditions are evaluated and revised as necessary based on the validated design. Design and operating system temperatures and pressures for a wide range of plant conditions were documented and transmitted to the SWEC-PSAS pipe stress analysts for use in validation. The SWEC-Mechanical Group validation effort is described in the Mechanical Project Status Report (PSR) (Reference 64). The SWEC-Mechanical Group identified essential[1] safety-related piping systems and components, high energy lines, and potential system fluid transients for evaluation by the SWEC-PSAS Fluid Transients Group. These fluid transients (such as quickly opening or closing control valves, relief valve discharge, pump startup or trip) were identified by following the guidance given in NUREG-0582 (Reference 23), using SWEC's past experience with other pressurized water reactors (PWRs), and by an overall review of the CPSES system design descriptions and flow diagrams.

The SWEC-Mechanical Group reviewed the CPSES flow diagrams and stress boundary isometric drawings (BRPs) to assure that applicable piping lines were included in the pipe stress analysis packages.

SWEC-PSAS Fluid Transient Group

The SWEC-PSAS Fluid Transient Group was responsible for developing the fluid transient loads (e.g., water hammer or steam hammer) from the potential transients identified by the SWEC-Mechanical Group. These loads were used to validate the design of safety-related piping systems. These efforts were necessary to address the issue of Subappendix A19. The fluid transient loads developed by SWEC-PSAS for safety-related piping are summarized in Table 5-2.

[1]Essential systems and components are required to shut down the reactor and mitigate the consequences of a postulated piping failure, without offsite power.

The fluid transient loads used for CPSES design validation process are documented as specified in CPPP-10 (Reference 21). Criteria for evaluation of the piping system responses due to fluid transient loads are described in CPPP-7.

SWEC-Civil/Structural Group

The SWEC-Civil/Structural Group has provided validated seismic Amplified Response Spectra (ARS), as discussed in Civil/Structural Project Status Report (PSR) (Reference 63).

5.1.2.2 Pipe Stress Analysis

Stress analysis of piping computes the responses (such as pipe stresses, loading on pipe supports, valve accelerations, and equipment nozzle loads) of a piping analytical model under the specified loading combinations (such as loads from deadweight, thermal, pressure, seismic, fluid transients, and Loss of Coolant Accident [LOCA]). In Unit 1 and Common, there are 457 small bore Seismic Category I and Seismic Category II pipe stress analysis packages with approximately 6,630 pipe supports.

SWEC-PSAS has validated 456 ASME Section III Code Class 1, 2, and 3 (Seismic Category I) pipe stress analysis packages. Westinghouse validated the other one ASME Section III Code Class 1 (Seismic Category I) pipe stress analysis package, including the continuation of Class 2 and nonsafety-related piping within the pipe stress analysis package boundary. The pipe stress validation flow chart is shown schematically in Figure 5.3.

SWEC-PSAS Piping and Pipe Support System Review

Prior to the initiation of the pipe stress analysis, each pipe stress analysis package, including the associated pipe supports, was jointly reviewed as a system by the pipe stress and pipe support engineers. The purposes of this review were to establish the piping physical configuration, to determine the location and orientation of the pipe supports with respect to the piping configuration, to evaluate the appropriateness of support types, and to identify areas of piping or pipe support designs which may require special modeling techniques to account for the interactions between the pipe and the pipe supports.

SWEC-PSAS reviewed the pipe support drawings and support location drawings to determine whether the existing supporting system was appropriate and could perform its safety-related function. SWEC-PSAS reviewed the pipe support drawings to determine the appropriate stiffness values for the input to the pipe stress analysis. The piping and pipe support system review also determined whether certain snubbers or other supports should be considered for elimination and whether additional pipe support optimization should be performed.

The results of this review were documented as a separate piping system review/stiffness assessment calculation for each pipe stress analysis package, which was used as design input for the pipe stress analysis. By the incorporation of this review into the validation process, SWEC-PSAS has assured that an integrated process, with consistent criteria for both pipe stress analysis

Piping Analytical Model

The first step in the pipe stress analysis is the formation of the pipe stress isometric drawings and mathematical models, which are developed by using the input information shown in Table 5-1, in conjunction with the results of the Piping and Pipe Support System Review.

The mathematical model analytically describes the piping configuration, mass, and boundary conditions. Piping mass is considered, including the applicable pipe support mass that affects the dynamic responses. Eccentric masses such as valve operators also are accounted for in the pipe stress analytical model. Sufficient mass points are included to assure that all significant dynamic modes are represented. Appropriate representation of pipe support stiffness from the piping and pipe support system review is included.

Static and dynamic piping analyses were performed using the computer program NUPIPE-SW (Reference 24). The computer program output consists of pipe stresses, displacements, valve accelerations, and interface loadings (e.g., loadings at pipe supports and equipment nozzles). This output was used to qualify the piping, pipe supports, and related components in accordance with the applicable codes and licensing commitments as specified in the governing Design Basis Documents (DBDs).

Static analysis was used for deadweight, thermal, and anchor movement loading cases. The time-history analysis method[2] was used for fluid transient loading cases, and the response spectrum analysis method[2] was used for seismic loading cases. Modal contributions above the cutoff frequency in the response spectrum method analyses were addressed by an analytical technique in accordance with NUREG/CR-1161 (Reference 25). This technique, which incorporated the resolution for the issues in Subappendix A18, assures that high frequency dynamic responses are included in the response spectrum analysis. For small bore cantilever vent and drain lines with no supports, standard and conservative equivalent static calculations can be performed in accordance with Section 4.1 of CPPP-15.

Based on the mathematical model and specified inputs, the computerized pipe stress analysis validates the following: the piping pressure boundary integrity, the piping system structural adequacy, and that maximum calculated stresses are within the specified code allowables.

Additional results (other than the computed pipe stresses) that were generated from the computerized pipe stress analysis and transmitted to other interfacing disciplines for acceptance (see Figure 5-3), are summarized as follows:

[2]Analytical technique used to determine the response of structures to dynamic loads.

Pipe Stress Analysis Results

1. Pipe support loads
2. Equipment nozzle loads
3. Containment penetration loads
4. Expansion joint movements
5. Valve accelerations
6. Valve operator support loads
7. Valve nozzle loads
8. Flange loads
9. Pipe movements at wall or floor sleeves
10. Instrument root valve movements
11. Pipe movements at pipe rupture restraints
12. Stress levels for pipe break/crack evaluations

Transmittal of Pipe Stress Analysis Results Package

Following completion of each pipe stress calculation, a results package that contains a summary of pipe stress analysis results was compiled and distributed to the SWEC-PSAS Pipe Support Group and other interfacing disciplines as shown in Figure 5-2. The results package, consisting of information such as the equipment nozzle loads and valve accelerations, was sent to other disciplines for acceptance. The pipe support summary transmittal identifies supports requiring modification and/or deletion and lists for each pipe support the support function, orientation, loads, and movements.

Integral Welded Attachment Analysis

A separate analysis was performed for each location on the piping which is fitted with an integrally welded pipe support attachment to assure that the local piping stress is within the allowable stress limit. For Integral Welded Attachments (IWAs) that could not be validated by the standard methods used by SWEC-PSAS for typical lug and trunnion configurations, the validation was based on finite element analysis techniques for the specific support, comparison to a similar specific support analysis, or comparison to a parametric finite element analysis study.

Pipe Break/Crack Analysis

As part of the CPSES licensing commitments, the locations of the postulated high energy line breaks (HELBs) and moderate energy line cracks (MELCs) have been evaluated and assessed using the validated results of SWEC-PSAS pipe stress analysis. Piping stresses, including the local pipe stress from Integrally Welded Attachment (IWA) pipe supports, were reviewed to postulate break and crack locations in accordance with SWEC-PSAS Procedure CPPP-20 (Reference 65). New mandatory break and crack postulation points were compared to previous locations, and the results were forwarded to the Ebasco Services Incorporated (Ebasco) - System Interaction Group to determine the impact. This impact may include elimination or addition of pipe rupture restraints or jet impingement shields, jet impingement system interaction studies, or reanalysis of the pipe stress if the consequences of the new postulated break locations are unacceptable. The evaluation results from System Interaction Group are described in the Mechanical Project Status Report (PSR).

Piping and Pipe Supports Attached to Secondary Walls

Special pipe stress analyses were performed in accordance with SWEC-PSAS Procedure CPPP-35 (Reference 59) to validate supports/penetrations that have been identified as being attached to a secondary wall.

5.1.2.3 Pipe Support Analysis

Based on the pipe support loads from the SWEC and Westinghouse stress analyses results (see Figures 5-3 and 5-4), individual calculations for all small bore pipe supports were prepared to assure code compliance with the design criteria. The pipe support validation process is shown schematically in Figure 5-4 and can be summarized as a process whereby the support analysis in conjunction with required modifications provide the final validation of the pipe support design.

Pipe support analysis results are distributed to the interface disciplines for acceptance as shown in Figure 5.4. The validated pipe support calculations and drawings are distributed and filed in accordance with project procedures and are included within each Piping - Design Validation Package (DVP).

The CPSES Unit 1 and Common small bore pipe supports can be categorized into four types as follows:

1. Standard Component Supports - Struts, spring hangers, and snubbers

2. Structural Frame Supports - Including supports for multiple pipes and modified rigid supports

3. Integrally Welded Attachment (IWA) Supports - Trunnions and lugs

4. Clamp Anchor Supports - Special type of pipe supports for small bore piping to provide translational and rotational restraints

Validation of these pipe support types is described below.

Standard Component Supports

Standard component supports were evaluated to assure that they are suitable to perform their design function. Loads from the pipe stress analysis were compared with the manufacturer's standard component support capacities. In addition, the relative displacements under all specified load conditions were evaluated to validate the displacement ranges and swing angles of standard components.

Structural Frame Supports

Frame type supports were validated by using hand calculations with standard structural analysis methods for simple designs or by computer analysis using

STRUDL, STRUDAT, and SANDUL computer programs (described in CPPP-7) for more complex designs. In addition to validating the adequacy of local stresses in the pipe, the validation included the evaluation of:

- Member stress versus applicable stress allowables
- Reactions at all support joints, including local stress effects on tube steel members
- Weld adequacy at welded joints
- Adequacy of bolted connections, including washer plate design and local stress effects on tube steel members
- Adequacy of concrete anchors and base plates
- Adequacy of clearances between piping and the frame

Special Pipe Support Frame Analysis

Two special groups of pipe support frames, (i) the wall-to-wall and floor-to-ceiling supports and (ii) corner supports, required special analysis to address the effects of differential building movement at the support attachment locations to the building and for restrained thermal expansion of the wall-to-wall and floor-to-ceiling supports. These designs are validated in accordance with the criteria contained in Attachment 4-19 of CPPP-7 in resolution of the external issue described in Subappendix A3.

Integral Welded Attachment Analysis

A separate analysis was performed for each location on the piping with an integrally welded pipe support attachment to assure that the local piping stresses and support member stresses are within the applicable stress allowables. The piping local stress is discussed in Section 5.1.2.2.

Clamp Anchors

Clamp anchors are used in small bore piping systems as an effective method to establish boundaries of pipe stress analysis packages. Standard clamp anchor designs have been established in CPPP-7. The pipe support engineers can specify a standardized and easy-to-install anchor in lieu of integral welded attachment.

5.1.2.4 Validation of Seismic Category II Small Bore Piping and Pipe Supports Over Seismic Category I Equipment

SWEC-PSAS developed a Field Verification Method (FVM) CPE-SWEC-FVM-PS-82 (Reference 52) to validate the integrity of seismic Category II piping and pipe supports in accordance with the FSAR and CPPP-30 (Reference 56). The purpose of this validation process is to provide additional assurance by engineering walkdown and evaluation that during or after a seismic event, Seismic

Category II piping systems identified in the FSAR will not fall and damage nearby Seismic Category I systems, structures, or components. This Field Verification Method (FVM) specifies the engineering field walkdowns necessary to assure that the as-built Seismic Category II piping and pipe supports are in compliance with the acceptance criteria. A detailed discussion of this validation process is contained in Section 5.1.3.1.

5.1.2.5 SWEC-PSAS Clearance Walkdowns

SWEC-PSAS developed a Field Verification Method (FVM) CPE-SWEC-FVM-PS-80 (Reference 50) to assure that sufficient clearance exists around validated piping in accordance with SWEC-PSAS Project Procedure CPPP-22 (Reference 32). Clearance is required to permit those anticipated piping displacements that could occur under plant operating conditions without any impediment to those displacements. Impediment is defined as any structure, system, or component (e.g., pipe, conduit, cable tray, equipment) that encroaches on the envelope of anticipated pipe displacement. A detailed discussion of this validation process is contained in Section 5.1.3.1.

5.1.2.6 Testing

The CPSES preoperational and startup testing program provides assurance that piping systems, components, supports, and related structures have been adequately designed and installed. The correctness or conservatism of assumptions made in predicting plant responses is validated by analyzing data obtained in a controlled testing environment.

The testing includes verification by observation and measurement (as appropriate) to assure that movement, vibration, and expansion of piping and components are acceptable for:

- ASME Section III Code Class 1, 2, and 3 piping systems.
- Other nonsafety-related high energy piping systems inside seismic Category I structures whose failure could reduce the functioning of any seismic Category I structure, system, or component.
- Seismic Category I portions of moderate energy piping systems located outside the containment.

The testing program consists of the following categories:

Vibration Testing

The CPSES vibration testing program is set forth in SWEC-PSAS Procedure CPPP-25 (Reference 57). This program follows the guidelines of NRC Regulatory Guide 1.68 (Reference 85) and ANSI/ASME Standard OM-3 (Reference 27) for steady state and transient vibration testing of piping systems. Piping systems are classified as Vibration Monitoring Group (VMG) VMG-1, VMG-2, or VMG-3, as defined in Reference 27. Piping systems which have no potential vibration problems are classified as VMG-3. If unexpected vibrations are observed during testing, additional inspections are performed to determine the degree of the problem and the resolution.

If a piping system is identified as posing a potential vibration problem, the affected portion of the system is classified as Vibration Monitoring Group 2 (VMG-2). This piping will be instrumented during testing to provide a means for ascertaining the maximum vibration response.

Piping systems which exhibit a response not characterized by simple piping vibration modes, and piping systems for which the methods of Vibration Monitoring Group 2 (VMG-2) and Vibration Monitoring Group 3 (VMG-3) are not applicable, are classified as Vibration Monitoring Group 1 (VMG-1). In these cases, more refined monitoring methods are utilized during testing.

All personnel who perform pipe vibration observations and measurements receive training and must pass a written certification examination (Reference 53).

The vibration data is analyzed subsequent to collection. Transient vibration test data which does not meet the acceptance criteria established from CPPP-25 must be referred to SWEC-PSAS for further analysis and resolution. When appropriate, corrective action is implemented and retesting is conducted to verify final acceptance.

For steady-state pipe vibration, the vibration measurements are taken if vibration can be visually observed. When the measured peak-to-peak pipe velocity exceeds the acceptance criteria, displacement measurements are obtained and compared to calculated allowable values. If the system steady-state displacement exceeds the calculated allowable values, corrective action will be implemented and appropriate retesting will be conducted to verify final acceptance.

Thermal Expansion Testing

As part of the piping and pipe support validation program, SWEC-PSAS has reviewed the impact of analysis and modification on thermal expansion tests (TET). Systems or portions of systems which require testing have been identified.

SWEC-PSAS Procedure CPPP-24 (Reference 66) sets forth the methods for identifying piping for thermal expansion tests, for identifying the locations and the supports to be monitored, for establishing acceptance criteria, for reconciling results, and for recommending modifications to correct discrepancies. Upon completion of all thermal expansion tests, an engineering report will be prepared summarizing the results.

In summary, the CPSES piping and pipe support validation program encompasses appropriate field testing. Rigorous requirements for evaluating and documenting piping systems under static, dynamic steady-state and transient conditions are set forth in the SWEC-PSAS procedures. The results of field testing will provide physical confirmation that large bore piping and pipe support design and installation comply with the design criteria.

5.1.2.7 Final Reconciliation of Small Bore Piping and Pipe Supports

The purpose of final reconciliation is to resolve and incorporate pipe stress and pipe support analysis results (see Figure 1-1) with the final design input and as-built configuration. The final reconciliation process is conducted in accordance with SWEC-PSAS Procedure CPPP-23, Pipe Stress/Pipe Support Reconciliation Procedure (Reference 29). The final reconciliation of small bore piping and pipe supports incorporates the following:

- The Post-Construction Hardware Validation Program (PCHVP) results which provide the as-built small bore piping and pipe support configurations (see Section 5.1.3).

- Resolution of the open items in NRC Staff positions in Supplementary Safety Evaluation Reports (SSERs) as described in Subappendixes A36, A37, and A38.

- Resolution of the piping-related Comanche Peak Response Team (CPRT) issue-specific action plans (ISAPs) and external issues.

Final reconciliation also includes confirmation that the interfacing organizations have accepted the SWEC-PSAS results as compatible with their validated design. Interfacing organizations receive results as described below and in Figure 5-2:

- SWEC-Mechanical Group - Required reflective insulation removal at sleeves, penetrations, or frame supports; expansion joint movements.

- Ebasco System Interaction Group - Postulated pipe break locations; pipe movements at pipe rupture restraint locations.

- Westinghouse - Results of ASME Section III Code Class 1 pipe supports validation, loads imposed by SWEC-PSAS analyzed piping on ASME Section III Code Class 1 piping, support reaction loads on Westinghouse-designed equipment supports, and valve accelerations and equipment nozzle loads for Westinghouse-supplied valves and equipment.

- SWEC-Civil/Structural Group - Structural interface reaction loads, including penetration loads, load patterns on embedments.

- Impell Equipment Qualification Group - Valve nozzle loads, valve accelerations and valve operator support requirements, and pipe movements at sealed sleeves.

- SWEC-Instrument and Control Group - Root valve movements for instrument systems.

In addition, the validated piping weld locations are provided to TU Electric for the identification of locations for preservice and inservice inspections.

Closure of open items, observations, and deviations related to small bore piping and pipe supports that were identified by TU Electric Quality Assurance, SWEC Engineering Assurance, and Engineering Functional Evaluation (EFE) are resolved prior to the completion of this reconciliation phase. Open items from the NRC Notices of Violation (NOVs), and the TU Electric Significant Deficiency Analysis Reports (SDARs) (10CFR50.55[e]) are also resolved during the final reconciliation.

Each pipe stress analysis package, at the conclusion of final reconciliation, will be compiled into the Piping - Design Validation Package (DVP) as described in Section 3.0 and SWEC-PSAS Procedure CPPP-23. The Piping-DVP consists of the pipe stress analysis calculations, the hanger location drawings (identifying the pipe support locations and stress problem boundaries), the pipe supports calculations and drawings (including the design changes and as-built modifications) within its pipe stress analysis package boundary, and related interface transmittals.

5.1.3 Post-Construction Hardware Validation Program (PCHVP)

The Post-Construction Hardware Validation Program (PCHVP) (Reference 48) is the portion of TU Electric's Corrective Action Program (CAP) which validates the final acceptance attributes for safety-related hardware. The Post-Construction Hardware Validation Program (PCHVP) process is shown diagrammatically in Figure 5-5.

The input to the Post-Construction Hardware Validation Program (PCHVP) is contained in the installation specifications. The installation specifications implement the licensing commitments and design criteria of the Design Basis Documents (DBDs), which were developed during the Corrective Action Program (CAP) Design Validation process.

Acceptance inspection requirements identified in the validated installation specifications were used to develop the Post-Construction Hardware Validation Program (PCHVP) attribute matrix. This matrix is a complete set of final acceptance attributes identified for installed hardware. The Post-Construction Hardware Validation Program (PCHVP), by either physical validations or through an engineering evaluation methodology, assures that each of the attributes defined in the attribute matrix is validated.

Physical validation of an attribute is performed by Quality Control inspection or engineering walkdown, for accessible components. Quality Control inspections and engineering walkdowns are controlled by appropriate Field Verification Method (FVM) procedures.

The Post-Construction Hardware Validation Program (PCHVP) engineering evaluation depicted in Figure 5-5 is procedurally controlled to guide the Corrective Action Program (CAP) responsible engineer through the evaluation of each item on the attribute matrix to be dispositioned by the engineering evaluation method. Dispositions of each attribute will be clearly documented. If the technical disposition of the final acceptance attribute is "not acceptable" or the attribute cannot be dispositioned based on available information, an alternate plan consisting of additional evaluations, testing, inspections/walkdowns or modification as necessary will be developed to demonstrate and document the acceptability of the attribute.

Recommendations from the Comanche Peak Response Team (CPRT) effort comprise a significant portion of this evaluation. A major component of the Comanche Peak Response Team (CPRT) program has been the inspection of a comprehensive, random sample of existing hardware using an independently derived set of inspection attributes. The inspection was performed and the results evaluated by third party personnel in accordance with Appendix E to the Comanche Peak Response Team (CPRT) Program Plan (Reference 33). The scope of the inspection covered the installed safety-related hardware by segregating the hardware into homogeneous populations (by virtue of the work activities which produced the finished product). Samples of these populations were inspected to provide reasonable assurance of hardware acceptability in accordance with Appendix D to the Comanche Peak Response Team (CPRT) Program Plan.

Corrective action recommendations were made to TU Electric based on the evaluated findings when a Construction Deficiency existed, an Adverse Trend existed, or an Unclassified Trend existed, as defined in accordance with Appendix E to the Comanche Peak Response Team (CPRT) Program Plan.

The Post-Construction Hardware Validation Program (PCHVP) assures that all Comanche Peak Response Team (CPRT) recommendations are properly dispositioned.

Figure 5-5 illustrates that during the evaluation of a given attribute from the Post-Construction Hardware Validation Program (PCHVP) attribute matrix, the initial task of the Corrective Action Program (CAP) responsible engineer is to determine if any of the following statements are true:

a. The attribute was recommended for reinspection by the Comanche Peak Response Team (CPRT).

b. Design Validation resulted in a change to design or to hardware final acceptance attribute that is more stringent than the original acceptance attribute, or Comanche Peak Response Team (CPRT) did not inspect the attribute.

c. Design Validation resulted in new work, including modification to existing hardware.

If the Comanche Peak Response Team (CPRT) had no recommendations and Items b or c above do not apply, the attribute under consideration will be accepted. This conclusion is justified by the comprehensive coverage of the Comanche Peak Response Team (CPRT) reinspection and the consistently conservative evaluation of each finding from both a statistical and adverse trend perspective. The attribute matrix is then updated to indicate that neither the engineering walkdown nor quality control inspection of the attribute is necessary. A completed evaluation package is prepared and forwarded to the Comanche Peak Engineering (CPE) organization for concurrence. The evaluation package becomes part of the Design Validation Package (DVP) after Comanche Peak Engineering (CPE) concurrence is obtained.

If any of the three statements are true, it is assumed that the final acceptance attribute must be further evaluated as follows:

Determine Attribute Accessibility

The Corrective Action Program (CAP) responsible engineer will determine if the attribute is accessible. If the attribute is accessible, a field validation of the item's acceptability will be performed and documented in accordance with an approved Field Verification Method (FVM).

If the Corrective Action Program (CAP) responsible engineer reaches the conclusion that the attribute is inaccessible, an engineering evaluation will be conducted by technical disposition of available information.

After completing the attribute accessibility review, the responsible engineer will update the attribute matrix as necessary to reflect the results of that review.

Technical Disposition

The Corrective Action Program (CAP) responsible engineer identifies the data to be considered during the subsequent technical disposition process. Examples of such items used in this disposition may include, but are not limited to:

- Historical documents (e.g., specifications, procedures, inspection results)
- Comanche Peak Response Team (CPRT) and external issues
- Construction practices
- Quality records
- Test results
- Audit reports
- Authorized Nuclear Inspector (ANI) records
- Surveillance reports
- NCRs, DRs, SDARs, and CARs
- Inspections conducted to date

- Results of Third Party reviews

- Purchasing documents

- Construction packages

- Hardware receipt inspections

After compiling the data identified as pertinent to the attribute, the technical disposition will be performed. The actual steps and sequence of actions required for each technical disposition will differ; however, the tangible results from each technical disposition will be consistent. These results will include as a minimum:

a. A written description of the attribute.

b. A written justification by the Corrective Action Program (CAP) responsible engineer for acceptance of the attribute.

c. A written explanation of the logic utilized to conclude that the attribute need not be field validated.

d. A chronology demonstrating that the attribute has not been significantly altered by redesign.

e. All documents viewed to support the disposition.

f. Concurrence of the acceptance of the attribute's validity by Comanche Peak Engineering (CPE).

If the Corrective Action Program (CAP) responsible engineer concludes that the data evaluated represents evidence of the attribute's acceptability, the conclusion will be documented. The documentation will be reviewed and approved by Comanche Peak Engineering (CPE) and filed in the Design Validation Package (DVP). If the Corrective Action Program (CAP) responsible engineer determines that the data reviewed does not provide evidence of the attribute's acceptability, the documentation will explain why the attribute cannot be accepted and recommend an alternate course of action. The alternate course of action may take various forms such as making the attribute accessible and inspecting it, or testing to support the attribute's acceptability. This alternate plan, after approval by Comanche Peak Engineering (CPE), will be implemented to validate the attribute.

In summary, the Post-Construction Hardware Validation Program (PCHVP) is a comprehensive process by which each attribute in the PCHVP attribute matrix is validated to the validated design. The TU Electric Technical Audit Program (TAP) will audit the Post-Construction Hardware Validation Program (PCHVP). This audit program is complemented by the Engineering Functional Evaluation being performed by an independent team comprised of Stone & Webster, Impell, and Ebasco engineering personnel working under the Stone & Webster QA Program and subject to oversight directed by the Comanche Peak Response Team's (CPRT)

Senior Review Team. The Post-Construction Hardware Validation Program (PCHVP) will provide reasonable assurance that the validated design has been implemented for safety-related hardware.

SWEC-PSAS prepared Post-Construction Hardware Validation Program (PCHVP) implementation procedures for small bore piping and pipe supports. The hardware validation process includes modifications, whenever necessary, to bring the piping and pipe supports into compliance with the validated design. The attributes contained within the Post-Construction Hardware Validation Program (PCHVP) Attribute Matrix for piping and pipe supports incorporate the recommended corrective actions in the CPRT-QOC Issue-Specific Action Plan, ISAP-VII.c Results Report (Reference 36), thus resolving the hardware-related issues (see Subappendix A39). The complete tabulation of piping-related inspection attributes to address CPRT-QOC recommendations is presented in Table 5-3.

5.1.3.1 Post-Construction Hardware Validation Program (PCHVP) Procedures

SWEC-PSAS developed procedures to validate that the as-built small bore piping and pipe supports are in compliance with the validated design procedures listed in Table 5-6. These procedures are designated as Field Verification Methods (FVMs) and are described below.

FVM-81, Piping and Pipe Supports Inspection and Hardware Validation

SWEC-PSAS developed the Field Verification Method (FVM) CPE-SWEC-FVM-PS-81 (Reference 51) to coordinate the Unit 1 and Common piping and pipe support inspection validation activities.

These piping inspections are performed and documented by Quality Control (QC) personnel to assure that applicable inspection attributes are acceptable. The piping inspection attributes are as below.

Equipment and piping configuration
Piping wall thickness at shop/field bends
Radial weld shrinkage at stainless steel piping joints
Equipment anchoring
Remote valve operators
Branch connections
All pressure boundary items installation/base metal defects
Valve orientations
Pipe/sleeve details
Permanent pipe support installation (no temporary or voided supports)
Verify location (span) dimensions/tolerances
Applicable dielectric insulating sleeves over bolts/studs
Linear dimensions of piping segments and in-line components

The hardware validation of pipe supports assures that the removable items on a pipe support are installed as required by the design documentation. The hardware validation is implemented by Quality Control (QC) personnel in compliance with the validated support drawing. Quality Control personnel verify and document that all applicable hardware attributes listed on the hardware validation checklists are acceptable. The following pipe support hardware validation checklists are used, as applicable:

- Adjacent Weld Checklist
- Bolted Connection Checklist
- Hilti Bolt Checklist
- Pipe Clamp Checklist
- Richmond Insert Checklist
- Snubber Checklist
- Support Checklist
- Sway Strut Checklist
- Through Bolt/Embedded Bolt Checklist
- U-Bolt/Bolted U-Guide Checklist
- Variable/Constant Spring Checklist

In addition to the hardware validation pipe support inspections, Quality Control (QC) personnel also conduct inspections for pipe support configuration attributes as below:

- Material acceptability
- Support configuration compliance with validated design drawing, including dimensions
- Support overhang length/tolerance
- Support projection length/tolerance
- Sway strut/snubber pin-to-pin dimension/tolerance
- Alignment and circumferential deviation of shear lugs
- Hilti bolt size/embedment
- Weld length of structural member on base plate
- Welded connection in accordance with validated drawing
- Edge distance for structural members and base plates
- Slope of bolted part with bolt head or nut
- Shim size/weld

FVM-080, Clearance Walkdowns

SWEC-PSAS developed the Field Verification Method (FVM) CPE-SWEC-FVM-PS-80 (Reference 50) to assure that sufficient clearance exists around the validated piping. Clearance is required to permit those anticipated piping displacements that could occur under plant operating conditions without any impediment to those displacements. An impediment is defined as any structure, pipe, conduit, cable tray, equipment, etc, that encroaches on the envelope of anticipated pipe displacement.

This field verification effort is performed by the SWEC-PAS engineering personnel. SWEC-PSAS has established clearance criteria and is responsible for training the clearance walkdown teams, evaluating clearance problems, and issuing design changes to correct any clearance violations, as follows:

1. SWEC-PSAS Site Engineering Group shall establish and train the clearance walkdown teams, consisting of a stress engineer, a pipe support engineer, and others as required.

2. Displacement and clearance criteria established by other disciplines will be used in the walkdown (e.g., conduit displacements, equipment displacements, proximity of heat sources), as applicable.

3. A table will identify each pipe stress analysis package and the associated maximum displacements for other components, such as equipment, conduit, cable trays, piping, and pipe supports.

4. An engineering walkdown is being performed for each pipe stress analysis package to validate the as-built clearances acceptance criteria. A Clearance Evaluation Form shall be completed for each violation of the clearance criteria.

Quality Control (QC) personnel will periodically accompany the SWEC-PSAS engineering walkdown teams and perform surveillance inspections to assure compliance with the Field Verification Methods (FVMs).

FVM-82, Validation of Seismic Category II Small Bore Piping and Pipe Supports Over Seismic Category I Equipment

SWEC-PSAS developed the Field Verification Method (FVM) CPE-SWEC-FVM-PS-82 (Reference 52) to validate the integrity of seismic Category II piping and pipe supports over Seismic Category I equipment as specified in the FSAR and CPPP-30. The purpose of this Field Verification Method (FVM) is to assure, by engineering inspection and evaluation, that during or after a seismic event, the Seismic Category II piping systems as identified in the FSAR will not fall and damage nearby Seismic Category I systems, structures, or components. This Field Verification Method (FVM) specifies the engineering field walkdowns required to assure that the installation of the piping and pipe supports is in compliance with the validated design.

The field verification effort is performed by SWEC-PSAS engineering personnel using the acceptance criteria for the configuration of the supports and the tolerances specified in Piping Erection Specification No. 2323-MS-100 (Reference 38). Tables 5-5 and 5-7 contain the piping and pipe supports checklists for this field verification effort.

Quality Control (QC) personnel will periodically accompany the SWEC-PSAS engineering walkdown teams and perform surveillance inspections to assure compliance with the Field Verification Methods (FVMs).

5.2 RESULTS

This section discusses the results of the SWEC-PSAS Small Bore Pipe Stress and Pipe Support Corrective Action Program (CAP).

5.2.1 Pipe Stress Analysis Results

The pipe stress analysis packages validated by SWEC-PSAS are within the allowable stress criteria of the ASME Section III Code.

The pipe stress analysis results are described below.

- Pipe Support Optimization (As a Result of Pipe Stress Design Validation Process)

  A total of 160 snubber supports were deleted through the pipe support optimization process. Approximately 90 additional snubber supports were converted to rigid supports, bringing the total number of snubbers eliminated for Unit 1 and Common to 250. This large reduction of snubbers (approximately 36 percent of the original total) is part of the overall plant improvement incorporated into the SWEC-PSAS validation effort. It represents a significant improvement in plant reliability and reduction in inservice inspection, worker radiation exposure, and cost of maintenance.

- Integral Welded Attachments (IWAs)

  All Integral Welded Attachments (IWAs) in small bore pipe stress analysis packages within Unit 1 and Common were analyzed, and 3 require modification.

- Pipe Rupture Analysis

  High energy piping arrangement in CPSES Unit 1 and Common utilized the design criteria of postulated pipe ruptures protection by physical separation. Consequently, of the 457 small bore pipe stress packages, pipe rupture analyses are required for 21 high energy and 2 moderate energy small bore pipe stress analysis packages. These stress analyses were analyzed with the following results:

  High Energy Line Break (HELB) Postulation - No mandatory postulated intermediate breaks were identified.

  Moderate Energy Line Crack (MELC) Postulation - A total of one mandatory postulated crack was identified.

- Piping and Pipe Supports Attached to Secondary Walls

  The piping and pipe support validation procedure for secondary wall displacements, CPPP-35 was used to qualify 202 small bore pipe supports/penetrations that have been identified as being attached to a secondary wall. Approximately 83 percent of these supports comply with the flexibility criteria of CPPP-35, and no further evaluation is required. Those supports which did not comply with the flexibility criteria affect 26 small bore pipe stress analysis packages in Unit 1 and Common. This validation requires no modifications of pipe supports that spanned secondary and primary walls within these small bore pipe stress analysis packages.

5.2.2 Pipe Support Analysis Results

The Pipe Support Analyses validated that approximately 6,630 pipe supports within the 457 small bore pipe stress analysis packages comply with the design criteria. During the SWEC-PSAS pipe support validation process, required support modifications were identified. The pipe support modifications are categorized as follows:

1. Prudent - Supports in this category may have been technically acceptable; however, more time and expense would have been involved in the detailed analysis than that required to physically modify the support and qualify the modification.

2. Recent Industry Practice - Modifications implemented to eliminate snubbers to enhance plant maintainability, reduce inservice inspection, and minimize worker radiation exposure during operating plant conditions.

3. Adjustment - Minor modifications (such as retorquing or shimming) implemented to meet installation criteria contained in the resolution of the CPRT and external issues.

4. Cumulative Effects - Modifications that are required due to the combined effect of previous issues.

From the results of the stress analysis, 449 supports were deleted and 315 supports were added (including the addition of 132 pipe anchors). The result of SWEC-PSAS pipe stress and support analysis has identified a total of 1,896 supports that require modification (including deletions and additions). Table 5-4 contains a description of the types of modifications by the above categories.

The plant modifications resulting from the Small Bore Pipe Stress and Support Corrective Action Program (CAP) has been determined by TU Electric to be reportable under the provisions of 10CFR50.55(e). TU Electric reported to the NRC the small bore piping modifications in the Significant Deviation Analysis Report SDAR-CP-86-72 (see Subappendix B2).

5.2.2.1 Pipe Support Modifications Identified Prior to Stress Analysis

The following types of pipe supports were identified for modification prior to stress analysis as a result of the resolution of the CPRT and external issues.

- Cinched U-Bolts on Single Struts or Snubbers

  To avoid lengthy detailed stress evaluations for the pipe, U-bolt, and crosspiece, all cinched U-bolts on single strut or snubber small bore pipe supports for Unit 1 and Common are identified for elimination or modification.

- Cinched U-Bolt Trapeze Supports

  All cinched U-bolt trapeze supports in Unit 1 and Common small bore pipe supports were identified for deletion or modification.

- Potentially Unstable Supports

  In addition to the cinched U-bolt supports, both single strut and trapeze, Project Procedure CPPP-7, Attachment 4-9, requires that potentially unstable supports be modified. Such configurations identified are trapeze supports with zero clearance box frames, spring hangers on trapeze, and spring hangers without a U-bolt. These supports were redesigned or identified for elimination during the validation process.

- Clearance on Rigid Supports

  The clearance between the pipe and the restraining surfaces for rigid restraints such as frames, straps, uncinched U-bolts and lugs is inspected and adjusted where required to meet the clearance requirements specified in Project Procedure CPPP-7, Attachment 4-11.

- Uncinched U-Bolts on Rigid Frames

  Uncinched U-bolts on rigid frames for pipe sizes 6 in. and smaller were analyzed and designed as two-way restraints in accordance with Project Procedure CPPP-7, Attachment 4-3.

- Single Tube Steel with Richmond Insert Bolts

  Supports with single tube steel Richmond insert connections loaded primarily in shear and/or torsion were identified for elimination or to be modified by the addition of "outriggers" to increase the rigidity of the support.

- Long Tube Steel with Richmond Insert Bolts

  Pipe supports with long tube steel anchored by Richmond inserts and subject to LOCA temperature effects were identified for elimination or to be modified by limiting the tube steel length. These supports were primarily "run together" multiple pipe supports.

5.2.2.2 Special Pipe Support Frame Results

Special analyses were required for certain supports to evaluate the effect of differential movement of the attachment points and/or restrained thermal expansion.

- Wall-to-Wall and Floor-to-Ceiling Supports

  Four wall-to-wall small bore pipe supports were identified in small bore pipe stress analysis packages within CPSES Unit 1 and Common. These supports were validated by meeting the requirements specified in Table 4.7.2-1 and Attachment 4-19 of SWEC-PSAS Procedure CPPP-7, and three modifications were required as a result of differential movement of attachment points and restrained thermal expansion.

- Corner Supports

  SWEC-PSAS Project Memorandum PM-39 (Reference 54) identifies the procedure for the identification, evaluation, and disposition of corner supports with wall-to-floor or wall-to-ceiling attachments encountered during the validation effort, with 30 small bore corner pipe supports identified in small bore pipe stress analysis packages within Unit 1 and Common. The design of all corner supports on CPSES Unit 1 and Common has been validated by meeting the requirements specified in Table 4.7.2-1 and Attachment 4-19 of SWEC-PSAS Procedure CPPP-7, and no modifications were required as a result of differential building movements.

5.2.2.3 SWEC-PSAS As-Built Verification of Modifications

SWEC-PSAS performs the as-built piping validation of the CPSES Unit 1 and Common small bore piping and pipe support modifications in compliance with NRC I&E Bulletin 79-14. This process is conducted as part of the final reconciliation process described in Section 5.1.2.7 in accordance with SWEC-PSAS procedure CPSP-12 (Reference 37). The piping linear dimensions, elevations, valve orientations, angles, wall and floor sleeve penetrations, and interconnecting equipment are validated. The modified pipe supports are validated to the as-built drawings, including configuration, mark number, dimensional location, function, angularity, and directions.

5.2.3 Post-Construction Hardware Validation Program (PCHVP) Results

The Post-Construction Hardware Validation Program (PCHVP) is implemented through the verification of the hardware-related attributes described in Section 5.1.3 for the small bore piping and pipe supports in Unit 1 and Common.

These field verifications listed below are in progress:

- Field Verification Method (FVM) for hardware inspection/validation (CPE-SWEC-FVM-PS-081).

- Field Verification Method (FVM) for clearance walkdowns (CPE-SWEC-FVM-PS-080).
- Field Verification Method (FVM) for Seismic Category II small bore piping and pipe supports over Seismic Category I equipment (CPE-SWEC-FVM-PS-082).

5.3 QUALITY ASSURANCE PROGRAM

All activities of the Unit 1 and Common small bore piping and pipe support Corrective Action Program (CAP) were performed in accordance with SWEC's Quality Assurance (QA) program. This program is consistent with SWEC's Topical Report SWSQAP 1-74A (Reference 20), Stone & Webster Standard Quality Assurance Program, which has been approved by the NRC.

In accordance with the Quality Assurance (QA) program, a project-specific QA program (Reference 6) including procedures covering the essentials of the SWEC-PSAS validation process were developed. These SWEC-PSAS project procedures were distributed to all supervisory engineers and were readily available to SWEC-PSAS personnel. The issuance of design criteria, validation procedures, and major revisions of these documents was followed up with detailed training programs for applicable personnel. In particular, pipe stress and support engineers on the project received training in the technical procedure (CPPP-7), and the design control procedure (CPPP-6).

A Project Quality Assurance (QA) Manager, who is directly responsible to the SWEC Vice President of QA and has management experience in auditing and QA program procedure development for engineering activities, was assigned to the project in the earliest stages of project mobilization. This reporting responsibility assures independence of the Quality Assurance (QA) functions. The SWEC-PSAS Quality Assurance (QA) Manager has a staff of Engineering Assurance (EA) engineers assigned to assist him in his duties. SWEC's EA Division is an integral part of SWEC's QA Program (Reference 20). These individuals provide assurance that the QA program properly addresses all project activities and assist SWEC-PSAS personnel to understand and properly implement the QA program.

To date, more than 164,000 man-hours have been expended by SWEC in activities directly attributable to the overall SWEC-PSAS Project Quality Assurance program (i.e., training, procedure development, auditing, and the project QA Manager's staff).

The adequacy and implementation of this Quality Assurance program was extensively audited by SWEC's Engineering Assurance Division, SWEC's Quality Assurance Auditing Division (QAAD), TU Electric Technical Audit Program (TAP) and the NRC's Vendor Program Branch (VPB) and Office of Nuclear Reactor Regulation. A total of 23 audits were performed by these organizations to date for both Units 1 and Common small bore piping and pipe supports as follows:

SWEC - EA	16
SWEC - QAAD	1
TU Electric - TAP[4]	5
NRC	1

The SWEC, NRC, and TU Electric Technical Audit Program (TAP) audits evaluated the technical adequacy of the engineering product (e.g., calculations, drawings, and specifications) and assessed the adequacy and implementation of the SWEC Quality Assurance Program. A summary of these audits is presented in Sections 5.3.1 and 5.3.2.

TU Electric conducted technical audits as part of the TU Electric Technical Audit Program (TAP). The details of calculations, drawings, and procedural compliance and technical interfaces were evaluated. These technical audits have resulted in enhancements to the procedures and methods and thus contributed to the overall quality of the CPSES small bore pipe and support design.

The NRC Staff performed surveillances on the SWEC-PSAS validaton process, including in-process reviews of SWEC-PSAS's progress and methods of resolving the generic technical issues and verification of the adequacy of SWEC-PSAS walkdowns. The NRC-VPB performed an audit of the SWEC-PSAS piping and pipe support Corrective Action Program (CAP).

A Third Party organization (TENERA, L.P.) was contracted by CPRT to overview the adequacy of SWEC-PSAS large bore piping and pipe support design methodology as discussed in Section 5.1.1. The Third Party concluded that SWEC-PSAS's large bore pipe stress analysis and pipe support validation program was comprehensive and capable of resolving Comanche Peak Review Team (CPRT) and external issues. This third party overview provides additional assurance that the CPSES large bore piping and supports meet the licensing commitments. Small bore piping and pipe supports Corrective Action Program (CAP) used the same technical and design control procedure as used in the large bore piping and pipe supports CAP.

In addition to these audits, TU Electric has initiated the Independent Engineering Functional Evaluation (EFE) program to provide an overview of the technical activities being conducted on the CPSES project. The Engineering Functional Evaluation (EFE) team has audited the SWEC-PSAS performance since June 1987. Technical specialists have been assigned to the EFE group to perform a detailed technical audit on samples of small bore pipe stress analysis package and pipe supports of the containment spray piping system. This effort evaluates the containment spray system validation process, which begins from the licensing commitments, through the design validation process (such as design basis documents, design criteria, calculations, drawings, and specifications in discipline interfaces), and finally the hardware validation process of the small bore piping and pipe supports.

[4] The TU Electric Technical Audit Program (TAP) has been in effect since January 1987. Prior to this the TU Electric Quality Assurance Department performed audits of selected engineering service contractors using technical specialists as part of its vendor audit program.

Surveillance activities have also been conducted by SWEC Engineering Assurance personnel to assure conformance to procedures and standards. Similar surveillances are performed by the TU Electric Technical Audit Program (TAP).

These audits described above represent a very detailed and complete assessment of the following:

1. Adequacy of the Project Quality Assurance program.

2. Implementation of the Quality Assurance program.

3. Technical adequacy of the design criteria and procedures.

4. Implementation of the design criteria and procedures.

These audits and surveillances identified instances in which some action was required to clarify or modify procedures to more clearly address some activities, revise calculations to address an omission of clarifying statements or more properly address a situation, and provide additional training or project guidance to assure continued compliance with procedures. A timely and complete response was developed for every item identified throughout the audit process. Whenever a question that suggests a need to improve any of these items was identified, the cause, extent of conditions, and any required corrective/preventive actions were determined, properly documented, and implemented. Subsequent audits have verified that appropriate actions were taken to address previously identified items in these cases, and identified a trend of improved overall performance by SWEC-PSAS. No audit items which would result in questions of technical adequacy of SWEC-PSAS's overall validation program have been identified.

In addition to the audits and surveillances, a rigorous Quality Control (QC) inspection program is in place on the CPSES site. QC personnel are responsible for performing inspections of attributes as delineated in the inspection procedures.

In summary, an appropriate level of attention has been given to the quality of activities; the Quality Assurance (QA) program is appropriate for the scope of work; project performance has been demonstrated to be in compliance with the QA program, and appropriate corrective and preventive actions were taken whenever they were required.

5.3.1 Summary of SWEC Engineering Assurance (EA) Audits

To date, SWEC EA has performed 16 audits of the SWEC-PSAS small bore piping and pipe support validation process. An average of five subjects were reviewed during each of these audits. The following list of audit subjects describes the depth of auditing that has been performed:

1. Adequacy of the SWEC-PSAS Design Procedures.

2. Adequacy of the SWEC-PSAS Project Procedures.

3. ARS Data Conversion.

4. Calculations - Technical adequacy.

5. Calculations - Documentation

6. Compliance with project procedures.

7. Construction support activities.

8. Document Control.

9. Field walkdown activities.

10. Indoctrination and training.

11. Licensing activities.

12. Records maintenance.

13. Maintenance of Project Procedure manuals.

14. Personnel qualification and experience verification.

15. System inputs to pipe stress and pipe support analyses.

A chronological tabulation of SWEC Engineering Assurance (EA) audits is presented in Table 5-9.

5.3.2 Summary of Audits by TU Electric-TAP, NRC-VBP, and SWEC-QAAD

In addition to the SWEC Engineering Assurance (EA) Audits, the SWEC-PSAS was audited by TU Electric Quality Assurance (QA), NRC Vendor Program Branch (VPB), and SWEC Quality Assurance Auditing Division (QAAD).

To date, TU Electric's Technical Audit Program (TAP) has performed 5 audits of the SWEC-PSAS. Each SWEC-PSAS location has been audited at least once. An average of nine (9) subjects were reviewed during each of these audits. These audits are essentially equivalent to the SWEC Engineering Assurance (EA) audits discussed in Section 5.3.1. Therefore, the list of audit subjects in Section 5.3.1 is representative for these audits. A chronological tabulation of the TU Electric Quality Assurance (QA) TAPs audits is presented in Table 5-10.

The NRC-Vendor Program Branch (VPB) performed one audit in mid-1986 of SWEC-PSAS validation process (Reference 31) and reviewed the following activities:

1. Design control (pipe stress and support analyses).

2. Document control (incoming and outgoing).

3. Procurement control.

4. Training.

5. Audits (SWEC-EA and TU Electric-TAP).

The SWEC Quality Assurance Auditing Division (QAAD) performed one audit of the SWEC-PSAS. This audit was performed to assess the Project Quality Assurance Manager's adherence to Corporate QA Program requirements, the adequacy of the Project's QA Program (CPPP-1), the Document Control Program, and the Records Management Program.

5.4 CORRECTIVE AND PREVENTIVE ACTION

SWEC-PSAS has developed technical and design control procedures and updated the design and installation/inspection specifications to implement the corrective actions resulting from the small bore piping and pipe supports Corrective Action Program (CAP). These procedures and specifications are identified within the Piping - Design Basis Documents (DBDs) which contain the bases for validating the small bore piping and pipe supports in Unit 1 and Common. As a result of this effort, the Comanche Peak Steam Electric Station - Unit 1 and Common small bore piping systems and supports are validated as being capable of performing their safety-related functions.

This validation is documented in the drawings, calculations, and specifications. The validated design documentation will be provided to TU Electric. This validated design documentation can provide the basis for configuration control of CPSES small bore piping and pipe supports to facilitate operation, maintenance, and future modifications following issuance of an operating license.

At the completion of the validation, SWEC-PSAS will provide TU Electric Comanche Peak Engineering (CPE) with the complete set of drawings and calculations, contained within the Small Bore Piping - Design Validation Packages (DVPs) for Unit 1 and Common. SWEC-PSAS procedures used for small bore piping and pipe supports validation will be provided to Comanche Peak Engineering (CPE). Implementation of these procedures by CPE assures that future CPSES small bore piping and pipe supports design is performed in accordance with the licensing commitments.

Training for Comanche Peak Engineering (CPE) personnel will be provided by SWEC-PSAS. The training will cover background assumptions and the methodology used in the validation of the piping and pipe support design. The importance of quality assurance will be stressed throughout the training program.

Practical experience has been provided to Comanche Peak Engineering (CPE) engineers who have worked alongside SWEC-PSAS engineers during the ongoing validation process. Experience gained by CPE engineers included changes in design documents and familiarization with procedures followed and regulatory requirements.

TU Electric Comanche Peak Engineering (CPE) is developing a program to assure a complete and orderly transfer of the engineering and design function from SWEC-PSAS to CPE. The plan will provide for the identification of those tasks presently being performed by SWEC-PSAS which are to be transferred to CPE and the identification of all procedures, programs, training, and staffing requirements. The program will be based upon three prerequisites, 1) the piping-related Corrective Action Program (CAP) effort to support plant completion is finished for the particular task; 2) the Piping - Design Validation Packages (DVPs) are complete; and 3) any required preventive action taken, as discussed in Appendix C, is complete.

This program will assure the transfer of complete design document and procedures to Comanche Peak Engineering (CPE).

FIGURE 5-1

CORRECTIVE ACTION PROGRAM (CAP)
FLOW CHART AND GOVERNING PROCEDURES
SMALL BORE PIPING AND PIPE SUPPORTS

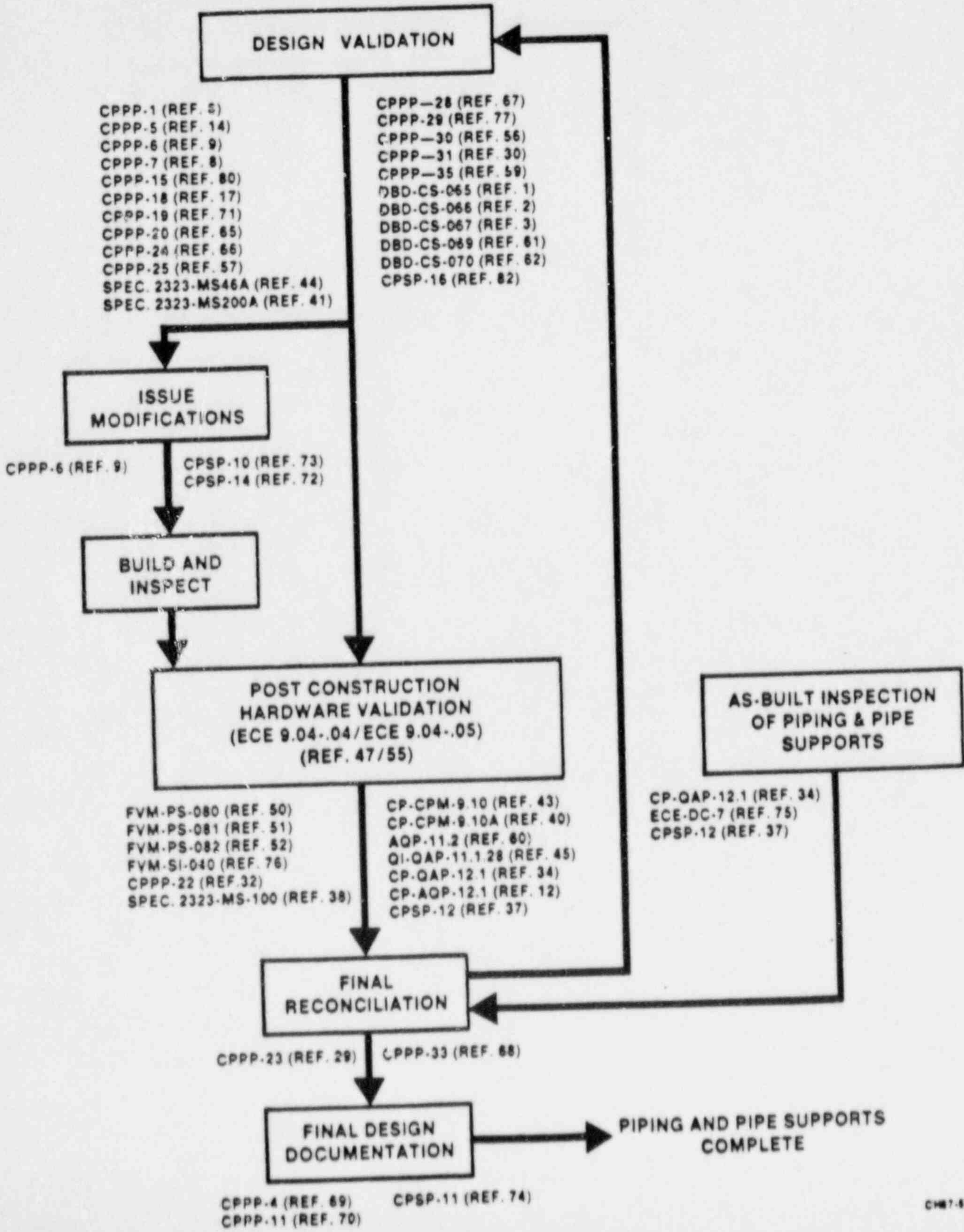


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FIGURE 5-2

CORRECTIVE ACTION PROGRAM (CAP) TECHNICAL INTERFACES SMALL BORE PIPING AND PIPE SUPPORTS

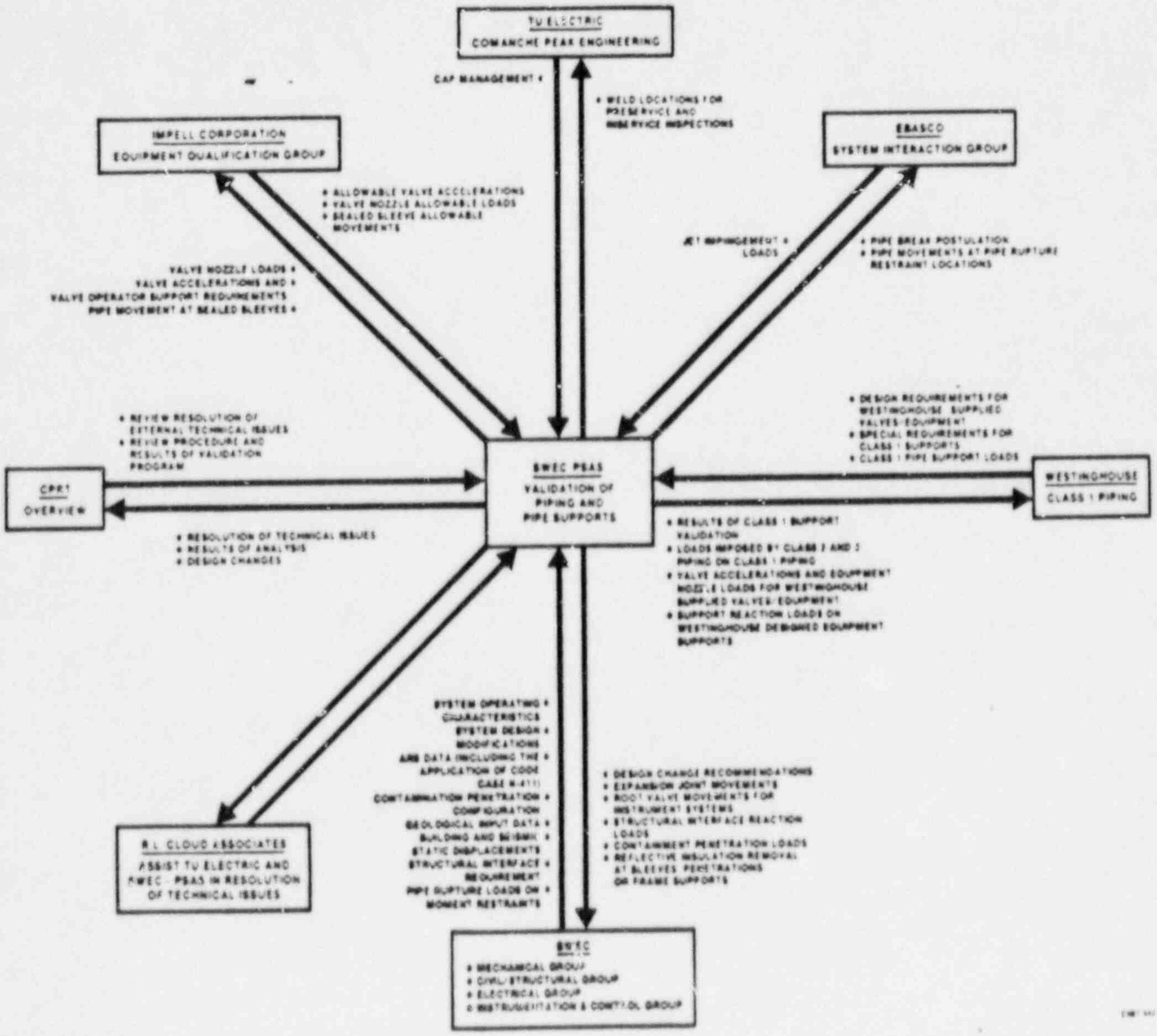
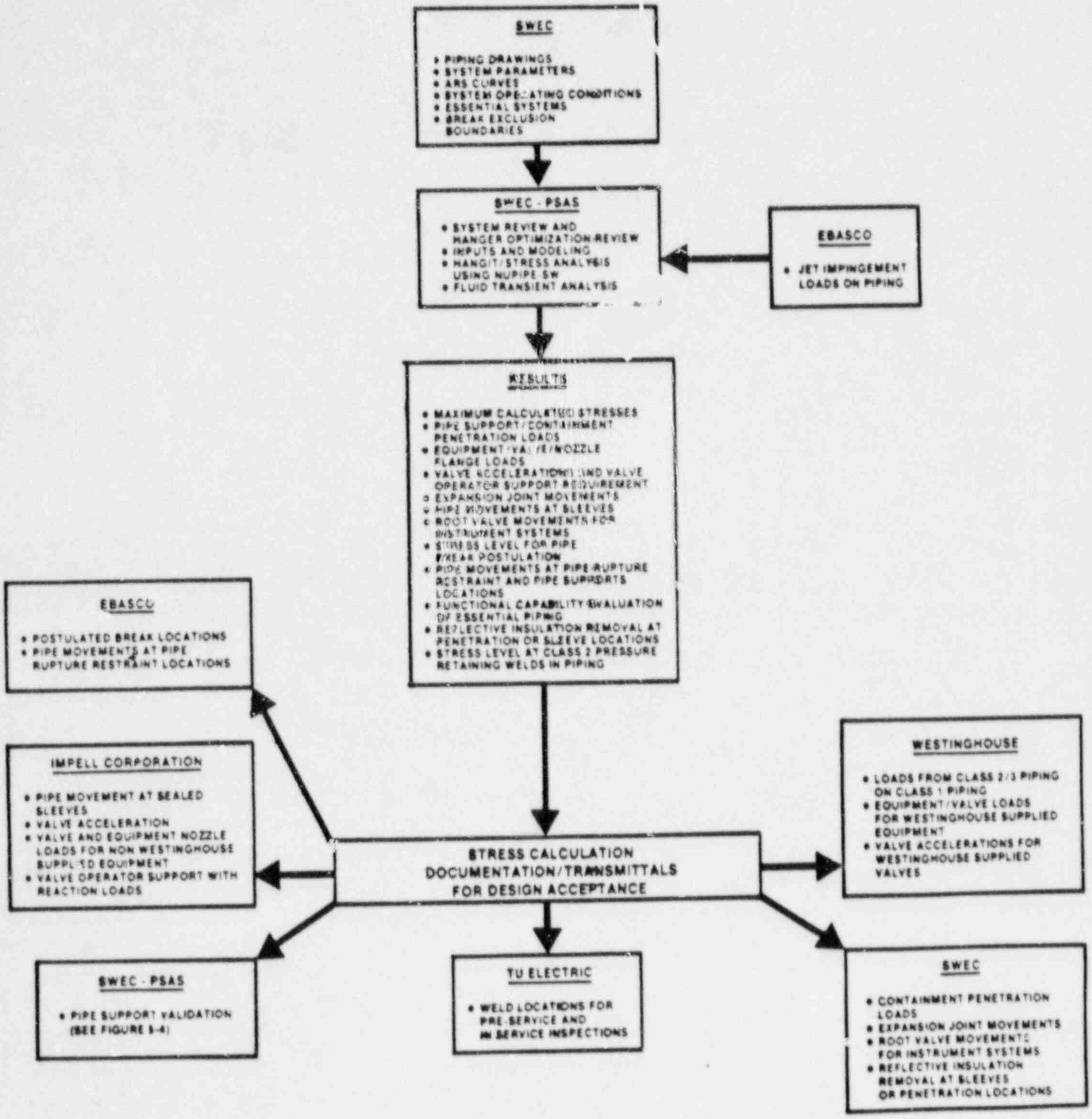


FIGURE 5-3

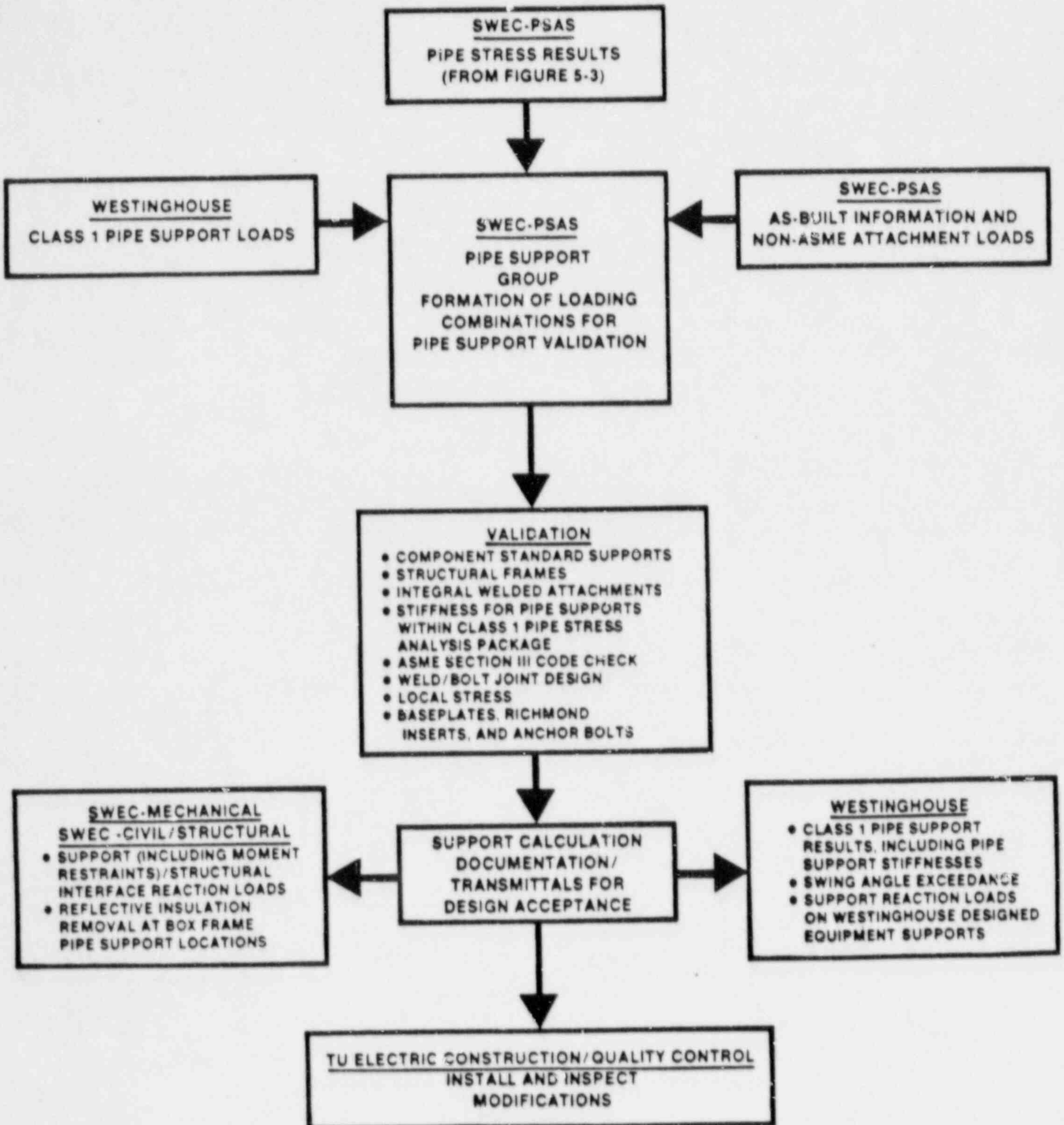
SWEC-PSAS PIPE STRESS DESIGN VALIDATION FLOW CHART



CH87-543

FIGURE 5-4

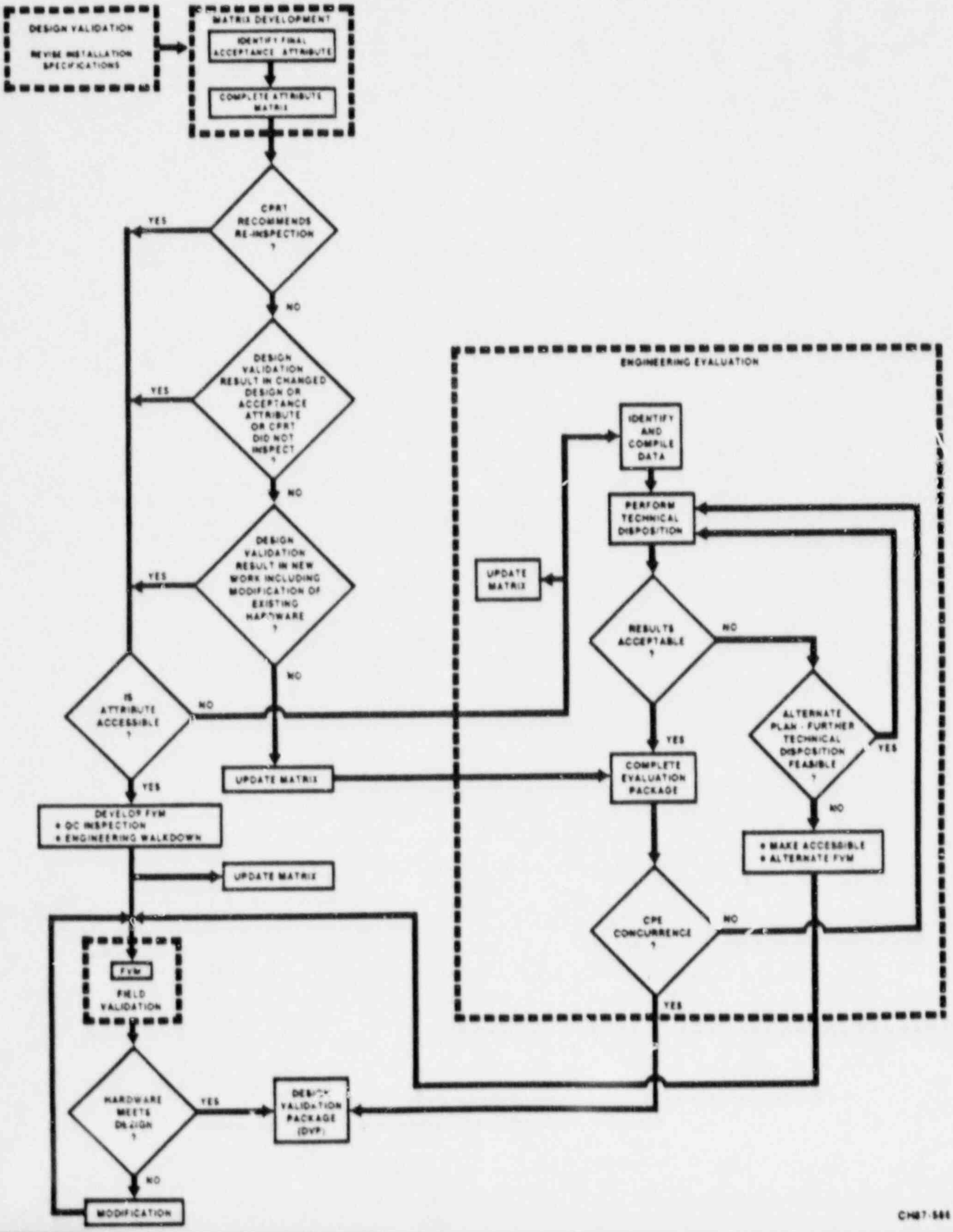
SWEC-PSAS PIPE SUPPORT DESIGN VALIDATION FLOW CHART



CH87-546

FIGURE 5-5

POST CONSTRUCTION HARDWARE VALIDATION PROGRAM (PCHVP)



CH87-566

TABLE 5-1

PIPING SYSTEM INPUT DATA

1. Final Safety Analysis Report (FSAR)
2. ASME III Code Class 1, 2, and 3 piping drawings and Seismic Category II piping drawings within the same piping stress analysis package
3. Pipeline designation list
4. Piping design specifications
5. Flow diagrams, system description and operating conditions
6. Seismic response spectra (including the application of ASME Code Case N-411)
7. Seismic structural displacements data
8. General arrangement and civil/structural drawings
9. As-built piping support location drawings
10. Pipe support drawings
11. Thermal structural displacements data
12. Containment pressure test displacement data
13. Wall and floor sleeve sealant design data
14. Jet impingement loads
15. Pipe whip impact loads
16. Structural and equipment layout drawings
17. Valve and valve operator weights (including extended attachments), center of gravity, yoke natural frequency and acceptable valve acceleration limit
18. Equipment movement data and allowable nozzle loads
19. As-built location of pipe with respect to wall and floor sleeves
20. Existing pipe break locations, pipe rupture restraint locations and detailed drawings
21. Valve nozzle allowables

TABLE 5-1 (Cont)

22. As-built pipe thickness

23. Westinghouse Class 1 pipe stress reports

24. ADLPIPE computer listing for each pipe stress analysis package

25. Containment displacements due to loss of coolant accident (LOCA)

26. Component drawings (equipment, penetration, valve, etc)

27. Calculations

    a. Pipe stress analysis (if applicable)

    b. Pipe support analysis and stress report (if applicable)

    c. Fluid transient analysis (if applicable)

28. Loads from non-ASME attachments on pipe supports

29. Geotechnical data for buried pipe analysis

30. Flexible hose design criteria and vendor's design report

31. As-built information for tie-back support

32. As-built pipe weld shrinkage and locations

TABLE ?-2

FLUID TRANSIENT LOADINGS

Containment Spray System

- Containment spray pump startup

Safety Injection System

- Check valve closure following pump trip

Service Water System

- Pump trip and pump start

Residual Heat Removal System

- Relief valve discharge

Chemical and Volume Control System

- Relief valve discharge

Main Steam System

- Main steam turbine trip
- Auxiliary feedpump turbine trip
- Feedpump turbine trip
- Safety and relief valve discharge

Feedwater System

- Check valve closure following pump trip
- Rapid closure of isolation or control valve
- Check valve closure analysis following postulated pipe rupture

Auxiliary Feedwater System

- Check valve closure following trip of one auxiliary feedwater pump

Boron Recycle System

- Relief valve discharge

Component Cooling Water System

- Relief valve discharge

TABLE 5-3

PCHVP REINSPECTION ATTRIBUTES AND RESOLUTIONS IN RESPONSE TO CPRT QUALITY OF CONSTRUCTION ISAP-VII.C RESULTS REPORT SMALL BORE PIPING AND PIPE SUPPORTS

Construction Work Category	ISAP-VII.c Results Report Recommendations	PCHVP Attributes FVM/Procedures
Small Bore Piping Configuration	Reinspect flow elements to verify that they are oriented in the proper direction	CPE-SWEC-FVM-PS-081 (Reference 51) CP-QAP-12.1 Figure F.23 (Reference 34)
	Verify existing piping clearance criteria and walk down all insulated small bore piping	CPE-SWEC-FVM-PS-080 (Reference 50) CPPP-22, Clearance Walkdown Procedure (Reference 32)
	Reinspect safety-related piping expansion joints	CPE-SWEC-FVM-PS-081 CP-QAP-12.1 Figure F.23
	Verify the accuracy and consistency of linear and locating dimensions in piping isometrics	CPE-SWEC-FVM-PS-081 CPSP-12, As-Built Verification (Reference 37)
Pipe Bend Fabrication	Verify by Ultrasonic Testing (UT) that installed pipe bends meet the minimum wall thickness requirement	CPE-SWEC-FVM-PS-081 CP-QAP-12.1 Figures F.23 and F.26
	Revise QC Procedure QI-QAP-11.1-26 to require that wall thickness after bending be verified by Ultrasonic Testing (UT) and recorded	Procedure AQP-11.2 (Reference 60) Superseded QI-QAP-11.1-26
Pipe Welds and Materials	Reinspect butt welds in Schedule 80 or thinner stainless steel piping made prior to 1982 that are replacement welds and/or have received extensive repairs	CPE-SWEC-FVM-PS-081 Figure F.23

TABLE 5-3 (Cont)

Construction Work Category	ISAP-VII.c Results Report Recommendations	PCHVP Attributes FVM/Procedures
Small Bore Pipe Supports	Inspect for proper gaps between pipe and pipe support and verify adequate clearance between pipe weld and pipe support	CPE-SWEC-FVM-PS-080 CPPP-22, Clearance Walkdown Procedure CP-QAP-12.1 Figure F.9
	Inspect and install suitable locking devices on all vendor-supplied components that do not have high-strength bolting; install locking devices on all high-strength bolting that is not torqued to an acceptable preload	CPE-SWEC-FVM-PS-081 Figures F.15, F.16, F.13, and F.20
	Verify that the fasteners have been secured for all vendor-supplied components (sway struts, snubbers, and spring cans) during plant startup and preoperation using a complete and detailed procedure and checklist provided and verified by QC	CPE-SWEC-FVM-PS-081 CP-QAP-12.1 Figures F.13, F.15, F.16, and F.17

TABLE 5-4

UNIT 1 AND COMMON SMALL BORE PIPE SUPPORTS MODIFICATION SUMMARY

Category	Number of Modifications
Prudent	189
Recent Industry Practice	626
Adjustment	76
Cumulative Effects	1005
TOTAL	1896

Description	Modification Category
Richmond Insert Single Tubes	Prudent
Allowable Stress Exceeded for Structural Member	Cumulative Effects
Support Deleted	Recent Industry Practice
Support Added	Cumulative Effects
Rigid Trapeze	Prudent
Trapeze Snubber	Prudent
Allowable Stress Exceeded for Welds	Cumulative Effects
Allowable Load Exceeded for Standard Component	Cumulative Effects
Allowable Load Exceeded for Concrete Anchor	Cumulative Effects
Cinched U-Bolt Modification	Prudent
Component Exceeds 5 Degree Offset	Adjustment
Revise Clearances	Adjustment
To be Modified Into a Clamp Anchor	Prudent
Box Frame on Pin Connection	Prudent
Modify to Increase Stiffness	Prudent
Preliminary Study Revises this into a Clamp Anchor	Prudent
Change from Rigid to Anchor or from Anchor to Rigid	Prudent
Change from Snubber to Rigid	Recent Industry Practice
Change from Rigid to Snubber	Cumulative Effects
Two Way Rigid Restraint Changed to a One Way Restraint or One Way Changed to Two Way Restraint	Cumulative Effects
Three Way Changed to One or Two Way Restraint	Cumulative Effects
U-Bolt on a Rigid Frame (One or Two Way Restraint)	Cumulative Effects
Change from Rigid Hanger to Spring or Spring to Rigid	Cumulative Effects
Relocate Hanger	Cumulative Effects
Pipe Bearing Stress Failure	Cumulative Effects
Reset Spring or Snubber Settings	Adjustment
Exceeds Lateral Movement for Spring	Adjustment

TABLE 5-5

SEISMIC CATEGORY II SMALL BORE PIPING OVER SEISMIC CATEGORY I EQUIPMENT PIPING CHECKLIST

The field verification of Seismic Category II piping located over Seismic Category I systems, structures, or components is documented using a checklist addressing these attributes:

1. Establish seismic to nonseismic boundaries in piping systems and determine whether the boundary requires further evaluation to ensure the integrity of the seismic portion during a seismic event.

2. Determine if pipe supports restrain thermal expansion of a long straight piping run.

3. Determine if supports have existing design loads that are less than calculated threshold loads.

4. Determine if supports are next to a heavy concentrated weight (valves or components).

5. Determine if long straight runs or risers are not adequately supported for seismic in axial direction of pipe.

6. Determine if piping extends to different buildings.

7. Determine if the system design temperature exceeds 150°F.

8. Verify that hot piping configuration and component alignment are in accordance with the design drawings.

TABLE 5-6

PCHVP SMALL BORE PIPING AND PIPE SUPPORTS INSTALLATION/INSPECTION PROCEDURES

SWEC-PSAS Field Verification Methods (FVMs) for large bore piping and pipe supports Post Construction Hardware Validation Program (PCHVP) are in compliance with the following procedures:

1. Comanche Peak Piping Erection Specification No. 2323-MS-100 (Reference 38)

2. Comanche Peak ASME Section III Code Class 2 and 3 Piping Design Specification No. 2323-MS-200 (Reference 41)

3. Comanche Peak Nuclear Safety Class Pipe Hangers and Supports Specification No. 2323-MS-46A (Reference 44)

4. Comanche Peak Structural Embedments Specification No. 2323-SS-30 (Reference 39)

5. Comanche Peak Construction Procedure CP-CPM-9.10, Component Support Installation (Reference 43)

6. Comanche Peak Construction Procedure CP-CPM-9.10A, Installation of Vendor-Supplied Component Supports Catalog Items (Reference 40)

7. CPSES Quality Assurance Procedure CP-QAP-12.1, Mechanical Component Installation Verification (Reference 34)

8. CPSES Quality Assurance Procedure QI-QAP-11.1-28, Fabrication and Installation Inspection of Safety Component Supports (Reference 45)

9. CPSES Quality Assurance Procedure QI-QAP-11.1-26, Piping and Equipment Installation Inspection (Reference 42)

TABLE 5-7

SEISMIC CATEGORY II SMALL BORE PIPING OVER SEISMIC CATEGORY I EQUIPMENT PIPE SUPPORT CHECKLIST

The field verification of Seismic Category II piping located over Seismic Category I systems, structures, or components is documented using a checklist addressing these attributes:

1. General Support Requirements

   a. Location
   b. Function
   c. Orientation
   d. Dimensions/configuration/material per control drawing/ document
   e. Physical damage/completeness
   f. Hole edge distance in structural members
   g. Gap clearances
   h. Minimum 1 in. clearance
   i. Voided supports removed

2. Welding

   a. Weld type
   b. Welds properly wrapped

3. Base Plates/Anchor Bolts

   a. Bolt size
   b. Edge distance of holes
   c. Size and hole spacing
   d. Attachment location
   e. Nut tightness/thread engagement
   f. Locking devices
   g. Washers
   h. Clearance with adjacent Hilti bolt

4. Bolted Connections (Including Clamps)

   a. Bolt/pin size
   b. Thread engagement
   c. Nut tightness
   d. Locking devices/cotter pins
   e. Clamp size/proper spacer
   f. Tightness of bolt and clamp

TABLE 5-7 (Cont)

5. Snubber/Strut/Spring Components

   a. Size/type/load pin size
   b. Spherical bearing adequacy/free to swivel
   c. Angularity with tolerance

   d. Setting adequate per drawing
   e. Eye rod thread engagement/nut tightness
   f. Ends not binding
   g. Locking devices
   h. Extension weld adequacy
   i. Lubrite plate

6. Design Considerations

   a. Support instability (e.g., uncinched U-bolts)
   b. Threshold loads exceed previous design load
   c. Nonseismic interface loads
   d. Seismic loading inclusion in original support load
   e. Adequacy of gang support
   f. Integral attachment adequacy

7. Aircraft Cables

   a. Cable diameter
   b. Ceiling/wall connection
   c. Clamp type/rod type
   d. End loop configuration
   e. Eye nut tightness/lock washers
   f. Cable clamp tightness
   g. Cable slack/configuration
   h. Tie spacing/bundled cables tied together
   i. Support location/span
   j. Cable restraint modifications for 12 in. and 10 in. diameter pipe
   k. End of cables wrapped to prevent fraying

TABLE 5-8

TYPICAL SWEC-PSAS TECHNICAL AND DESIGN CONTROL PRACTICES

1. Add terminal anchors in the pipe stress problem boundary to bound the stress problem.

2. Establish a seismic-to-nonseismic piping interface anchor design requirement.

3. Revise pipe stress analysis package boundary decoupling requirement.

4. Establish branch line mass effect on main piping requirement.

5. Establish functional capability evaluation requirement.

6. Document the validation of thermal stress cycles and stress range reduction factor requirement.

7. Establish stiffness modeling of sleeve sealant.

8. Revise clearance requirement between pipe and structural frame.

9. Establish a clamp anchor design for 6 in. and smaller nominal size pipe.

10. Revise the seismic design loads for nonsafety-related piping attached to safety-related ganged pipe supports.

11. Revise the tube steel wraparound welding length evaluation requirement.

12. Document the strut, snubber, and spring hanger swing angle evaluation requirement, including thermal, seismic, and fluid transient movements.

13. Establish an integrated clearance validation program (engineering walkdown to validate clearance).

14. Establish the requirement to validate the valve weight list and the valve stem extension in the as-built drawing.

15. Establish the pipe stress and pipe support system review documentation requirement.

16. Establish the review and validation of CPSES plant design and operating conditions.

TABLE 5-9

SUMMARY OF SWEC ENGINEERING ASSURANCE AUDITS
SMALL BORE PIPING AND PIPE SUPPORTS

Engineering Assurance Audit No.	Location*	Dates of Audits	Audit Report Transmittal	Audit Response Transmittal
Project No. 1	at NY	10/06/85 - 10/11/85	IOM - 85/610/CPI-653	CPO-134, 11/15/85
Project No. 2	at CH	10/28/85 - 11/08/85	IOM - EA-1735/CPI-1085	2CPO-34, 12/20/85
SWCL No. 1	at SWCL	12/17/85 - 12/19/85	IOM - 86/015, 01/30/86	CPI-1468, 02/21/85 CPI-2115, 04/11/86
Site No. 2	at Site	12/16/85 - 02/13/86	IOM - 86/088/CPI-1490	CPO-863, 04/15/86
Project No. 5	at BOS	02/10/86 - 03/07/86	IOM - 86/100/CPI-1768	CPO-746, 04/03/86
Project No. 7	at NY	03/24/86 - 03/28/86	IOM - 86/160/CPI-2192	CPO-1215, 05/14/86 CPO-1592, 06/19/86
Site No. 3	at Site	05/19/86 - 05/23/86	IOM - 86/256/CPI-2827	CPO-1958, 07/25/86
SWCL No. 2	at SWCL	06/02/86 - 06/06/86	IOM - 86/284/CPI-2819	CPI-3557, 08/12/86
Project No. 13	at CH	12/01/86 - 12/05/86	IOM - EA-1894/CPI-5420	No Response Required
Site No. 4	at Site	01/19/87 - 01/23/87	IOM - 87/044/CPI-6064	IOM-237, 03/24/87
Project No. 14	at BOS	02/23/87 - 03/06/87	IOM - 87/120, 04/09/87	EMD File 16.1.2 (016)
SWCL No. 3	at SWCL	03/09/87 - 03/13/87	IOM - 87/108/CPI-6690	CPO-6496, 05/14/87
Project No. 15	at CH	03/16/87 - 03/27/87	2CPI-3336/CPI-6703	CPO-6432, 05/11/87
Project No. 16	at NY	04/13/87 - 04/24/87	IOM - 87/175/CPI-7022	2CPO-2543, 06/26/87
Project No. 17	at HOC	06/08/87 - 06/12/87	IOM - 87/308/CPI-7447	2CPO-2636, 08/14/87
Site No. 5	at Site	05/22/87 - 06/26/87	IOM - 87/256, 08/03/87	2CPO-2664, 08/20/87

*Site: SWEC-PSAS at CPSES
HOC: SWEC-Houston
NY: SWEC-New York
SWCL: SWEC-Toronto
BOS: SWEC-Boston
CH: SWEC-Cherry Hill

TABLE 5-10

SUMMARY OF TU ELECTRIC AUDITS
SMALL BORE PIPING AND PIPE SUPPORTS

Audit No.	Location*	Dates of Audits	Audit Report Transmittal	Audit Response Transmittal
TSWEC-3	at BOS	12/03/85 - 12/05/85	CPI-1266/QXX-2861	CPO-501, 02/21/86
TSWEC-5	at Site	04/14/86 - 04/18/86	CPI-2401/QVC-168	CPO-1388, 06/13/86
TCP-86-43	at Site	11/10/86 - 11/14/86	CPI-5077/QIA-331	CPO-4611, 01/16/87
TSWEC-11	at HOC	03/31/87 - 04/03/87	CPI-6901/QVC-821	No Response Required
ATP-87-18	at Site	06/01/87 - 06/05/87	CPI-7320/ATP-7107	CPO-7315, 07/24/87

*Site: SWEC-PSAS at CPSES
HOC: SWEC-Houston
NY: SWEC-New York
SWCL: SWEC-Toronto
BOS: SWEC-Boston
CH: SWEC-Cherry Hill

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APPENDIX A

COMANCHE PEAK RESPONSE TEAM (CPRT) AND EXTERNAL ISSUES

INTRODUCTION

This appendix describes the details of the resolutions of issues resulting from the Comanche Peak Response Team (CPRT) and from external issues. Each of thirty-nine issues listed below is described in an individual subappendix which includes discussions of resolution methodology and corrective and preventive actions.

SWEC-PSAS has reviewed the CPSES Supplemental Safety Evaluation Reports (SSERs) (NUREG-0797), and determined that the procedures and design criteria for the piping and pipe support Corrective Action Program (CAP) are consistent with the actions required of TU Electric by the NRC staff as stated in the SSERs.

Issue No.	Issue Title
A1	Richmond Inserts
A2	Local Stress - Piping
A3	Wall-to-Wall and Floor-to-Ceiling Supports
A4	Pipe Support/System Stability
A5	Pipe Support Generic Stiffness
A6	Uncinched U-Bolt Acting as a Two-Way Restraint
A7	Friction Forces
A8	AWS Versus ASME Code Provisions
A9	A500, Grade B Tube Steel
A10	Tube Steel Section Properties
A11	U-Bolt Cinching
A12	Axial/Rotational Restraints
A13	Bolt Hole Gap
A14	OBE/SSE Damping
A15	Support Mass in Piping Analysis
A16	Programmatic Aspects and QA Including Iterative Design
A17	Mass Point Spacing
A18	High-Frequency Mass Participation
A19	Fluid Transients
A20	Seismic Excitation of Pipe Support Mass
A21	Local Stress in Pipe Support Members
A22	Safety Factors
A23	SA-36 and A307 Steel
A24	U-Bolt Twisting
A25	Fischer/Crosby Valve Modeling/Qualification
A26	Piping Modeling
A27	Welding
A28	Anchor Bolts/Embedment Plates
A29	Strut/Snubber Angularity

Issue No.	Issue Title
A30	Component Qualification
A31	Structural Modeling for Frame Analysis
A32	Computer Program Verification and Use
A33	Hydrotest
A34	Seismic/Nonseismic Interface
A35	Other Issues
A36	SSER-8 Review
A37	SSER-10 Review
A38	SSER-11 Review
A39	CPRT Quality of Construction Review on Piping and Pipe Supports

SUBAPPENDIX A1

RICHMOND INSERTS

1.0 Definition of the Issue

There were several interrelated issues regarding the use of Richmond inserts (see Figure A1-1). The issues were related to design allowables, methods for calculating bolt loads in tube steel connections, and modeling of insert/tube steel connections. The specific issues are as follows (see References 4.1 through 4.9):

1.1 Safety Factors/Testing

The issue was that a safety factor of two was used for Richmond insert designs instead of the manufacturer's recommended safety factor of three. Related questions were raised regarding the tests performed by TU Electric on Richmond inserts to determine the load-carrying capacity of the insert and to examine the behavior of the connection for combined loading. In specific, the representativeness of the tests to actual plant conditions and the interpretation of the test results was questioned.

1.2 Concrete Strength

The issue was that Richmond inserts may have been installed in concrete weaker than the 4000 psi design strength used in the analyses.

1.3 Fatigue Life

The issue was that the reduction in fatigue life of the threaded rod in Richmond insert tube steel connections caused by cyclic loading was not considered.

1.4 Simplified Evaluation Method

The issue was that justification of the simplified method of Richmond insert design was based on improperly interpreted finite element analysis results.

1.5 Richmond Insert/Tube Steel Finite Element Modeling

The issue was that a simplified method was used in evaluating connections made with tube steel without considering bolt angularity or bending in the bolt due to the torsion in the tube steel member.

Tube steel/insert connections were inconsistently modeled as pin or fixed connections. This affects the support stiffness, support frame stresses, and the evaluations of the loads on bolts/rods and inserts.

1.6 Allowable Spacing

The issue was that the lack of a structural attachment interface program may have resulted in a failure to consider spacing effects of nearby anchors/sleeves in the structural evaluation of inserts.

1.7 Allowable Shear Loads

The issue was that allowable shear loads for 1 1/2 in. Richmond inserts, which were extrapolated from test data for 1 in. and 1 1/4 in. size inserts, may not be conservative.

1.8 Thermal Expansion of Long Tube Steel Members

The issue was that thermal expansion of long tube steel members, under LOCA conditions, anchored by two or more inserts was not considered.

1.9 Tube Steel Local Stress

The issue was that the local stress in tube steel walls, which may cause punching-type failure, was not evaluated.

1.10 Oversized Holes

The issue was that the holes made in the connections are oversized, and therefore the sharing of shear loads cannot be assumed to be equal for all of the bolts.

1.11 Misuse of Allowable Loads

The issue was that tension and shear allowables for inserts were occasionally used to evaluate threaded rods/bolts in the analyses.

2.0 <u>Issue Resolution</u>

2.1 Safety Factors/Testing

SWEC-PSAS has specified a safety factor of 3 for Richmond inserts under normal, upset, and emergency loading conditions, as recommended by the Richmond Screw Company. For faulted conditions, a safety factor of 2 has been specified based on ACI 318-71 (Reference 4.10). The allowables are based on averaging TU Electric insert capacity failure loads based on test results as described in References 4.11 and 4.12. SWEC-Civil/Structural Group has verified (Reference 4.13) that the tests were representative of CPSES Richmond insert installation and that the tests were performed in accordance with the industry-wide accepted ASTM Standard E488-76 (Reference 4.14).

The allowable loads for Richmond inserts and threaded rods, based on the appropriate safety factors, are provided in Attachment 4-5 of CPPP-7.

2.2 Concrete Strength

This issue is addressed in Subappendix A36.

2.3 Fatigue Life

CPPP-7, Section 4.3.1, specifies that threaded rods used in Richmond inserts/tube steel connections are designed in accordance with AISC requirements. SWEC-PSAS has demonstrated by analysis that the number of equivalent stress cycles on pipe supports at CPSES is less than 7,000, and therefore in accordance with AISC 7th Edition (Reference 4.15), Sections 1.7.1 and 1.7.2 and Appendix B, fatigue is not a concern for threaded rods used in these connections.

2.4 Simplified Evaluation Method

The procedure developed and implemented by SWEC-PSAS for the qualification of Richmond inserts and bolts (Attachment 4-5 of CPPP-7) is independent of previously completed finite element analyses.

2.5 Richmond Insert/Tube Steel Finite Element Modeling

SWEC-PSAS established the tube steel to bolt load transfer mechanism for shear and torsion loads (with respect to the tube steel) and developed a conservative design methodology for evaluating these connections. R. L. Cloud and Associates (RLCA) performed an independent analysis of the tube steel to bolt load transfer mechanism and confirmed that the SWEC-PSAS methodology is appropriate (Reference 4.16).

The SWEC-PSAS model simulated a member with bolt properties (in the STRUDL computer program) to connect the center of tube steel to the face of concrete. Support joints were modeled as fixed except for the bolt's torsional moment. The force and moment reactions were first used directly in the interaction equation for qualifying the bolts and were later converted to tension for evaluating the inserts. This interaction equation was documented by both RLCA (Reference 4.17) and SWEC-PSAS (Reference 4.18). This method of analysis represents a conservative means of transferring shear and torsion loads from the tube steel to the bolts. Single tube steel members, subject to torsion, were modified by outriggers installed at the connections to eliminate the moment on the bolt.

Attachment 4-5 of CPPP-7 provides the modeling procedure for qualifying the Richmond insert when used in conjunction with tube steel for all support configuration types, including the proper interaction equation for qualifying the bolts/rods.

2.6 Allowable Spacing

Attachment 4-5 of CPPP-7 specified spacing requirements and the effects of reduced spacing on Richmond insert allowables. A project-wide program on Richmond insert spacing, conducted by the SWEC Civil/Structural Group as discussed in the Civil/Structural PSR (Reference 4.13), is being implemented (also see Subappendix A28, Sections 1.1 and 2.1).

2.7 Allowable Shear Loads

TU Electric performed additional tests (see Section 2.1 above and References 4.11 and 4.12) to establish shear allowables for all discrete sizes of Richmond inserts used at CPSES including the 1 1/2 in. Richmond insert. Design allowable values were based on these tests.

2.8 Thermal Expansion of Long Tube Steel Members

The effects of thermal expansion on long tube steel members anchored by two or more inserts was evaluated by RLCA in Reference 4.19, and limits on tube steel length were established.

Attachment 4-5 of CPPP-7 provides limits on tube steel length of long tube steel members anchored by two or more inserts due to the effects of LOCA-induced thermal expansion.

2.9 Tube Steel Local Stress

SWEC-PSAS developed and implemented a procedure for the evaluation of local stresses due to nuts bearing on tube steel walls. This was incorporated into Attachment 4-13 of CPPP-7. For additional discussion of this issue, refer to Subappendix A21, Section 2.0.

2.10 Oversized Holes

SWEC-PSAS procedures assume equal distribution of shear loads resulting from rod and hole fit-up tolerances, where tubing is anchored by two or more Richmond inserts. However, for Richmond inserts and threaded rods with high shear interaction ratios (greater than 0.25), potential unequal shear loading is addressed by checking that these Richmond inserts and rods are capable of resisting twice the calculated shear (Reference 4.20).

2.11 Misuse of Allowable Loads

The SWEC-PSAS procedure for the validation of Richmond inserts and bolts (Attachment 4-5 of CPPP-7) requires separate evaluations for the inserts and for the threaded rods/bolts using specified allowables and interaction equations.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action to resolve the issues regarding the analysis and design of Richmond inserts used in conjunction with tube steel was accomplished through the implementation of the criteria provided in CPPP-7, Attachment 4-5 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

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4.2 Reply to NRC Staff questions from W. A. Horin to G. Mizuno, June 11, 1984

4.3 Reply to NRC Staff questions, September 1984

4.4 Affidavit of CASE witness M. Walsh before the ASLB, September 11, 1984

4.5 Structural Embedments Specification No. 2323-SS-30, Revision 1, Gibbs & Hill, Inc., February 10, 1984

4.6 Richmond Inserts/Anchorages for Concrete Constructions, Bulletin No. 6, Richmond Screw Anchor Co., 1971

4.7 Testimony of N. H. Williams in response to CASE questions of February 22, 1984, to CYGNA Energy Services, April 12, 1984

4.8 June 20, 1984, and August 9, 1984, meeting with NRC Staff discussing Richmond Inserts' affidavit

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4.10 ACI Code 1971, Building Code Requirements for Reinforced Concrete, American Concrete Institute, Detroit

4.11 TU Electric Test Report, Shear Tests on Richmond 1 1/2 in. Type EC-6W Inserts, March 30, 1983

4.12 TU Electric Test Report, Shear and Tension Loading on Richmond Inserts, 1 1/2 in. Type EC-6W and 1 in. Type EC-2W, April 19, 1984

4.13 TU Electric Units 1 and Common, Civil/Structural Project Status Report, Revision 0, October 1987

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4.16 RLCA Report No. RLCA/P142/01-85/003, Richmond Insert/Structural Tube Steel Connection, Revision 0, September 10, 1986

4.17 RLCA Report No. RLCA/P142/01-86/008, Richmond Insert/Structural Tube Steel Connection, Design Interaction Equation for Bolt/Threaded Rod, Revision 0, September 10, 1986

4.18 SWEC-PSAS Report No. 15454.05-N(C)-002, Interaction Relation for a Structural Member of Circular Cross Section, May 1986

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4.20 SWEC-PSAS Project Memorandum 141, Unequal Shear Loading Effect on Richmond Insert and Threaded Rods Used in Conjunction with Tube Steel

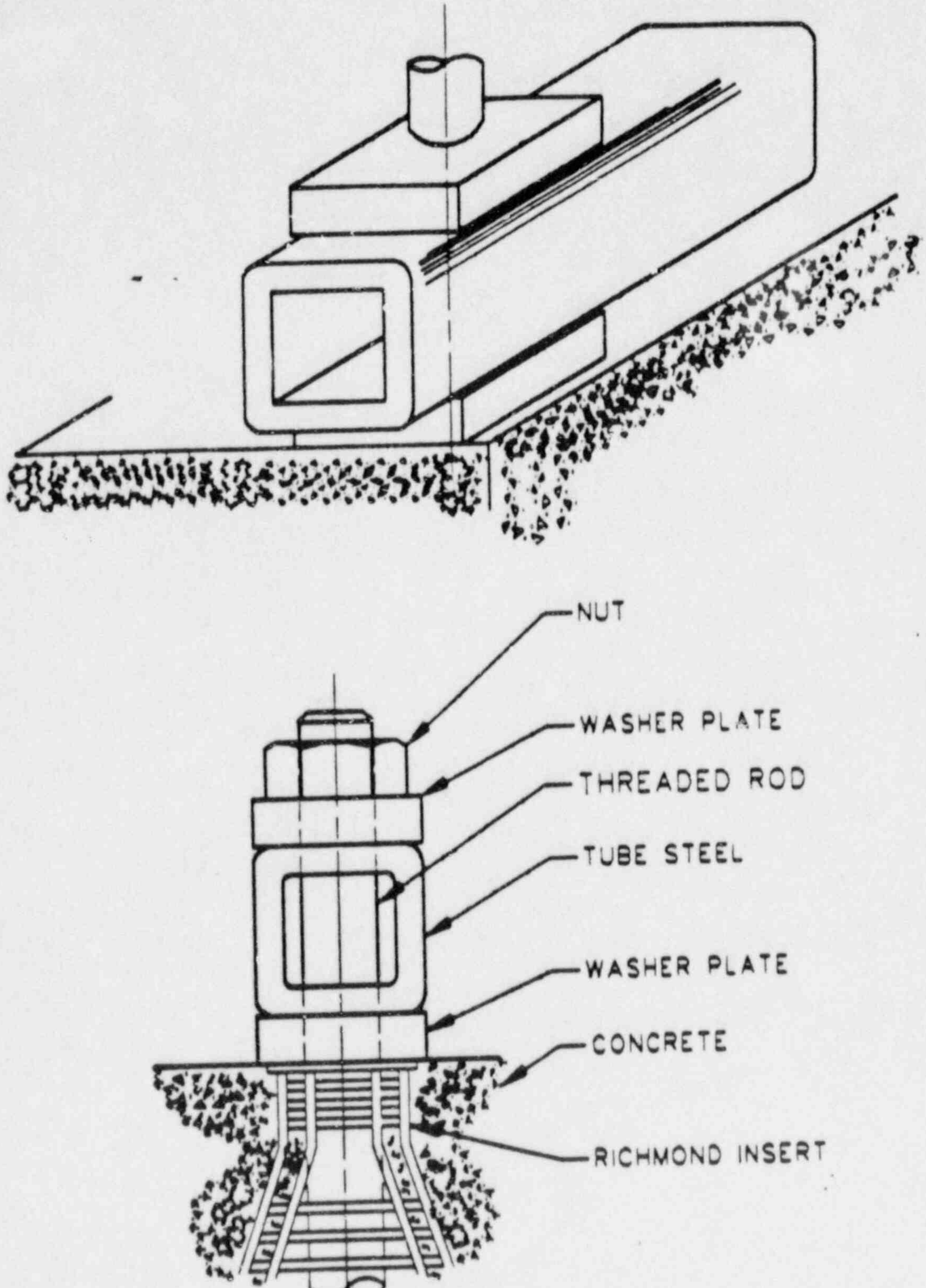


FIGURE A.1-1
TYPICAL RICHMOND INSERT / TUBE STEEL CONNECTION

SUBAPPENDIX A2

LOCAL STRESS - PIPING

1.0 Definition of the Issue

The issue was (References 4.1 through 4.4) that local stresses in piping, due to the relative displacements between the pipe and supports, were not properly addressed at CPSES in the items listed below:

1.1 Zero Gap Restraints

Zero gap restraints are box frame pipe supports with the specified gap on the pipe support drawing less than the predicted radial thermal expansion of the pipe. Therefore, these support types restrain the radial thermal expansion of the pipe. The loads due to the restrained pipe expansion, combined with the mechanical loads, have the potential to overstress the frame, welds, and pipe. In addition, zero gap restraints used in conjunction with struts or snubbers are potentially unstable.

1.2 Integral Welded Attachments (IWAs)

Integral welded pipe support attachments (IWAs), such as trunnions and lugs, induce local stresses in the pipe wall. Anchor supports with opposing trunnions attached to different support structures may restrain the radial thermal pipe expansion and induce additional load in the pipe, trunnions, and support structures.

The load from restrained radial thermal pipe expansion, when combined with the mechanical loads, has the potential to overstress the pipe, trunnion, welds, support structure, and support structure anchorage.

2.0 Issue Resolution

The issue of local stress on piping was resolved as follows:

2.1 Zero Gap Restraints

Frame-type pipe supports, designed to restrain the lateral movement of the pipe through point, line, or surface contact, induce local stresses in the pipe wall due to the bearing contact force. The issue of local pipe stress due to bearing contact was resolved as follows:

2.1.1 Zero clearance box frames are eliminated or modified to provide sufficient gaps to allow for the thermal expansion of the pipe in accordance with CPPP-7, Attachment 4-11. The modification of zero gap restraints on struts or snubbers, to provide stability, is discussed in Subappendix A4.

2.1.2 Guidelines were provided in CPPP-7, Attachments 4-6B and 4-6C, to assess the local longitudinal line/point contact and circumferential bearing stresses in piping restrained by pipe support frames.

2.2 Integral Welded Attachments

CPPP-7, Attachment 4-6A provided simplified analysis methods for the evaluation of pipe local stress at trunnions and lugs, with and without pipe reinforcing pads. The local pipe stress for trunnions on elbows is evaluated in accordance with PM-162. Local pipe stresses at IWAs that did not meet the geometric limitations of the simplified methods (such as multiple trunnions attached at the same location, or pipe-through trunnions) were qualified based on finite element analysis techniques.

In accordance with CPPP-7, Section 4.6.4.1, supports with opposing trunnions attached to different support structures were specially analyzed to predict the additional load induced on the pipe, trunnion, support structure, welds, and support structure anchorage due to the restrained thermal expansion of the pipe. This load was added to the thermal load due to the longitudinal thermal expansion of the pipe to determine the thermal design load for the pipe local stress evaluation and the design of the trunnion, support structure, welds, and support structure anchorage. The trunnion was then analyzed in accordance with CPPP-7, Attachment 4-6A as discussed above.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action to resolve the local pipe stress issues with zero clearance box frames was to eliminate the support or modify the support to provide proper gaps between the pipe and support during the design validation. The corrective action to resolve the stability issue for zero gap restraints is discussed in Subappendix A4. The corrective action to resolve the local pipe stress issue with frames and IWAs was to provide analysis methodologies and acceptance criteria consistent with licensing commitments in CPPP-7, Attachments 4-6A, B, and C during the design validation. All local pipe stress design validation analyses were performed in accordance with these attachments.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Finding of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section IV, August 22, 1983.

4.2 CASE's Answer to Applicant's Statement of Material Facts as to which there is no Genuine Issue Regarding Consideration of Local Displacements and Stresses, August 24, 1984.

4.3 CASE's Answer to Applicant's Reply to CASE's Answer to Applicant's Motion for Summary Disposition Regarding Local Displacements and Stresses, October 4, 1984.

4.4 CYGNA Pipe Support Review Issues List, Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987.

SUBAPPENDIX A3

WALL-TO-WALL AND FLOOR-TO-CEILING SUPPORTS

1.0 Definition of the Issue

The issue (References 4.1 and 4.2) was that when a pipe support is attached from floor-to-ceiling or wall-to-wall, the support members effectively act as building structural members. Loadings due to the thermal expansion of the frame, relative displacements between building attachment points from seismic building movements, time-dependent displacements such as concrete creep, and the cumulative effects of these could be significant. Since these loads and displacements were not considered in the design, the potential existed for support members to become overstressed.

2.0 Issue Resolution

2.1 Floor-to-Ceiling and Wall-to-Wall (F-C/W-W) Supports

The large F-C/W-W frames were qualified for loading combinations that include frame thermal expansion, differential building displacements due to seismic movements, long-term concrete creep, and live loads. Relative building displacements, long-term creep, and live load effects were demonstrated to be insignificant for corner supports. The loading combinations and the allowable stresses are delineated in Attachment 4-19 of CPPP-7.

2.1.1 Large Frames Outside the Service Water Tunnel

All large F-C/W-W frames, except those in the service water tunnel, are being modified by adding slip joints.

2.1.2 Large Frames in the Service Water Tunnel

The large F-C/W-W frames in the service water tunnel were assessed for stresses caused by floor live load, differential floor/wall displacements due to long-term concrete creep, thermal expansion, and seismic excitation as specified in Section 2.1. Supports assessed as being inadequate are being modified (Reference 4.3).

2.2 Corner Supports

A generic study of these supports was performed utilizing the assessment methods in Section 2.1. The supports were then reviewed based on the study results, and the designs were validated.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- All the pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action to resolve the issue with the proper evaluation of floor-to-ceiling and wall-to-wall and corner supports was accomplished through the implementation of the criteria of CPPP-7, Attachment 4-19 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section VI, August 22, 1983

4.2 CASE's Partial Answer to Applicant's Statement of Material Facts, in the Form of Affidavit of CASE Witness, Mark Walsh, August 27, 1984

4.3 SWEC-PSAS Report No. 15454.05-N(C)-013, Qualification of Wall-to-Wall/Floor-to-Floor Supports, April 1987

4.4 SWEC-PSAS Report No. 15454.05-N(C)-012, Revision 1, Qualification of Corner Supports, June 2, 1987

SUBAPPENDIX A4

PIPE SUPPORT/SYSTEM STABILITY

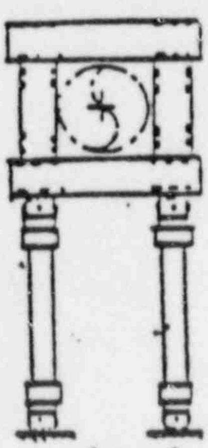
1.0 Definition of the Issue

The issue (References 4.1 through 4.5) was that certain pipe support configurations installed at CPSES were potentially unstable or their buckling capacity was not properly evaluated. An unstable support is defined as a support that can shift or move to an unqualified position. An unqualified position is a position other than that assumed in the piping stress analysis. A related issue was that the stability of the overall piping systems must be assured.

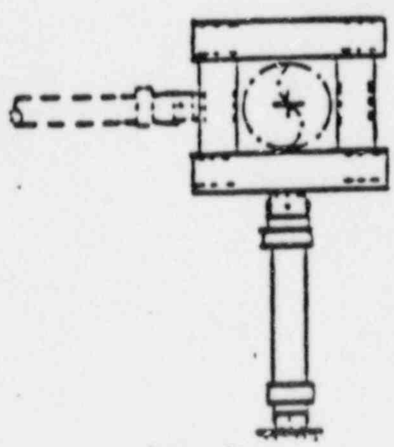
1.1 Potentially Unstable Support Configurations

The following are configurations whose buckling capacity was not properly assessed, or which were potentially unstable because they had the potential to move axially along the pipe and/or rotate around the pipe, creating a three-pin linkage system.

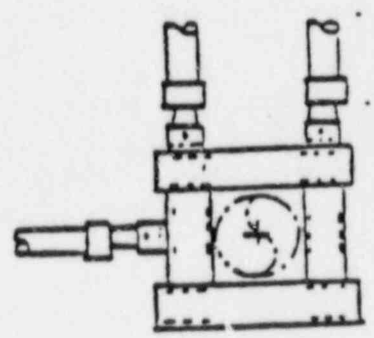
1.1.1 Zero-Clearance Box Frames Supported by Single and/or Multiple Struts or Snubbers



Case 1

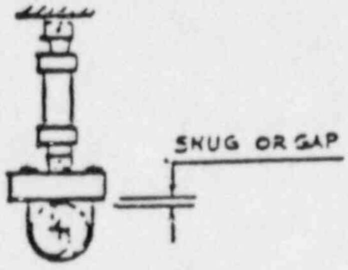


Case 2

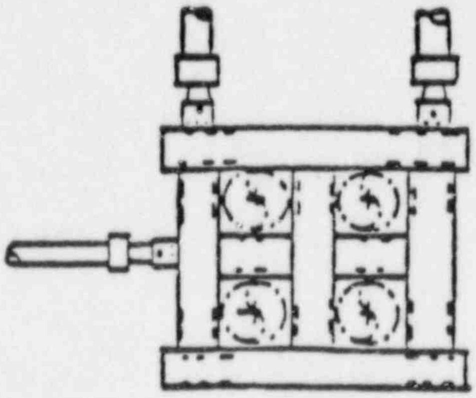


Case 3

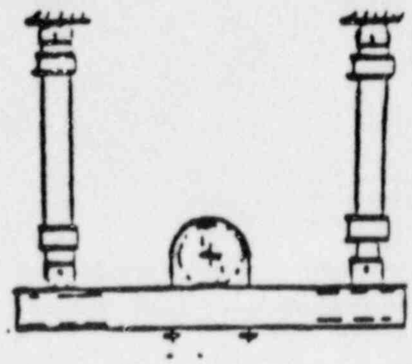
1.1.2 Uncinched U-Bolts on Single Strut or Snubber



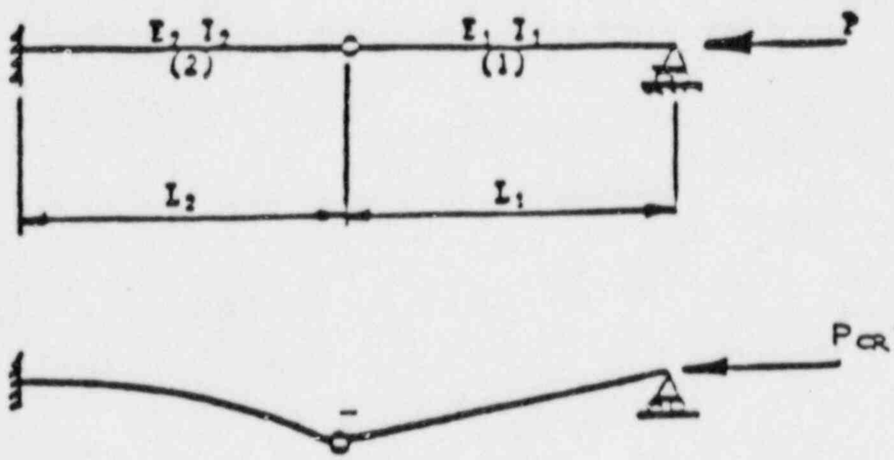
1.1.3 Multi-Strutted Frame Gang Supports



1.1.4 Trapeze Supports With U-Bolts



1.1.5 Column-Strut Stability



1.2 System Stability

The stability of the overall piping system is dependent upon the stability of each individual support. The issue was that if there were unstable supports in a piping system, then the overall system would be unstable.

2.0 <u>Issue Resolution</u>

2.1 Potentially Unstable Support Configurations

A stable support is a support that cannot shift or move to an unqualified position. Unqualified position means a position that exceeds the specified tolerances from the position assumed in the pipe stress analysis.

The stability of supports was assured by qualifying column-strut supports and by modifying potentially unstable configurations in accordance with CPPP-7, Section 4.2.4 and Attachment 4.9, as follows:

2.1.1 Zero-Clearance Box Frame Supported by Single or Multiple Struts or Snubbers

These support types were either eliminated or modified, such as by removing the existing box frame and replacing it with a standard pipe clamp or rigid frame.

2.1.2 Uncinched U-Bolts on Single Strut or Snubber

All supports of this nature were eliminated or are being modified by replacing the U-bolt assembly with a design consistent with the required support function.

2.1.3 Multi-Strutted Gang Support Frames

These supports were redesigned as rigid frames.

2.1.4 Trapeze Supports With U-Bolts

All supports of this nature were eliminated or are being modified as described in Subappendix A12, Axial, Rotational, and Trapeze-Type Restraints.

2.1.5 Column-Strut Stability

A procedure to evaluate the critical buckling load of a column-supported strut was developed and is included in CPPP-7, Attachment 4-9.

2.2 System Stability

The stability of the overall piping system was assured by the following:

1) Each installed support was individually qualified to be stable (in accordance with the definition in Section 2.1).

2) The system integrity was analyzed and qualified to the ASME Section III, Division 1 Code allowables for deadweight, thermal, and applicable occasional loads (fluid transients) and seismic excitations in three orthogonal directions.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action to resolve the issue of pipe support and system stability was accomplished through the analysis methods and support modifications specified in CPPP-7, Section 4.2.4 and Attachment 4-9 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section III, August 22, 1983

4.2 CASE's Motions and Answer to TU Electric's Motions for Summary Disposition Regarding Stability of Pipe Supports, October 15, 1984

4.3 Testimony of N. H. Williams in Response to CASE Question of February 22, 1984, to CYGNA Energy Services

4.4 Letter to Mr. J. B. George of TU Electric from N. H. Williams of CYGNA in reference to stability of pipe supports, April 30, 1985

4.5 CYGNA Pipe Support Review Issues List, Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987.

SUBAPPENDIX A5

PIPE SUPPORT GENERIC STIFFNESS

1.0 Definition of the Issue

1.1 Generic Stiffness Methodology

The issue (References 4.1 through 4.6) was that there is no assurance that the assumed set of generic stiffness values used in the piping stress analyses were sufficiently representative of the stiffnesses of the installed supports. Therefore, the results of the pipe stress analyses may not be valid.

Supports were designed to allowable stresses and to a deflection limit of 1/16 in. for Level B (upset condition) loads. No check was performed on the support stiffness, since it was assumed that the 1/16-in. deflection limit would ensure that the actual support stiffness was acceptably close to the assumed values used in the piping stress analyses.

1.2 Pipe Support Stiffness Evaluation

It was also noted that the flexibilities of all pipe support components, such as U-bolts and base plates, should have been included in the support stiffness calculation.

1.3 Effect of Oversize Holes on Pipe Support Stiffness Evaluation

The bolt hole sizes for 1 in. diameter bolts were 1/16 in. larger than allowed by the ASME Section III Code of record. The issue was that these oversized holes were ignored in the pipe support deflection check and therefore could have an unconservative impact on the seismic analysis of the piping system.

2.0 Issue Resolution

2.1 Generic Stiffness Methodology

Pipe support stiffnesses were represented in the pipe stress analysis in accordance with CPPP-7, Section 3.10.8.

The following approach was followed to develop a generic stiffness methodology for CPSES.

2.1.1 Determination of Generic Values

The following three types of supports were selected from the CPSES pipe supports installed in the plant:

1) Rigid supports, including frames and struts

2) Anchors

3) Snubbers

For rigid supports, generic values were analytically developed (Reference 4.7) for groups of pipe sizes. For snubbers, generic values were based on snubber sizes.

The generic values for anchors were developed in terms of nondimensional values, which are independent of pipe sizes. The nondimensional stiffness values of all sample anchors for all pipe sizes can thus be used together in developing histograms.

2.1.2 Pipe Support Stiffness Histograms

For all the supports evaluated, stiffness values were calculated.

Histograms of the calculated stiffnesses (Reference 4.8) were developed and representative values (median values) determined.

2.1.3 Minimum Acceptable Stiffness for Use of the General Value

To assure that the use of generic values produce valid pipe stress analyses, a minimum stiffness value was established. The minimum stiffness was determined with consideration of its effect on thermal, static, and dynamic responses (Reference 4.7). This approach utilized simplified piping models and fundamental engineering principles.

2.1.4 Screening Procedure

Before the beginning of pipe stress analyses, each pipe support was assessed to determine if its stiffness falls above the minimum stiffness; if so, it was assigned the generic stiffness. When a pipe support's stiffness had been determined to fall below the minimum value, the calculated stiffness value was used in the pipe stress analysis in lieu of the generic value. A set of CPSES generic stiffness values and acceptable minimum values have been incorporated in the design criteria, CPPP-7, Section 3.10.8.

2.2 Pipe Support Stiffness Evaluation

In accordance with CPPP-7, Section 4.3.2.2, the stiffness of each component in the support assembly, such as vendor-supplied components, structural members, and base plates was assessed in the evaluation of the support stiffness.

To facilitate the support stiffness evaluation, the stiffnesses of commonly used supports and subassemblies have been provided in graphic and tabular forms and incorporated in Attachment 4-18 of CPPP-7.

2.3 Effect of Oversize Bolt Holes on Pipe Support Stiffness Evaluation

As discussed in Subappendix A13, Bolt Hole Gaps, CPSES anchor-bolt hole sizes were in compliance with ASME 1985 Summer Addenda NF-4721(a) and are not oversized. Therefore, consistent with industry practice, the effects of bolt hole gaps were not included in the support stiffness assessments.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action to resolve the issues regarding pipe support generic stiffness was accomplished by implementing the procedures provided in CPPP-7, Sections 3.10.8 and 4.3.2 and Attachment 4-18 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations) Section IX, August 22, 1983

4.2 Affidavit of CASE Witnesses J. Doyle and M. Walsh, CASE's Partial Answer to Applicants' Statement of Material Facts as to which there is no Genuine Issue Regarding Applicants' Use of Generic Stiffnesses Instead of Actual Stiffnesses in Piping Analysis, August 24, 1984, and August 27, 1984

4.3 CYGNA Phase 3 Final Report, TR-84042-01, Revision 1, Appendix J, Note 8, November 20, 1984

4.4 N. H. Williams (CYGNA) letter to V. Noonan (USNRC), Open Items Associated with Walsh/Doyle Allegations, CYGNA Letter No. 84042.022 dated January 18, 1985

4.5 Testimony of N. H. Williams in response to CASE questions of February 22, 1984, to CYGNA Energy Services

4.6 CYGNA Pipe Support Review Issues List Revision 4, CYGNA Letter No. 84056.120 dated September 18, 1987

4.7 SWEC-PSAS Report No. 15454-N(C)-003, Generic Pipe Support Stiffness Values for Piping Analysis, September 1986

4.8 Pipe Support Generic Stiffness Study, CPPA-48,974, TU Electric, February 13, 1986

SUBAPPENDIX A6

UNCINCHED U-BOLT ACTING AS A TWO-WAY RESTRAINT

1.0 Definition of the Issue

The issue (References 4.1 and 4.2) was that certain uncinched U-bolts attached to rigid frames were modeled and analyzed as one-way restraints (i.e., as providing restraint in the direction parallel to the axis of the threaded portion of the U-bolt) but will actually behave as two-way restraints (i.e., as stated above and laterally). This was viewed as having a two-fold effect:

1.1 Modeling

Failure to include the two-way restraining action of the U-bolts may invalidate the results of pipe stress analyses that utilized U-bolts modeled as one-way restraints.

1.2 Uncinched U-Bolt Qualification Guideline

Such U-bolts may not meet the manufacturer's recommended interaction limits when the lateral loads are applied.

2.0 Issue Resolution

2.1 Modeling

2.1.1 For pipe sizes equal to or greater than 8 in. NPS, uncinched U-bolts were replaced in the model with a component commensurate with the support function.

2.1.2 In the piping analysis, uncinched U-bolt supports for pipe sizes 6 in. and smaller that are attached to rigid frames were modeled as two-way restraints.

2.2 Uncinched U-Bolt Qualification Guideline

2.2.1 STRUDL models of U-bolts were developed to derive the stiffness value and resultant loading (moment, shear, and tension) at the attachment to the frame. For static (i.e., signed) loads, a friction coefficient of 0.3 was considered to act in the axial direction of the pipe. Resolution of the friction issue is discussed in Subappendix A7.

2.2.2 Based on the above STRUDL analyses, allowable U-bolt load ratings were developed.

2.2.3 The uncinched U-bolt qualification procedure was incorporated in Section 4.2.5.2 and Attachment 4-3 of CPPP-7.

2.2.4 Stiffness values for uncinched U-bolts, modeled as two-way restraints were developed and issued in CPPP-7, Section 4.3.2.2 and Attachment 4-18.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action to resolve the concern of U-bolts acting as two-way restraints was accomplished by implementing the criteria of CPPP-7, Sections 4.2.5.2 and 4.3.2.2, and Attachments 4-3 and 4-18 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law, (Walsh/Doyle Allegations) Section II, August 22, 1983

4.2 CASE's Answer to Applicant's Motion for Summary Disposition of CASE's Allegations Regarding U-Bolts Acting as Two-Way Restraints, August 20, 1984

SUBAPPENDIX A7

FRICTION FORCES

1.0 Definition of the Issue

The issue (References 4.1 through 4.4) was that friction loads were not considered in the original pipe support designs when the predicted pipe movement was less than 1/16 in.

2.0 Issue Resolution

Friction loads were considered in the validation of pipe supports at CPSES. Section 4.7.3 and Attachment 4-7 of CPPP-7 required that friction be considered in all load cases for noncyclic loads (i.e., static and/or steady state loads) regardless of the magnitude of pipe movement.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action to resolve the issue of friction forces was accomplished through the implementation of the criteria provided in CPPP-7, Attachment 4-7 during the design valiation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section XVI, August 22, 1983.

4.2 CASE's Answer to Applicants' Motion for Summary Disposition Regarding Consideration of Friction Forces in the Design of Pipe Supports with Small Thermal Movements, August 6, 1984.

4.3 CASE's Answer to Applicants' Reply to CASE's Answer to Applicants' Motion for Summary Disposition Regarding Consideration of Friction Forces, October 1, 1984.

4.4 CYGNA Pipe Support Review Issues List, Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987

SUBAPPENDIX A8

AWS VERSUS ASME CODE PROVISIONS

1.0 Definition of the Issue

The issue (References 4.1 through 4.4) was that certain aspects of weld design, welding practices, and the effects of punching shear (local stress) on structural members were not adequately addressed. The items discussed are grouped into the following four groups:

1.1 Skewed T-Joint Welds

The issue was that the effective throats of skewed T-joint welds were incorrectly calculated in the original design. The AWS angle limitation between the joined parts was violated in the evaluations of skewed T-joint welds at CPSES.

1.2 Effective Throat of Flare Bevel Welds

The issue was that since the ASME Code does not adequately address the determination of the effective throat for flare bevel welds, there is no assurance that the evaluations of these welds were properly performed.

1.3 Welding Practices

The issue was that since the ASME Code does not adequately address various welding practice related items such as preheat requirements, cap welding, weave welding, downhill welding, drag and work angles (which limit the space allowed for welders to function), and lap joint requirements, that these welding processes may not have been properly addressed in the existing welding procedures.

1.4 Punching Shear (Local Stress)

The issue was that punching shear has not been considered in the designs at CPSES since the ASME Code does not adequately address this subject. Local stresses, which can be significant, develop in the immediate vicinity of the joint between two members. Based on the relative sizes of items joined, one member tends to punch through the wall of the other.

2.0 Issue Resolution

2.1 Skewed T-Joint Welds

Pipe support welds at CPSES were installed in accordance with Weld Procedure BR-WPS-11032. Weld configurations contained in this procedure were qualified by testing in accordance with ASME Section III, Subsection NF requirements; therefore, the limitations of prequalified welds did not apply.

Guidelines for the design validation of the effective throat of skewed T-joint welds were incorporated in CPPP-7, Attachment 4-2. These requirements were consistent with AWS D1.1.

2.2 Effective Throat of Flare Bevel Welds

Resolution of the issue regarding the determination of the effective throat for flare bevel welds is addressed in Subappendix A10.

2.3 Welding Practices

Resolution of the issues regarding inadequate weld procedure-related items is addressed in Subappendix A27.

2.4 Punching Shear (Local Stress)

Resolution of the issue regarding the evaluation of local stresses in the walls of structural pipe support members is addressed in Subappendix A21.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- Pipe support modifications resulting from the resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action to resolve the issue of AWS versus ASME Code provisions was accomplished through the implementation of the criteria provided in Section 4.4 and Attachment 4-2 of CPPP-7 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle allegations), Section V, August 22, 1983.

4.2 CASE's Answer to Applicant's Statement of Material Facts as to which there is no Genuine Issue Regarding Certain Case Allegations Regarding AWS and ASME Code Provisions Related to Design Issues, August 4, 1984.

4.3 NRC Staff Response to Applicant's Motion for Summary Disposition on AWS and ASME Code Provisions on Weld Design, November 2, 1984.

4.4 Affidavit of David Terao on AWS and ASME Code Provisions on Weld Design, November 2, 1984.

SUBAPPENDIX A9

A500, GRADE B TUBE STEEL

1.0 Definition of the Issue

The original design of CPSES pipe supports used a design yield strength Sy of 42 ksi for A500, Grade B, tube steel (cold formed) in accordance with ASME Code Case N-71-9. Later versions of ASME Code Cases N-71-10 through N71-14 revised the yield strength from 42 ksi to 36 ksi. Therefore, the issue (References 4.1 through 4.4) was that all designs for tube steel supports at CPSES should be revised to incorporate the lower design yield strength.

2.0 Issue Resolution

2.1 Basis of ASME Code Case Revision

The basis of the ASME Section III NF Code Committee revision of ASME Code Case N-71-9 (42 ksi) to N-71-10 (36 ksi) is the concern that the yield strength in the heat-affected zone at weldments could be slightly reduced. Since test data were not available at the time to quantify the reduction, the ASME Section III Code allowable for A500 Grade B (cold-formed tube steel) was reduced to that of A501 (hot-formed). The Code Committee's action was considered a conservative measure.

The Code Committee has evaluated test data on this issue. The test data demonstrate that the yield strength in the heat-affected zone of A500 Grade B tube steel is not reduced below 46 ksi.

ASME Code Case N-71-15, which specifies Sy = 46 ksi for A500 Grade B7 tube steel in rectangular shapes, was issued in December 1986.

2.2 SWEC-PSAS Validation

The design of pipe supports using A500, Grade B tube steel at CPSES were validated using a yield strength of 36 ksi in accordance with CPPP-7, Section 4.7.2.1.

Pipe supports where the calculated stress exceeded 36 ksi but did not exceed 42 ksi were not modified. The yield stress of 42 ksi is based on ASME Section III Code Case N-71-9 which is consistent with CPSES licensing commitments and is acceptable and conservative in light of ASME Section III Code Case N-71-15 which specifies the allowable yield strength of A500 Grade B tube steel as 46 ksi.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- Pipe support modifications resulting from resolution of issues in Subappendix A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action to resolve the A500, Grade B tube steel issue was accomplished through the implementation of criteria provided in CPPP-7, Section 4.7.2.1, during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 Affidavit of W. P. Chen on Revised A500 Steel Yield Values, May 29, 1984

4.2 Testimony of N. H. Williams in Response to CASE Questions of February 22, 1984, to CYGNA Energy Services

4.3 Meeting Between CASE and TU Electric with SWEC in Attendance, Large Bore Pipe Supports, March 12, 13, and 14, 1987

4.4 CYGNA Pipe Support Review Issues List, Revision 4, Transmittal Letter No. 84056.120 dated September 18, 1987

SUBAPPENDIX A10

TUBE STEEL SECTION PROPERTIES

1.0 Definition of the Issue

1.1 Section Properties

The section properties for A500 Grade B cold-formed tube steel used in the pipe support design at CPSES had been obtained from three authoritative source documents. Each source document listed small differences in section properties based on different nominal corner tangent radii (RT) as follows:

a. AISC Manual of Steel Construction, 7th Edition, RT ≅ 3t. (t = thickness of tube steel wall)

b. 1974 Welded Structural Tube Institute (WSTI) Manual of Cold-Formed Welded Structural Steel Tubing, RT ≅ 1t.

c. AISC Manual of Steel Construction, 8th Edition, RT ≅ 2t.

These small differences in nominal section properties led to the contention that tube steel milled prior to 1980 had different corner radii and that tube steel had been procured for use at CPSES both prior to and after 1980. Therefore, the issue was that the vintage of the tube steel must be established and the proper section properties used (References 4.1 and 4.2).

1.2 Effective Throat of Flare Bevel Welds

The 8th Edition of AISC states that the effective throat of flare bevel groove welds is t_e = 5/16 R unless it can be established that a larger effective throat can be obtained. The design of flare bevel welds at CPSES used two different effective throats of t_e = 0.645t and t_e = t.

Because of the differences in assumed corner radii of tube steel, the effective throat evaluation of flare bevel welds was questioned.

1.3 Bolt Hole Effects

The issue was that the effect of bolt holes on section properties had not been considered in the design.

2.0 Issue Resolution

2.1 Section Properties

SWEC reviewed the material manufacturer's dimensional standards for A500, Grade B tube steel supplied to CPSES.

The review was performed for ASTM A500 (standard specification for cold-formed welded and seamless structural tubing in rounds and shapes), which included a 12-year span starting from issue date 1974 through 1986. Since the standard mill tolerances did not change during this period of time, it was concluded that the fabrication tolerances and section properties of tube steel members in CPSES have been maintained to a consistent standard.

SWEC-PSAS also confirmed that Welded Steel Tube Institute (WSTI) amended its 1974 issue to agree with the 8th Edition of the AISC. This amendment is the latest revision to date. These section properties are based on a nominal corner tangent radius of 2t and are considered representative of cold-formed tube steel.

SWEC-PSAS resolutions are summarized as follows:

- The use of section properties in AISC Manual of Steel Construction, 8th Edition is appropriate, since it represents the actual cold-formed tube steel used at CPSES.
- The 8th Edition of AISC is used by SWEC-PSAS in the selection of section properties for structural tube steel.
- SWEC-PSAS surveyed tube steel corner dimensions on installed supports at CPSES (Reference 4.3) and confirmed that the installed supports have a nominal 2t corner radius.
- Section 4.3.2.1 of CPPP-7 specifies that structural tube steel section properties are selected from the 8th Edition of the AISC steel manual.

2.2 Effective Throat of Flare Bevel Welds

SWEC-PSAS performed a survey of tube steel dimensions on installed ASME Section III, Subsection NF pipe supports at CPSES and weld tests of worst-case configurations to determine the appropriate effective throat to be used for flare bevel welds (Reference 4.3). Based on the results of this survey, it was concluded that an effective throat of $t_e = t - 1/16$ in. is justified for all tube sizes except TS 2 x 2. For TS 2 x 2 sections, an effective throat $t_e = t - 1/8$ in. is appropriate.

Existing welds on TS 2 x 2 sections are qualified to the t_e = t - 1/8 in. criteria, unless it is verified that the weld has a larger effective throat by performing a field inspection of the weld in accordance with the methods described in SWEC-PSAS Project Memorandum No. 140 (PM-140).

Specification No. 2323-MS-100 was revised on March 2, 1987 to assure that an effective throat of t_e = t - 1/16 in. is achieved for welds on TS 2 x 2 tube steel for any subsequent work.

Section 4.4 and Attachment 4-2 of CPPP-7, as amended by SWEC-PSAS PM-140, specify the effective throats of flare bevel welds.

2.3 Bolt Hole Effects

The section properties for tube steel are reduced for the effects of bolt holes as required by CPPP-7, Section 4.3.2.1 which is in accordance with the requirements of ASME Section III, Appendix XVII requirements.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- Pipe support modifications resulting from resolution of issues in Subappendix A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action for tube steel section properties and bolt hole effects was provided in Section 4.3.2.1 of CPPP-7. The corrective action for the effective throats of flare bevel welds was accomplished through the implementation of the criteria provided in Attachment 4-2 of CPPP-7 and SWEC-PSAS PM-140 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section XVIII, August 22, 1983

4.2 CASE's Answer to Applicants' Statements of Material Facts as to Which There Is No Genuine Issue Regarding CASE's Allegations Regarding Section Property Values, August 12, 1984

4.3 SWEC-PSAS Report No. 15454-N(C)-004, Survey of Structural Tube Steel Dimensions to Verify the Effective Throat of Flare Bevel Welds, March 1987

SUBAPPENDIX A11

U-BOLT CINCHING

1.0 Definition of the Issue

The following issues (References 4.1 through 4.6) were raised regarding the use of cinched U-bolt supports with single struts or snubbers.

1.1 Evaluation of the Cinched U-Bolt Assembly

The stresses in the run pipe, the U-bolt, and the support cross-piece due to the combined effect of preload (i.e., cinching), pipe thermal and pressure expansion, and external loadings were not considered in the design of the cinched U-bolt supports.

1.2 Use of SA-36 and A307 Material for Cinched U-Bolts.

1.2.1 Preload Maintenance

SA-36 material is similar to A307 material, which is prohibited in the AISC Code, 7th Edition, Table 1.5.2.1, as bolting material in friction connections. Maintenance of joint preload is the underlying issue.

1.2.2 Fatigue

ASME Section III, Appendix XVII, Table XVII-3230-1, Footnote 4, and AISC 7th Edition, Appendix B, Table B2, Footnote 4, recommend that A307 bolts not be used in connections subject to stress reversal. Fatigue of the A307 material is the issue. Both these issues regarding the use of A307 material were extended to the SA-36 U-bolt used in cinched U-bolt supports.

1.3 Preload-Torque Relationship

The established preload-torque relationship was questioned, especially in light of the potential for galling under U-bolt nuts while tightening.

1.4 Stability of Cinched U-Bolt Supports

The stability of the cinched U-bolt pipe support assembly is dependent on attaining and maintaining the required preload. In light of the uncertainty in the preload-torque relationship, as discussed in Section 1.3, and the issue regarding the fatigue life and preload maintenance ability of A307 material, as discussed in Section 1.2, the stability of cinched U-bolt supports with struts and snubbers was questioned.

2.0 Issue Resolution

Due to the extensive engineering effort required to validate cinched U-bolt type supports with struts or snubbers, and the uncertainty in the ability to attain and maintain required preload levels, all cinched U-bolt supports with struts or snubbers are deleted or modified to other stable support designs consistent with the required support functions.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action to resolve the issues of 1) the proper evaluation of the pipe and cinched U-bolt assembly, 2) the use of SA-36 material in cinched U-bolts, 3) the preload-torque relationship, and 4) stability, is being accomplished through the elimination or modification of cinched U-bolt supports with struts or snubbers in accordance with the criteria provided in CPPP-7, Section 4.2.5.1 used during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Finding of Fact and Conclusions of Law, (Walsh/Doyle Allegations) Section IV, August 22, 1983

4.2 ASLB Memorandum and Order at 27, 28, 33-41, December 28, 1983, and reconsidered in Memorandum and Order at 25-6A, 20-4C, February 8, 1984

4.3 Westinghouse Report No. WCAP-10620, U-bolt Support/Pipe Test, July 1984

4.4 Westinghouse Report No. WCAP-10627, U-bolt Support Assembly Finite Element Analysis, July 26, 1984

4.5 CASE Answer to Applicant's Statement of Material Facts as to Which There is No Genuine Issue Regarding to Consideration of Cinched U-bolts, Affidavit of CASE Witness J. Doyle, October 8, 1984

4.6 CYGNA Pipe Support Review Issues List (RIL), Revision 4, Transmittal Letter No. 84056.120 dated September 18, 1987

SUBAPPENDIX A12

AXIAL/ROTATIONAL RESTRAINTS

1.0 Definition of the Issue

Three groups of axial and/or trapeze-type supports listed below use welded lug or trunnion attachments to transfer loads to frames or component hardware.

a. Single or dual trunnions with component supports

b. Non-trunnion component supports

- Trapeze supports with U-bolts
- Riser clamps with dual components
- Riser clamps with single components

c. Frame supports with lugs

The issues (References 4.1 and 4.2) regarding these specific types of supports are summarized as follows:

1.1 Rotational Load

The issue was that rotational restraint effects must be treated as a primary load for the support design.

1.2 Eccentric Loading

The issue was that eccentric loading, which can result from effects such as differential snubber lockup and support steel stiffness variations, must be considered in the design process.

1.3 Snubber Lockup

The issue was that snubber end clearance effects may cause significant increase in loads or invalidate linear analysis results.

1.4 Lug/Frame Design Load

The issue was that multiple lug configurations must consider a conservative loading distribution for lug and frame design.

1.5 Clearances

The issue was that insufficient clearances or eccentricities may exert rotational restraint on the pipe.

2.0 Issue Resolution

2.1 Rotational Load

The eccentric line of action of single component riser clamps and single axial trunnion, and the rotational resistance to the pipe of dual trunnion-type supports, were modeled in the pipe stress analysis. The pipe supports were design validated considering the resulting load as a primary load.

2.2 Eccentric Loading

The effect of differential snubber lockup in the dual trunnion support was addressed by increasing the design load on each trunnion snubber and its supporting structure by 20 percent. The variation in support steel stiffnesses for dual component riser clamps was addressed by limiting the acceptable variation in stiffness between the supporting structures for each component and increasing the component design load from 50 percent to 75 percent of the total support design load.

Four lugs are typically used for nonintegral axial clamp supports. Each lug was validated to 50 percent of the total load for dual component supports modeled as a single component.

Dual component riser clamps with variations in support stiffnesses exceeding the acceptable value were modeled in the stress analysis as eccentric (one-sided) translational restraints, and the support is being modified by the removal of the component on the softer side. For such eccentrically modeled supports, the load for each lug is based on statics with the assumption that all of the moment is reacted at the lugs, i.e., the clamp-to-pipe connection does not resist the moment.

Trapeze supports with cinched U-bolts are being eliminated or modified to provide a stable support configuration consistent with support function as discussed in CPPP-7, Attachment 4-8.

2.3 Snubber Lockup

To assure valid stress analysis results, snubber pairs used in dual component applications (dual trunnions and riser clamps) are matched as defined in Reference 4.3.

2.4 Lug/Frame Design Load

Lugs for rigid frame-type axial restraints were each validated for the total load if only two lugs are used, or 50 percent of the total load if four lugs are used.

Analysis of load distribution at lug/frame interfaces was based on CPPP-7, Attachment 4-8, which maximized the critical stress in the frame.

2.5 Clearances

The clearances between the pipe and the frame and the lugs and riser clamps and frame are controlled in accordance with CPPP-7, Attachment 4-11 to assure proper function of the pipe support. Pipe support eccentricities are discussed in Section 2.2 above.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action to resolve the issue of axial/rotational restraints was accomplished through the implementation of the criteria in CPPP-7, Section 3.10.6.2 and Attachment 4-8 of CPPP-7.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section XII, August 22, 1983

4.2 Affidavit of Case Witness Mark Walsh - CASE's Partial Answer to Applicant's Statement of Material Facts as to Which There was No Genuine Issue Regarding Allegations Concerning Consideration of Force Distribution in Axial Restraints, August 27, 1984

4.3 Nuclear Standard, Mechanical and Hydraulic Snubbers for Nuclear Application, NE-E7-9T, September 1984, U.S. Department of Energy, Nuclear Energy Program

SUBAPPENDIX A13

BOLT HOLE GAP

1.0 Definition of the Issue

Bolt hole gap, as used herein, refers to the radial clearance between an anchor bolt and the bolt hole edge in pipe support member/base plates. Issues regarding the effect of bolt hole gaps are as follows (References 4.1 to 4.4):

1.1 Oversized Holes

The issue was that bolt holes in support base plates are oversized. Bearing connections are not allowed if the bolt hole is greater than the standard size hole specified by the AISC Code.

1.2 Shear Distribution

The issue was that it is impossible to predict how many bolts are involved in the transfer of shear. Inelastic action that distributes the shear load to all anchor bolts is appropriate for static loads only.

1.3 Effect on Support Stiffness

The issue was that the presence of gaps in joints under dynamic conditions adversely affects the stiffness of the pipe support and its seismic response. The usual procedure is to assume that two bolts react to the load regardless of the number of bolts in the pattern.

2.0 Issue Resolution

2.1 Oversized Holes

Hole sizes allowed by the ASME Section III Code, paragraph NF-4721, were compared to existing hole sizes at CPSES as shown below.

ASME Code Table NF-4721(a)-1 specifies the allowable bolt hole sizes for bearing-type connections as follows:

Bolt Size	Hole Size
Equal to or less than 1 in.	Bolt diameter +1/16 in.
Between 1 and 2 in.	Bolt diameter +1/8 in.

The allowable bolt hole sizes of the installed CPSES base plates were as follows:

Bolt Size	Hole Size
Equal to or less than 3/4 in.	Bolt diameter +1/16 in.
1 in. to 1 1/2 in.	Bolt diameter +1/8 in.

Therefore, it was concluded that only the bolt holes for 1-in. diameter bolts at CPSES have an allowable size larger than the code allowable (by 1/16 in.). The 1985 Summer addenda of the ASME Section III Code, paragraph NF-4721(a) clarified that for anchor bolts, the hole size may be increased by 1/16 in. over the values specified in Table NF-4721(a)-1.

ASME Section III, 1985 Summer Addenda NF-4721(a) was added to the CPSES Code of Record in CPPP-7, Section 2.2, and Specification No. MS-46A (Reference 4.5).

2.2 Shear Distribution

Design of base plate connections at CPSES is based on standard steel design practices where equal shear load sharing among bolts is used. This practice is described in References 4.6 and 4.7, which compare the ultimate shear load sharing in plate connections to the equal distribution assumed at design levels.

Support designs at CPSES were examined and it was concluded that the Richmond insert to tube steel connection may not be covered by these normal practices. Therefore, Richmond insert to tube steel connection designs are reviewed in accordance with SWEC-PSAS Project Memorandum No. 141 (PM-141) to confirm that unequal shear load sharing is not an issue.

2.3 Effect on Support Stiffness

The effect of bolt hole gap on support stiffness is discussed in Appendix A5.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action to resolve the bolt hole gap issue was accomplished through the implementation of the criteria provided in CPPP-7, Attachments 4-4 and 4-5, SWEC-PSAS PM-141, and Specification No. MS-46A during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section XXI, August 22, 1983

4.2 CASE's Answer to the Applicants' Statement of Material Facts in the Form of Affidavit of CASE Witness M. Walsh, August 12, 1984

4.3 CYGNA's response to CASE Question No. Doyle 16

4.4 CASE's 4th Round Answer to Applicants' Reply to CASE's Answer to Applicants' Motion for Summary Disposition Regarding the Effects of Gaps, December 19, 1984

4.5 Comanche Peak Nuclear Safety Class Pipe Hangers and Supports Specification No. 2323-MS-46A, Revision 7, July 6, 1987

4.6 B. Kuzmanovic and N. Williams, Steel Design for Structural Engineer, 2nd Edition, 1983, Prentice Hall, Inc., page 321

4.7 C. Salmon and J. Johnson, Steel Structures Design and Behavior, 1971, Intext Educational Publishers

SUBAPPENDIX A14

OBE/SSE DAMPING

1.0 Definition of the Issues

The issue (References 4.1 to 4.4) was that the improper damping values were used in the stress analysis at CPSES.

1.1 NRC Regulatory Guide 1.61 Damping

The issue was that piping systems containing active components (e.g., valves) used the damping for piping which was higher than the damping prescribed by NRC Regulatory Guide 1.61 (Reference 4.5) for active valves.

Damping values higher than the allowables in NRC Regulatory Guide 1.61 were used in the pipe stress analysis at CPSES.

1.2 Damping for Mixed Size Piping

The issue was that in certain pipe stress analysis packages which are comprised of piping of different sizes, the damping values for the 12-in. or greater piping were used even though the pipe stress analysis package contained piping smaller than 12 in.

2.0 Issue Resolution

2.1 NRC Regulatory Guide 1.61 Damping

CPPP-7 Section 3.4.5.4.1 specified the use of NRC-recommended damping values for piping addressed in NRC Regulatory Guide 1.61. In fact, the NRC has recently approved the higher damping values for piping systems contained in ASME Code Case N-411 (Reference 4.6). Therefore, the lower damping for active components in NRC Regulatory Guide 1.61 is not applicable to the CPSES piping system analysis.

2.2 Damping for Mixed Size Piping

CPPP-7 specified that mixed-size piping systems (containing pipes above and below 12-in. NPS) are conservatively evaluated with the lower damping values of NRC Regulatory Guide 1.61.

Use of the damping values specified in ASME Code Case N-411 that are applicable to all pipe sizes was approved for implementation at CPSES by the NRC Staff. CPPP-7 authorized the use of Code Case N-411 for all systems, including mixed-size CPSES piping systems, except where stress analysis is performed using the Independent Support Motion Method.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- All the pipe support modifications resulting from resolution of issues in Subappendix A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action to resolve OBE/SSE damping issue was accomplished through the implementation of the criteria provided in CPPP-7, Section 3.4.5.4.1 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section XXII, August 22, 1983

4.2 CASE's Answer to Applicant's Motion for Summary Disposition Regarding Alleged Errors Made in Determining Damping Factors for OBE and SSE Loading Conditions, August 6, 1984

4.3 CASE's Answer to Applicant's Reply to CASE's Answer to Applicant's Motion Regarding Alleged Errors Made in Determining Damping Factors for OBE and SSE Loading Conditions, October 2, 1984

4.4 CYGNA Pipe Stress Review Issues List, Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987

4.5 USNRC Regulatory Guide 1.61, Damping Values for Seismic Design of Nuclear Power Plants, October 1973

4.6 NRC Letter from V. S. Noonan to W. G. Counsil dated March 13, 1986, Evaluation of Request for Use of ASME Code Cases N-397 and N-411

SUBAPPENDIX A15

SUPPORT MASS IN PIPING ANALYSIS

1.0 Definition of the Issue

The issue was that the mass contribution of the support to the piping system is significant and it cannot be omitted from the analysis (Reference 4.1).

The support mass contribution to the piping model was not always considered in the CPSES pipe stress analysis, because it was considered small relative to the total mass of the piping system.

2.0 Issue Resolution

The support mass, eccentric and noneccentric, was accounted for in pipe stress analyses in accordance with CPPP-7, Section 3.10.4. A detailed procedure for pipe support mass determination and inclusion in the piping system analysis was included in Attachment 3-4 of CPPP-7, with additional guidance on the modeling of eccentric mass included in Attachment 3-11.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- All the pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action to resolve the support mass in piping analysis issue was accomplished through the implementation of the criteria provided in CPPP-7, Attachments 3-4 and 3-11 during the design validation.
- The preventive action for this issue is specified in Appendix C.

4.0 References

4.1 CASE'S Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section XIV, August 22, 1983

SUBAPPENDIX A16

PROGRAMMATIC ASPECTS AND QA INCLUDING ITERATIVE DESIGN

1.0 Definition of the Issue

The following miscellaneous issues with programmatic aspects and QA were identified (References 4.1 and 4.2).

1.1 Fragmented Responsibility and Interface Control

The issue was that inadequate interface control and fragmented responsibilities between analysis, design, and construction phases of piping and support design phases resulted in numerous inadequacies and inconsistencies.

1.2 Iterative Design

The issue was that the identification and correction of design errors was delayed until the end of the iterative design process.

1.3 Quality Assurance and Personnel

The issue was that calculations did not follow project guidelines for quality assurance. No standards were specified for the qualification of personnel at different levels.

1.4 Timeliness

The issue was that problems which were generic in nature were not resolved promptly, resulting in numerous deficiencies of a similar nature.

1.5 Construction and Field Changes

The issue was that procedures for construction and installation were inadequate and were not kept up to date. Field changes were not approved, and resulted in calculations justifying as-built conditions.

1.6 Procedures

The issue was that frequent changes and lack of adequate control of procedures resulted in many violations of the procedures.

1.7 Calculation Errors

The issue was that in random checks of calculations, numerous errors were found.

1.8 Miscellaneous

The issue was that various other issues were raised regarding the updating of criteria and the adequacy of various practices used in design/qualification activities.

2.0 Issue Resolution

SWEC-PSAS's Management Plan for Project Quality, CPPP-1 (Reference 4.3), outlines SWEC-PSAS's approach to resolving the various programmatic issues through issuance of Project Procedures, which implement SWEC corporate procedures (Engineering Assurance Procedures, and Quality Standards). CPPP-1 addresses each of the 18 criteria of 10CFR50, Appendix B. The individual issues listed in Section 1.0 are resolved as follows:

2.1 Fragmented Responsibility and Interface Control

The issue of fragmented responsibility between piping analysis and support design was resolved by the integrated design process in the SWEC-PSAS validation program.

All ASME Section III Code Class 2 and 3 piping systems and all ASME Section III Code Class 1, 2, and 3 supports were validated by SWEC-PSAS in accordance with CPPP-7 which provides consistent criteria for both pipe stress analysis and pipe support design. Each pipe stress analysis package was reviewed in accordance with Section 7.3 of CPPP-6, as a system, by pipe stress and pipe support engineers to assure that the interactions between the pipe stress and the pipe support efforts are properly accounted for in the SWEC-PSAS portion of the Corrective Action Program (CAP).

As part of the integrated design process, interfaces between analysis, design, and construction are controlled in accordance with CPPP-6. Personnel performing the validation effort are trained by project management in the use of the applicable project procedures.

2.2 Iterative Design

Design criteria changes were issued during the pipe stress and pipe support validation by means of controlled documents (project memoranda) and revisions to CPPP-7. Prompt review was required for any design criteria changes containing the potential for support modification.

As-built verification of piping and pipe supports is being performed as part of the PCHVP. All modifications are provided to TU Construction via procedurally controlled design change documentation prepared by SWEC-PSAS.

2.3 Quality Assurance and Personnel

SWEC-PSAS's Management Plan for Project Quality (CPPP-1) identifies the procedures to be followed during the generation and review of project calculations. These procedures appropriately emphasize review of calculations for technical adequacy of the resulting designs (calculation conclusions). The emphasis on review for technical adequacy assures that any inconsistencies/documentation discrepancies will not affect the overall conclusion of the calculations. All identified occurrences of inconsistencies and documentation discrepancies are promptly resolved.

Engineering personnel are assigned to tasks after an evaluation of their ability to perform that task. This evaluation is initiated by verification of the employee's academic and professional credentials and employment history in conjunction with the normal employment interviews. Personnel are then assigned to work at an appropriate level under a supervisor. The supervisor is responsible for evaluating and training the employee. This process assures that appropriately qualified personnel are assigned to all engineering tasks.

Personnel involved in the validation effort were trained in the use of the applicable project procedures.

2.4 Timeliness

Early in the validation process, all CPRT and external issues were identified and SWEC-PSAS resolutions to these issues were developed.

During the design validation, any additional issues identified were addressed in a timely manner and appropriate corrective and preventive actions identified and implemented.

2.5 Construction and Field Changes

Field changes were controlled by SWEC-PSAS project procedures which required that new designs, modifications, or reconciliations with as-built conditions be documented and approved by qualified responsible engineers. Walkdowns in accordance with SWEC-PSAS procedures, as well as inspection under the PCHVP, assured that the as-built condition of piping and pipe supports was properly reflected in the design validation.

2.6 Procedures

Controlled copies of CPPP-6 and CPPP-7 (and revisions/changes thereto) were issued to the pipe stress and pipe support supervisory personnel assigned to the SWEC-PSAS CPSES effort.

The issuance and modification of these procedures are controlled in accordance with CPPP-14 (Reference 4.4).

Revisions to these procedures were followed by detailed training of pipe stress and support personnel.

2.7 Calculation Errors

As addressed under paragraph 2.3 above, the SWEC QA Program assures the technical adequacy of the engineering product. SWEC-PSAS requires all employees to develop technically correct and precise calculations. Whenever documentation discrepanices are observed, they are promptly corrected.

2.8 Miscellaneous

The various project procedures used in the validation effort along with the corporate engineering and quality assurance procedures were sufficient to address any issues related to the validation of pipe stress and pipe supports at CPSES. This conclusion was also reached by the third party reviewers (see Section 5.1.1).

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action to control discipline interfaces and to provide consistent design criteria between pipe stress analysis and pipe support design was accomplished through the issue and control of CPPP-1, CPPP-6, CPPP-7, and other project procedures during the design validation. Many audits were conducted to assure that SWEC-PSAS personnel followed the procedures (see Section 5.3).

- The preventive action for this issue is specified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), August 22, 1983

4.2 Comanche Peak Response Team, Design Adequacy Program, Discipline Specific Results Report, Piping and Supports, DAP-RR-P-001, Revision 1, August 27, 1987

4.3 SWEC-PSAS Project Procedure CPPP-1, Revision 7, Management Plan for Project Quality (Piping System Qualification/Requalification), March 25, 1987

4.4 SWEC-PSAS Project Procedure CPPP-14, Revision 3, Procedure for the Preparation and Control of Project Procedures, September 19, 1986

SUBAPPENDIX A17

MASS POINT SPACING

1.0 Definition of the Issue

The issue (Reference 4.1) was that the project procedures which established requirements for minimum mass point spacing were not followed and that the computer program used improperly lumped concentrated masses.

2.0 Issue Resolution

Modeling guidelines for locating the mass points in the computerized pipe stress analysis were included in Section 3.10.6.1 and Attachment 3-7 of CPPP-7. To assure adherence to these requirements, mass point spacing was included as a review item in the pipe stress analysis checklist in CPPP-6, Attachment 9-9.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- All the pipe support modifications resulting from resolution of issues in Subappendix A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action to resolve the issue of mass point spacing was accomplished through the implementation of the criteria provided in CPPP-7, Section 3.10.6.1 and Attachment 3-7 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CYGNA Pipe Stress Review Issues List, Revision 4, and Transmittal Letter No. 84056.119, dated September 16, 1987

SUBAPPENDIX A18

HIGH FREQUENCY MASS PARTICIPATION

1.0 Definition of the Issue

The issue (References 4.1 and 4.2) was that the 33-Hz cutoff frequency criteria used in the CPSES pipe stress seismic analysis may not be adequate. The pipe stress analysis did not comply with the CPSES FSAR requirement that the inclusion of high frequency modes beyond the cutoff frequency in the response spectrum analysis do not result in more than a 10-percent increase in the system response.

2.0 Issue Resolution

Two analysis options were developed and utilized to address the high-frequency mass participation issue.

- Perform seismic amplified response spectrum (ARS) modal analysis with 50-Hz cutoff frequency, including a high-frequency missing mass correction option, by using NUPIPE-SW (V04/L02) or later issue.

- Perform an equivalent static analysis by using the zero-period acceleration (ZPA) values in all three directions. Combine these results by the square root of the sum of the squares (SRSS) method with the results of the seismic analysis with a 50-Hz cutoff frequency that did not include the high-frequency missing mass correction. Additional studies (Reference 4.3) verified the adequacy of this methodology for CPSES piping systems whose ZPA is less than 50 Hz.

The high-frequency mass participation criteria was specified in Section 3.10.6.8 of CPPP-7.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.

- All the pipe support modifications resulting from resolution of issues in Subappendix A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action to resolve the high frequency mass participation issue was accomplished through the implementation of the criteria provided in CPPP-7, Section 3.10.6.8 and the use of NUPIPE-SW(V04/L02) during design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 Question 2, CYGNA Communications Reports, J.O.No. 83090 dated October 5, 1983

4.2 CYGNA Pipe Stress Review Issues List, Revision 4, CYGNA Letter No. 84056.119 dated September 16, 1987

4.3 SWEC-PSAS Letter No. CH-1CPO-1456 dated February 6, 1987, from A. Chan to L. Nace, Attachment A, Justification for Terminating Comanche Peak Piping Response Spectrum Analysis at 50 Hz Instead of at the Frequency Corresponding to the Zero Period Acceleration

SUBAPPENDIX A19

FLUID TRANSIENTS

1.0 Definition of the Issue

Fluid transients are occasional mechanical loads that should be considered in stress evaluation of ASME Section III Code Class 2 and 3 piping. The previous analysis prepared for CPSES considered fluid transients on several piping systems. The issue was that the adequacy of the analysis and the completeness of the identification of these fluid transients was questioned (Reference 4.1).

2.0 Issue Resolution

The following process was followed to assure that fluid transients were properly addressed in the SWEC-PSAS validation of the pipe stress analysis.

- Specific fluid transients were identified and summarized in Attachment 1 of CPPP-10. These transients were identified by following the guidelines given in NUREG-0582, past experience with other PWRs, and by assessing an overall review of the CPSES system flow diagrams. Additionally, system engineers reviewed the piping system operating components which could produce significant fluid transients, such as rapid valve opening or closing actions of control valves, relief valve discharge, pump startup or trip, and turbine trip.

- The piping systems identified in Attachment 1-1 of CPPP-10 were analyzed for the effects of fluid transients in accordance with the requirements of CPPP-7, Section 3.4.5.5 and Attachment 3-1. These analysis methods resolve CPRT and external fluid transient issues.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action to resolve the fluid transient issue was accomplished through the implementation of the criteria provided in CPPP-7, Attachment 3-1 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 TES draft Letter No. 6216-7 dated February 21, 1985, from D. F. Landers to V. S. Noonan, Director, Comanche Peak Project, U.S. Nuclear Regulatory Commission, which transmitted Technical Report No. TR-6216B, Preliminary Consulting Report on Comanche Peak Steam Electric Station - Piping and Support Design

SUBAPPENDIX A20

SEISMIC EXCITATION OF PIPE SUPPORT MASS

1.0 Definition of the Issue

The issue was that the effect of seismic acceleration of the support mass (i.e., self-weight excitation) was not included in the design of the CPSES pipe support structures (References 4.1 and 4.2).

2.0 Issue Resolution

SWEC-PSAS resolved these issues by the following methodology:

- Seismic acceleration of pipe support mass was evaluated for all pipe supports with frames on seismic systems.
- The procedure to include the effects of pipe support self-weight excitation in the pipe support evaluation was incorporated in CPPP-7 as Attachment 4-21.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action to resolve the seismic excitation of pipe support mass issue was accomplished through the implementation of the criteria provided in CPPP-7, Attachment 4-21 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), August 22, 1983, Section X

4.2 NRC Inspection Report 50-445/82-26 and 50-446/82-14, February 14, 1983 (NRC Staff Exhibit 207, pages 34, 35, and 36)

SUBAPPENDIX A21

LOCAL STRESS IN PIPE SUPPORT MEMBERS

1.0 Definition of the Issue

The issues (References 4.1 through 4.6) regarding the evaluation of local stress in pipe support members are as follows:

1.1 Local Stress in Tube Steel Members

The issue was that local stress in tube steel members, induced by attached support components, such as beam brackets, lugs, or other tube steel members, was not considered in the design.

1.2 Other Support Configurations Requiring Local Stress Evaluations

The issue was that several other support types and support details were identified as requiring evaluations for local stresses:

- Cinched U-bolt supports with struts and snubbers
- Piping anchors
- Zero gap box frames
- Wide flange webs at connections

1.3 Short Beam Stresses

The issue was that short structural members were incorrectly analyzed in full flexure. It was noted that more localized stress distribution due to plate behavior would result.

2.0 Issue Resolution

Attachment 4-13 of CPPP-7 specified the requirements to evaluate local stresses in pipe support members.

2.1 Local Stress in Tube Steel Members

A procedure to evaluate local stress in tube steel members based on the methods of AWS Code D1.1 Section 10.5, including yield line analysis, was developed and incorporated in Attachment 4-13 of CPPP-7.

2.2 Other Support Configurations Requiring Local Stress Evaluations

Resolutions for the issue regarding the need for local stress evaluations on other support configurations is as listed below:

- Cinched U-bolt supports on struts and snubbers are being eliminated or modified as discussed in Subappendix A11.

- Resolution of the issue regarding the local stress evaluation for piping anchors is addressed in Subappendix A2
- Zero gap box frames are being eliminated or modified as discussed in Subappendix A2
- Requirements for the evaluation of local stresses in wide flange member webs at connections, consistent with the AISC Code requirements, were developed and incorporated into Attachment 4-13 of CPPP-7

2.3 Short Beam Stresses

Attachment 4-13 of CPPP-7 requires that short beam support members be analyzed for local stress effect.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendix A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action to resolve the issue of local stress in pipe support members was accomplished through the implementation of the criteria provided in CPPP-7, Attachment 4-13 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section IX, August 22, 1983

4.2 CASE's Answer to Applicants' Statement of Material Facts as to Which There is No Geniune Issue Regarding Consideration of Local Displacements and Stresses, August 27, 1984.

4.3 CASE's Answer to Applicant's Reply to CASE's Answer to Applicants' Motion for Summary Disposition Regarding Local Displacements and Stresses, October 9, 1984.

4.4 NRC Staff Response to Applicant's Motion for Summary Disposition on AWS and ASME Code Provisions on Weld Design, November 2, 1984

4.5 CASE's Answer to Applicant's Motion for Summary Disposition of Certain CASE Allegations Regarding AWS and ASME Code Provisions Related to Design Issues, August 6, 1984

4.6 Transcript of Proceedings Before the United States Nuclear Regulatory Commission, Washington, DC, in the Matter of Meeting to Conduct Feedback Discussions with Messrs. Walsh and Doyle Re Concerns About the Comanche Peak Plant Held March 23, 1986

SUBAPPENDIX A22

SAFETY FACTORS

1.0 Definition of the Issue

The issue (References 4.1 and 4.2) was that the industry practice of neglecting to factor small potential loads into design calculations is not supported by adequate CPSES factors of safety. The issue also was that CPSES safety factors had already been eroded by poor and insufficient design practices.

2.0 Issue Resolution

CPRT and external issues have been resolved and incorporated into the technical and design control procedures. Therefore, the inherent design margin (safety factor) accumulated from the built-in conservatisms in codes, inputs, and regulatory positions is applicable.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action to resolve the issue of safety factors has been implemented in the SWEC-PSAS Corrective Action Program (CAP) through the resolution of all applicable CPRT and external issues which have been incorporated into the technical and design control procedures.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section I, August 22, 1983

4.2 CASE's Partial Answer to TU Electric's Statement of Material Facts as to Which There is No Genuine Issue Regarding Safety Factors, August 27, 1984

SUBAPPENDIX A23

SA-36 AND A307 STEEL

1.0 Definition of the Issue

The following issues were identified (References 4.1 through 4.3) regarding the use of SA-36 and A307 material in pipe supports at CPSES.

1.1 Design Allowables Derived from Tests

The issue was that the material allowables used in the design of cinched U-bolts, U-bolts as two-way restraints, and SA-36 threaded rod used with Richmond inserts for pipe supports at CPSES were derived from tests and not from the ASME Section III Code minimum yield stress, since questions arose as to whether the material tested in the following tests represented the actual material used onsite.

1.1.1 Cinched U-Bolt Tests Conducted by Westinghouse

1.1.2 U-Bolts as Two-Way Restraints Tests Conducted by ITT Grinnell

1.1.3 Richmond Insert Tests Conducted by TU Electric

1.2 Friction Connections

The issue was that AISC Code 7th Edition Table 1.5.2.1 prohibits the use of A307 as bolting material in friction connections. Attainment and maintenance of joint preload is the underlying issue. SA-36 and A307 materials are similar. ASME Section III Code Inquiry NI86-030 (Reference 4.4) clarifies that cinched U-bolts are not friction connections. However, since the U-bolt design relies on friction and preload to provide stability, the AISC prohibition needs to be addressed.

1.3 Fatigue

The issue was that SA-36 material used in cinched U-bolts, U-bolts as two-way restraints, and as rod, threaded into Richmond inserts, are subject to load cycling, which must be considered in the qualification. ASME Section III, Appendix XVII, Table XVII-3230-1, footnote 4; and AISC 7th edition, Appendix B, Table B2, footnote 4, state "Where stress reversal is involved, use of A307 bolts is not recommended." Fatigue of the A307 material is the issue. Since SA-36 material is similar to A307, this issue was extended to SA-36 U-bolts and threaded rods used with Richmond inserts.

1.4 Allowable Stresses in Bolting Material

The issue was that the allowable stresses used in the design of bolting material exceed the material yield strength under the faulted condition (Level D) service limit. This does not conform to the guidance of NRC Regulatory Guide 1.124, Reference 4.5, which limits the load increases to 1.5 times the normal operating (Level A) service limit, because of the potential for nonductile behavior.

1.5 Use of Low-Strength Nuts with High-Strength Bolts

The issue was that low-strength nuts, A563 Grade A, were used with high-strength bolting, instead of the code compatible A194 Grade B nut. The issue was that the resultant connection capacity should have been reduced in the analysis.

2.0 Issue Resolution

2.1 Design Allowables Derived from Tests

In accordance with CPPP-7, Section 4.2.5.1, cinched U-bolts with struts or snubbers are being eliminated or modified.

Design allowables for linear components, such as SA-36 U-bolts and SA-36 threaded rod used with Richmond inserts, were derived by SWEC-PSAS from the ASME Section III Code minimum yield strength specified in Section 2.2 of CPPP-7 and not from tests.

2.2 Friction Connections

In accordance with CPPP-7, Section 4.2.5.1, cinched U-bolts with struts or snubbers are being eliminated or modified.

U-bolts used as two-way restraints do not rely on preload for load transfer. Richmond insert connections were designed as bearing connections and do not rely on friction (preload) for load transfer capability.

2.3 Fatigue

U-bolts used as two-way restraints and SA-36 threaded rod used with Richmond inserts were subject to reversing stress fields due to seismic and fluid transient loads.

The SA-36 U-bolts used as two-way restraints as well as the threaded rod used with Richmond insert tube steel joints were designed as ASME Section III, linear NF support components in accordance with ASME Section III, Appendix XVII, and AISC, respectively. ASME Section III Code Appendix XVII Table XVII-3230-1 and AISC Code 7th Edition, Appendix B, Table B2, footnote 4 define the lower bound value for consideration of stress cycles as 20,000. SWEC-PSAS demonstrated that the number of equivalent stress cycles for these components was less than 7,000. Therefore, fatigue was not relevant as defined in these codes.

2.4 Allowable Stresses in Bolting Material

Bolting material was designed in accordance with ASME Section III, Paragraph NF-3225 Summer 1983 addenda, which limited the stresses at temperature at the faulted condition (Level D) to yield. The use of this later code paragraph assures ductile behavior and thus conforms to the guidance of NRC Regulatory Guide 1.124.

2.5 Use of Low-Strength Nuts with High-Strength Bolting

In accordance with CPPP-7, Attachment 4-5, the tensile allowable load for high-strength bolts using low-strength nuts was reduced to 60 percent of the normal high-strength bolt allowable, to account for the reduced proof load stress of the A563 Grade A nut.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- Pipe support modifications resulting from resolution of issues in Subappendix A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action to resolve the SA-36 and A307 steel issue was accomplished through the implementation of the criteria provided in CPPP-7, Sections 2.2 and 4.2.5.1, and Attachment 4-5 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations, Section III), August 22, 1983.

4.2 CASE's Fourth Motion for Summary Disposition to Disqualify the Use of A307 and SA-36 Threaded Parts, January 14, 1985.

4.3 CASE's Partial Answer to Applicants' Statement of Material Facts Relating to Richmond Inserts as to Which There are No Material Facts, September 10, 1984

4.4 ASME III Code Inquiry NI86-030 "Section III, Division 1, NF-3324.6 (a)(3)(b) Friction Type Joints, NF-3324.6(a)(4) Slip Resistance, Friction Type Joints, NF-3225.4, Friction Type Joints, 1983 Edition with the Winter 1985 Addenda," June 25, 1986

4.5 NRC Regulatory Guide 1.124, Service Limits and Loading Combinations for Class 1 Linear Type Component Supports, Revision 1, January 1978

SUBAPPENDIX A24

U-BOLT TWISTING

1.0 Definition of the Issue

This issue (References 4.1 through 4.3) was that out-of-plane rotation of the crosspiece of a trapeze cinched U-bolt support may result when the struts are in compression. This rotation would induce twisting on the U-bolt, for which it was not designed.

2.0 Issue Resolution

Due to the extensive engineering effort required to demonstrate the acceptability of this type of support, cinched U-bolt trapeze supports with struts or snubbers are being eliminated or modified. Modification options are discussed in Subappendix A12, Axial/Rotational and Trapeze Restraints.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action for the twisting of U-bolts on trapeze supports with struts or snubbers is being accomplished through the elimination or modification of this support type in accordance with CPPP-7, Section 4.2.5.1 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section III, August 22, 1983

4.2 CASE's Motions and Answer to Applicants' Motions for Summary Disposition Regarding Stability of Pipe Supports, October 15, 1984

4.3 CYGNA Pipe Support Review Issues List, Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987

SUBAPPENDIX A25

FISHER/CROSBY VALVE MODELING/QUALIFICATION

1.0 Definition of the Issue

The issues (References 4.1 through 4.4) related to Fisher and Crosby valve modeling and qualification were as follows:

1.1 Crosby Valves

The issue was that the main steam (MS) safety relief valves (SRV) which have a double-ported outlet configuration used an unconservative assumption of a 55/45 split in the flow distribution in lieu of the 60/40 split flow distribution, as suggested by Crosby Valve. There are five such valves located along the MS line that discharges into vent stacks.

1.2 Fisher Valves

The issue was that the Fisher valve operators may not be qualified to withstand the loads imposed on them by the snubbers that support the valve operator.

The Fisher valve is a control valve that is used to control main steam (MS) flow by relieving steam to the atmosphere.

1.3 Flexible Valves

The issue was that the modeling of "flexible" valves (frequency less than 33 cycles per second) was inadequate. It was found that valves noted in Reference 4.4 (excluding Fisher valves) were the only "flexible" valves within the original scope of work. It was determined that the valve accelerations for those valves were acceptable; however, the modeling of the Fisher valve yoke, which is laterally supported at the end, was not addressed. If the yoke is modeled much stiffer than it actually is, it may have an effect on the analysis results.

1.4 Valve Accelerations and Loads

The issue was that the validity of a sampling process to assure the acceptability of valve accelerations and valve flange loads has not been demonstrated.

2.0 Issue Resolution

2.1 Crosby Valves

- SWEC-PSAS discussed the flow distribution of doubled-ported SRV with Crosby (Reference 4.5), and Crosby verified that the SRV has an equal

(50/50) flow distribution ratio (instead of 60/40, as was thought). For conservatism, a 55/45 SRV flow distribution ratio was used to calculate the blowdown force.

- SWEC-PSAS evaluated the multiple SRV loading combination issue and concurred that all five valves opening simultaneously must be considered for piping and pipe support design. Since valves may open in a set or random sequence, those cases were also considered. The validation process identified the design basis for multiple SRV openings, including five simultaneous valves opening, for stress analysis evaluation. The cases evaluated covered all possible circumstances based on the system design, including the worst load condition.

2.2 Fisher Valves

The SWEC-PSAS validation of the Fisher relief valve branch connection piping model included the effects of the snubber supports at the valve. In accordance with Section 7.4.3 of CPPP-6 both valve accelerations and support loads on the valves were transmitted to the equipment qualification organization (Impell Corporation) for validation, except for Westinghouse-supplied valves, which were transmitted to Westinghouse for validation.

2.3 Flexible Valves

The yokes of flexible valves were modeled to properly predict the yoke frequency. CPPP-7, Section 3.10.6.5 specified the proper valve yoke modeling of flexible valves.

2.4 Valve Accelerations and Loads

All valves were validated for applicable accelerations and valve nozzle loadings in accordance with CPPP-7, Section 3.10.5.2. Also, since all valves were validated, the concern regarding sampling has been satisfied.

3.0 <u>Corrective and Preventive Action</u>

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendix A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action to resolve the issue of valve modeling and qualification was accomplished through the implementation of the criteria provided in CPPP-6, Section 7.4.3 and CPPP-7, Sections 3.10.5.2 and 3.10.6.5 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 Tel-con dated October 21, 1976, between Crosby Valve and Gibbs & Hill, J. R. Zahorsky and M. H. Giden, regarding Contract No. 2323A, Double-Ported Safety Valves

4.2 Telex from Crosby Valve to Gibbs & Hill regarding Contract No. 2323A, Main Steam Safety Valves, J. R. Zahorsky to Dr. Kim, October 12, 1976

4.3 CYGNA Pipe Stress Review Issues List, Revision 4, and Transmittal Letter No. 84056.119 dated September 16, 1987.

4.4 Communications Report between Krishnan/Ray (Gibbs & Hill) and Minichiello (CYGNA), June 18, 1984.

4.5 Tel-con dated February 21, 1986, between R. Martin and J. R. Zahorsky of Crosby Valve and W. Wang, A. J. Cokonis, and W. H. Green of SWEC, regarding Crosby double-ported relief valve discharge loads.

SUBAPPENDIX A26

PIPING MODELING

1.0 Definition of the Issue

The issue was that incorrect inputs were used in the pipe stress analysis as follows (Reference 4.1):

- Incorrect pipe wall thickness was used to calculate an allowable nozzle load (Reference 4.1, Issue 2).
- Improper stress intensification factors were used (Reference 4.1, Issue 10).
- Fluid content and insulation weights were not included for valves and flanges (Reference 4.1, Issue 4).
- Valve acceleration and flange loads were not always checked in the piping analysis (Reference 4.1, Issue 21).
- Two piping segments were input into the stress analysis with the incorrect wall thickness (Reference 4.1, Issue 12).

2.0 Issue Resolution

All pipe stress analysis packages were validated in accordance with Project Procedures CPPP-6 and CPPP-7, which provided direction for the proper modeling of piping systems. SWEC Engineering Assurance Procedure EAP 5.3 provided guidance on the preparation and review of calculations, including the need to assure that proper input is used. Checklists were included in project procedures to provide additional assurance that correct piping models were created and that proper review of the input and output was performed.

In addition, personnel were trained in the implementation of the procedures. This training was further enhanced by daily contact with the experienced on-project technical supervision. The SWEC Engineering Assurance Division performed audits of project activities to verify that procedural requirements were met and that calculations were technically acceptable. The combination of the procedures, the procedural control, and the audit program provided assurance that the inputs were correct and the calculations were complete and technically acceptable.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action to resolve the issues related to piping modeling was accomplished through the implementation of the criteria provided in Section 3.0 of CPPP-7 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CYGNA Pipe Stress Review Issues List, Revision 4, and Transmittal Letter No. 84056.119 dated September 16, 1987

SUBAPPENDIX A27

WELDING

1.0 Definition of the Issue

The following welding-related issues were identified (Reference 4.1):

1.1 Undersized Fillet Welds

The issue was that the sizes of two fillet welds were found to be less than the minimum requirements of Table XVII-2452.1-1 in Appendix XVII of the ASME Code Section III.

1.2 Penetration Weld Subsurface Cracking

The issue was that there is a potential for subsurface cracking on welds with deep penetrations. The shrinkage due to weld cooling may be resisted where the joined surfaces approach being parallel. Under these conditions, subsurface cracking can occur without the crack propagating to the surface. Upon loading, this subsurface crack may propagate through the weld causing joint failure.

1.3 Eccentricity of Three-Sided Welds (Unsymmetrical Welds)

The issue was that analyses of three-sided welds have not consistently considered the eccentricity between the center of gravity of the member and the weld.

1.4 Linear Versus Plate and Shell Weld Design for Base Plates

The issue was that the practice of qualifying base plate welds using linear analyses (as opposed to plate and shell analyses) was questioned.

1.5 Combination Welded/Bolted Connections

The issue was that no evidence was found to support the fact that combination welded/bolted connections are designed in accordance with Appendix XVII, subparagraph XVII-2442, Section III of the ASME Code.

1.6 Crosspiece Cover Plate Welds

The issue was that it was observed that shear flow has not always been considered in the analysis of welds attaching cover plates to crosspiece members.

1.7 One-Third Increase of Weld Allowable Stress for Emergency and Faulted Conditions

The issue was that the practice of increasing weld allowable stresses by one-third for emergency and faulted conditions was questioned.

1.8 Welding Practices

The issue was whether welding procedures qualified by test in accordance with the ASME Code are adequate in light of AWS requirements for prequalified welds. This issue involves the following inadequate welding practices: cap welding, weave welding, lap joint requirements, downhill welding, and preheat requirements.

2.0 Issue Resolution

2.1 Undersized Fillet Welds

ASME Code Case N-413 eliminated the minimum weld size requirements of Table XVII-2452.1-1 in the ASME Section III Code. Attachment 4-2 of CPPP-7 incorporates ASME Code Case N-413.

2.2 Penetration Weld Subsurface Cracking

As part of the resolution of this issue, SWEC-PSAS reviewed Reference 4.3, which states that the tendency to develop subsurface weld cracks stems from the "... misuse of a welding process that can achieve deep penetration or poor joint design. A few preventive measures can ensure elimination of both of these factors. Limiting the penetration and the volume of weld metal deposited per pass, through speed and amperage control, and using reasonable depth of fusion are both steps in the right direction."

- All CPSES pipe support welds are fabricated in accordance with CPSES Weld Procedure WPS-11032.

SWEC-PSAS reviewed WPS-11032 and concluded that it is a qualified procedure in accordance with ASME Section IX which adequately controls the joint design, travel speed, electrode size, and amperage and that the SMAW process is not a deep penetration process.

Therefore, all pipe support welds fabricated in accordance with CPSES Weld Procedure WPS-11032 are in compliance with the ASME Code.

2.3 Eccentricity of Three-Sided Welds (Unsymmetrical Welds)

In accordance with CPPP-7, Attachment 4-2, paragraph 3, the eccentricity between the center of gravity of the member and the weld has been considered.

2.4 Linear Versus Plate and Shell Weld Design for Base Plates

ASME Section III, Subsection NF-1230 allows the use of either plate-and-shell or linear-type support analysis for the design of welds connecting linear and plate and shell elements. In accordance with CPPP-7, Attachment 4-2, these welds were validated using the linear-type support analysis.

2.5 Combination Welded/Bolted Connections

Welds used in combination welded/bolted connections were designed in accordance with CPPP-7, Attachment 4-2, paragraph 3.1.3 for the entire shear force, which complies with ASME Section III, paragraph XVII-2442.

2.6 Crosspiece Cover Plate Welds

In accordance with CPPP-7, Attachment 4-2, paragraph 3.1.5, members which use cover plates for strength purposes had the plate-to-member attachment weld validated for shear flow.

2.7 One-Third Increase in Allowable Weld Stress for Emergency and Faulted Conditions

2.7.1 A one-third increase in allowable weld stress for emergency and faulted conditions is acceptable. ASME Code, Section III Subsection NF, paragraph NF 3231.1(b), Design of Linear-Type Supports by Analysis for Class 1 Component Supports, and Appendix XVII-2110(a), Linear Elastic Analysis, specify an allowable stress increase for emergency and faulted conditions. The emergency condition is stated as having a one-third allowable increase. Both paragraph NF 3231.1(b) and Appendix XVII-21100 refer to ASME Section III, Subsection NF for the faulted condition, where the factor is always greater than one-third.

2.7.2 AISC has allowed the one-third increase since the 7th edition.

2.7.3 Correspondence from K. Ennis, Assistant Secretary of ASME, to W. M. Eifert of SWEC, dated September 25, 1985, confirms this position (Reference 4.2).

2.8 Welding Practices

SWEC-PSAS reviewed WPS-11032 and concluded that it is a qualified procedure in accordance with ASME Section IX, and thus, the limitations of AWS for prequalified weld configurations do not apply.

Therefore, all pipe support welds fabricated in accordance with weld procedure WPS-11032 are in compliance with the ASME Code.

Furthermore, the Atomic Safety and Licensing Board (ASLB), using an NRC staff comparison of ASME versus AWS and their own review of existing welding procedures, concluded (on June 29, 1984, Reference 4.4) that compliance with the ASME code has been adequate to assure the acceptability of the CPSES welding procedures.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- All the pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action to resolve pipe support welding concerns was accomplished through the implementation of the criteria provided in Attachment 4-2 of CPPP-7 during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CYGNA Pipe Support Review Issues List Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987.

4.2 Letter from K. Ennis, Assistant Secretary of ASME, to W. M. Eifert of SWEC dated September 25, 1985.

4.3 Design of Welded Structures, Omer W. Blodgett, 1966.

4.4 ASLB Memorandum and Order LBP-84-25 (Written - Filing Decisions, No. 1: Some AWS/ASME Issues), June 29, 1984.

SUBAPPENDIX A28

ANCHOR BOLTS/EMBEDMENT PLATES

1.0 Definition of the Issue

Issues were raised (Reference 4.1) involving embedment plate, anchor bolt, and base plate designs at CPSES. They are as follows:

1.1 Embedment Plates and Through-Bolts

The issue was that there was no evidence that the spacing between attachments to embedment plates was checked at CPSES and that for existing designs, moment connections to the embedments require stiffeners, but no procedure for the design of a stiffener was provided.

Also, there was no written evidence documenting that as-built loads from pipe supports that use through-bolts were transmitted to the Civil/Structural Group for acceptance.

In addition, several instances were observed of Hilti Kwik-bolts installed close to through-bolt base plates that were not shown on the support drawing.

1.2 Base Plate Edge Distance

The issue was that anchor bolt edge distance tolerances could result in a 15-percent increase in base plate stresses for base plate designs with struts, springs, or snubbers with a 5-degree offset.

1.3 Hilti Kwik-Bolt Embedment Length

The issue was that there was a discrepancy identified between the bolt embedment lengths on support drawings and the lengths used in calculations.

1.4 Concrete Edge Distance Violation

The issue was that instances were observed where pipe sleeve penetrations exist close to support base plates but were not shown on support drawings.

2.0 Issue Resolution

These issues were addressed as described below:

The SWEC Civil/Structural Corrective Action Program (SWEC-C/S-CAP) developed uniform design criteria for all concrete anchorages (References 4.2 and 4.3), including the evaluation of spacing between different discipline commodities. The design criteria were incorporated into CPPP-7, Attachments 4-4, 4-5, and 4-25 via SWEC-PSAS Project Memorandum PM-210. Pipe support anchorage validation was performed in accordance with these attachments. Specific resolutions of these issues are as follows:

2.1 Embedment Plates and Through-Bolts

SWEC Civil/Structural is responsible for structural attachment load evaluations. CPPP-6 controlled the transmittal of pipe support attachment loads on embedded plates, through-bolts, and base plates to SWEC Civil/Structural discipline. SWEC Civil/Structural will identify base plates installed close to through-bolts to SWEC-PSAS for validation. SWEC Civil/Structural design validation of embedded plates and structures is described in the Civil/Structural PSR (Reference 4.3).

2.2 Base Plate Edge Distance

An analysis was performed by SWEC-PSAS to determine the effects of edge distance tolerances on the bolt loads and plate stresses, and it was concluded that the edge distance tolerance was acceptable.

Furthermore, the PCHVP will validate the as-built base plate bolt hole edge distances.

2.3 Hilti Kwik-Bolt Embedment Length

Embedment lengths shown on the drawings were used in calculations to validate pipe support anchorage designs in accordance with Attachment 4-4 of CPPP-7.

2.4 Concrete Edge Distance Violation

During PCHVP, SWEC Civil/Structural will identify base plates which are installed close to pipe sleeve penetrations and transmit this information to SWEC-PSAS for validation. Base plate validation is performed in accordance with CPPP-7.

3.0 <u>Corrective and Preventive Action</u>

- No additional issues were discovered during the review and resolution of the issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action to resolve the anchorage issues has been accomplished by the incorporation of the DBD (Reference 4.2) into CPPP-7 for the validation of embedments in concrete and the PCHVP for the identification of anchorage spacing violations.

- The preventive action for this issue is identified in Appendix C

4.0 References

4.1 CYGNA Pipe Support Review Issues List Revision 4, and Transmittal Letter No. 84056.120, dated September 18, 1987.

4.2 TU Electric, CPSES Units 1 and 2, Design Basis Document DBD-CS-015, Revision 4, June 10, 1987

4.3 TU Electric, CPSES Unit 1 and Common, Civil/Structural Project Status Report, Revision 0, October 1987

SUBAPPENDIX A29

STRUT/SNUBBER ANGULARITY

1.0 Definition of the Issue

1.1 The issue (Reference 4.1) was that the loading component ("kick" load) resulting from the angular swing of the strut/snubber from its nominal position, due to construction tolerances and pipe movements, was not assessed in designs.

1.2 The NRC Inspection and Enforcement Bulletin IEB-79-14 program requires all as-built angular tolerances over ± 2 deg to be measured and assessed (Reference 4.2). The issue was that the construction angular tolerance for the installed CPSES struts/snubbers was ± 5 degrees.

2.0 Issue Resolution

2.1 The angular swing of struts/snubbers due to construction tolerances and pipe movements from applicable thermal, seismic, and/or fluid transients were assessed. The effect of the swing angle load component (maximum swing angle of ± 5 deg) was considered in the support design. If the ± 5-deg tolerance was exceeded, the proper function and load rating of strut/snubber assemblies were ensured in addition to the component load consideration. These requirements were included in Sections 4.2 and 4.2.6 of CPPP-7.

2.2 All installed struts/snubbers were measured and those that exceeded ± 2-deg tolerance were assessed in the validation program.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action to resolve the issue of strut/snubber angularity was accomplished through the implementation of the criteria provided in Sections 4.2 and 4.2.6 of CPPP-7 during the design validation and is physically validated in the Post Construction Hardware Validation Program (PCHVP) through the implementation of Field Verification Method CPE-SWEC-FVM-PS-081 (Reference 4.3).
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 Transcript of Proceedings of Feedback Discussion Between USNRC and Walsh and Doyle on the Concerns About the CPSES, March 23, 1985

4.2 NUREG-0797, Supplementary No. 11, Safety Evaluation Report Related to the Operation of CPSES Units 1 and 2, USNRC, Docket Nos. 50-445 and 50-446, May 1985

4.3 SWEC-PSAS Comanche Peak Field Verification Method, Hardware Validation and Supplemental Inspection Programs CPE-SWEC-FVM-PS-081, Revision 0, July 29, 1987

SUBAPPENDIX A30

COMPONENT QUALIFICATION

1.0 Definition of the Issue

Issues related to the qualification of member components in CPSES pipe supports were identified as follows (Reference 4.1):

1.1 Dynamic Pipe Movements in Support Design

The issue was that all dynamic piping movements were not included in the support design when checking frame gaps, swing angles, or spring travel. Existing designs addressed only the seismic effects. This is applicable to frame gaps in the unrestrained direction, strut/snubber swing angles, and both spring and snubber travel.

1.2 Incorrect Standard Component Allowables

The issue was that incorrect U-bolt allowables were used in the design of support RH-1-064-011-S22R.

1.3 Untightened Locknut On Struts

The issue was that the upper locknut on one strut was not tightened, which could lead to rotation of the strut and a subsequent load redistribution.

1.4 Inverted Snubbers

The issue was that four supports were identified in which the snubbers were installed 180 degrees from the configuration shown on the support drawings.

2.0 Issue Resolution

2.1 Dynamic Pipe Movements in Support Design

Predicted pipe movements for all design conditions for pipe supports were evaluated in the design validation in accordance with CPPP-7, Section 4.2.

2.2 Incorrect Standard Component Allowables

RH-1-064-011-S22R was a cinched U-bolt support with a strut. This support is being modified in accordance with CPPP-7, Section 4.2.5.1.

Component standard-type pipe supports were validated in accordance with CPPP-7, Section 4.1, by comparison to vendor-supplied load capacity data sheets (LCD) or certified design report summaries (CDRS).

2.3 Untightened Locknuts on Struts

The Post-Construction Hardware Validation Program (PCHVP) is being performed to validate the proper hardware installation including locknuts through inspections performed in accordance with Field Verification Method CPE-SWEC-FVM-PS-081.

2.4 Inverted Snubbers

The Post-Construction Hardware Validation Program (PCHVP) is being performed to validate the proper hardware installation including snubbers through inspections performed in accordance with Field Verification Method CPE-SWEC-FVM-PS-081.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of the issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action to resolve the locknut and snubber installation issues is being accomplished through the implementation of pipe support hardware inspections and rework. The corrective action to resolve the component allowable and dynamic pipe movement issue was accomplished through the implementation of the criteria provided in Sections 4.1 and 4.2 of CPPP-7 during the design validation. The corrective action to resolve the design of Support RH-1-064-011-S22R was accomplished through the implementation of the criteria provided in CPPP-7, Section 4.2.5.1.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CYGNA Pipe Support Review Issues List, Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987

4.2 SWEC-PSAS Comanche Peak Field Verification Method, Hardware Validation and Supplemental Inspection Programs CPE-SWEC-FVM-PS-081, Revision 0, July 29, 1987

SUBAPPENDIX A31

STRUCTURAL MODELING FOR FRAME ANALYSIS

1.0 Definition of the Issue

Issues were raised (Reference 4.1) relating to the structural modeling for frame supports:

1.1 Torsion Evaluation

The issue was that for wide flange members, the torsional deflections were underestimated and members were not checked for local stresses at points of torsional loading.

1.2 Boundary Conditions for Richmond Insert/Tube Steel Connections

The issue was that modeling of member end restraints at Richmond insert/tube steel connections was inconsistent. Three different member end conditions varying from fully fixed to fully free were assumed. Each assumption may be conservative for one member and unconservative for another.

1.3 Support Boundary Conditions

The issue was that supports were identified in which the assumed boundary conditions were questionable.

2.0 Issue Resolution

2.1 Torsion Evaluation

In accordance with Section 4.3.2.1 of CPPP-7 member properties used in the pipe support validation, including values for torsional resistance, were taken from AISC Manual of Steel Construction, 8th Edition. Tables 4.7.2-3 through 4.7.2-7 of CPPP-7 provided equations for evaluating member stresses, including local effects due to torsional loading.

2.2 Boundary Conditions for Richmond Insert Tube Steel Connections

Consistent modeling techniques were used for Richmond insert tube steel connection validation as specified in CPPP-7, Attachment 4-5 to assure that member end restraints were properly modeled.

2.3 Support Boundary Conditions

Attachment of the pipe support to the building structure was reflected in the frame analysis by the proper modeling of the connection stiffness in accordance with CPPP-7, Attachment 4-18.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action to resolve this issue was accomplished through the implementation of the criteria provided in CPPP-7, Section 4.3.2.1, Tables 4.7.2-3 and 4.7.2-7, and Attachments 4-5 and 4-18 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Sections VII and XII, August 22, 1983

SUBAPPENDIX A32

COMPUTER PROGRAM VERIFICATION AND USE

1.0 Definition of the Issue

The issue (References 4.1 and 4.2) was whether there was adequate quality assurance for the verification and use of appropriate versions of the following computer programs:

- ADLPIPE Version 2C (dated April 1977) - Piping Analysis
- FUB-II - Base Plate Qualification - ITT Grinnell
- Corner and Lada Base Plate Qualification Program

2.0 Issue Resolution

The computer programs for which specific issues were raised were not used in the pipe stress and pipe support validation effort.

The computer programs that were used for piping and pipe support validation were identified in CPPP-7, Section 5.0.

The computer programs used in the validation effort were verified in accordance with SWEC QA program requirements for verification, technical adequacy, and appropriate version. The computer program verification was documented, and identified the various project applications.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under the provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).

- The corrective action to resolve the concern regarding computer program verification was accomplished through the implementation of the SWEC Quality Assurance Program.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CYGNA Design Control Review Issues List, Revision 1, June 21, 1985

4.2 NRC Inspection Report No. 50-445/83-12:50-446/83-07, Inspection Conducted by J. I. Tapia and W. Paul Chen, May 13, 1983

SUBAPPENDIX A33

HYDROTEST

1.0 Definition of the Issue

The issue (References 4.1 and 4.2) was that hydrostatic test loading conditions were not properly considered for ASME Section III Code Class 2 and 3 piping analysis and pipe support designs.

2.0 Issue Resolution

The hydrotest loads for piping and supports were evaluated for 1.5 times the design pressure, in accordance with the ASME Section III Code of Record, except for the ASME Section III Class 2 and 3 piping, which was evaluated for 1.25 times the design pressure consistent with the actual hydrostatic test conditions. The lower design pressure for Classes 2 and 3 piping is in accordance with a later code version which is acceptable, since the project met the requirements of ASME Section III Code paragraph NA-1140, which allows the use of later Code provisions where appropriate. Evaluation of piping and supports for hydrotest loading was performed as specified in CPPP-7, Sections 3.6.2.4 and 4.7.2.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action to resolve the hydrotest issue was accomplished through the implementation of the criteria provided in CPPP-7, Sections 3.6.2.4 and 4.7.2, during the design validation.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations), Section XIII, August 22, 1983

4.2 CYGNA Pipe Support Review Issues List, Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987

SUBAPPENDIX A34

SEISMIC/NONSEISMIC INTERFACE

1.0 Definition of the Issue

The following issues (Reference 4.1) were raised relating to the design of isolation anchors:

1.1 Seismic Category I Piping Attached to Nonseismic Piping

The issue was that the seismic effects of nonseismic piping attached to safety-related piping were not adequately considered.

1.2 Piping Routed Between Seismic Category I and Nonseismic Buildings

1.2.1 The issue was that safety-related piping was not seismically isolated when it was routed between seismic Category I and nonseismic buildings.

1.2.2 The issue was that postulated failure of the turbine building due to an earthquake, which is a nonseismic building, was not considered in the design of safety-related piping which is routed between the turbine building and seismic Category I buildings.

2.0 Issue Resolution

2.1 Seismic Category I Piping Attached to Nonseismic Piping

In accordance with CPPP-7, Attachment 4-10, Sections 1.4, 1.5, and 1.6 the following two methods were used for the design validation of safety-related piping attached to nonseismic piping:

2.1.1 A plastic hinge was assumed to occur on the nonseismic piping immediately adjoining the anchor. The anchor was analyzed for plastic moments.

2.1.2 One or more restraints and the piping supported by these restraints on the nonseismic side were seismically analyzed. In addition, the effect of the remaining portion of nonseismic piping was accounted for by the assumption of a plastic hinge.

2.2 Piping Routed Between Seismic Category I and Nonseismic Buildings

SWEC-PSAS Project Memorandum No. PM-203 clarified the requirements of CPPP-7, Attachment 4-10, and limits the use of Option 2.1.2 to piping in seismically analyzed buildings. Therefore, the interface between seismic Category I piping and nonseismic piping occurring at the boundary between seismic Category I and nonseismic buildings (e.g., the main steam line) was modeled by a plastic hinge as discussed in Item 2.1.2.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under the provisions of 10CFR50.55(e) (See Subappendix B2, SDAR-CP-86-72).

- The corrective action to resolve the seismic/nonseismic interface issue was accomplished through the implementation of criteria provided in CPPP-7, Attachment 4-10 during the design validation.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CYGNA Pipe Support Review Issues List, Revision 4, and Transmittal Letter No. 84056.120 dated September 18, 1987

SUBAPPENDIX A35

OTHER ISSUES

1.0 Definition of the Issue

Subappendixes A1 through A34 have addressed the CPRT and external issues (excluding the SSER and CPRT-QOC issues addressed in Subappendixes A36 through A39). These 34 subappendixes represent the consolidation of all but 51 of the 972 piping-related Discrepancy Issue Reports (DIRs), generated by TENERA, L. P. to track closure of issues as part of their third party review. The remaining 51 DIRs (Reference 4.1, Attachment B) are unrelated to the 34 primary issue topics discussed in the previous 34 subappendixes. The issues raised by these 51 DIRs must be resolved by the SWEC-PSAS validation effort.

2.0 Issue Resolution

SWEC-PSAS resolved the issue identified in each of the 51 DIRs described above by referencing the applicable design or administrative procedure that resolved each issue. These 51 DIRs are considered closed by SWEC-PSAS and TENERA, L. P.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- Pipe support modifications resulting from resolution of issues in Subappendixes A1 through A35 were determined to be reportable under provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72).
- The corrective action to resolve this issue was accomplished through the implementation of the criteria provided in CPPP-6 and CPPP-7.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CPRT Design Adequacy Program Descipline Specific Results Report: Piping and Supports, DAP-RR-P-001, Revision 1, August 27, 1987

SUBAPPENDIX A36

SSER-8 REVIEW

1.0 Definition of the Issue

SSER-8 describes the NRC Staff evaluation and resolution of technical issues relating to the civil, structural, and miscellaneous issues of CPSES (Reference 4.1).

The issue was whether the concrete design strength of CPSES safety-related concrete installed between January 1976 and February 1977 was 4,000 psi or greater.

2.0 Issue Resolution

The results of the concrete strength tests, performed between January 1976 and February 1977, were reviewed by the SWEC Civil/Structural Group (Reference 4.2). As a result of the consistency between the cylinder data and the Schmidt-Hammer data, SWEC Civil/Structural concluded that there is no evidence of systematic falsification of cylinder data or improper testing; therefore, it was further concluded that the 4000 psi design strength of the safety-related concrete placed during that period was substantiated (Reference 4.3).

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- This issue has been determined to be not reportable in accordance with 10CFR50.55(e).
- No corrective action on the design basis is required due to this issue.
- Current construction and QC concrete testing procedures are adequate. No additional preventive action is required due to this issue.

4.0 References

4.1 NUREG-0797, Supplement No. 8, Sections 3.1.3 and 4.1.2, Safety Evaluation Reported Related to the Operation of CPSES Units 1 and 2, Docket Nos. 50-445 and 50-446, USNRC, February 1985

4.2 TU Electric CPSES Unit 1 and Common, Civil/Structural, Project Status Report, Revision 0

4.3 CPRT Action Plan II.b Results Report, Concrete Compression Strength, Revision 1, February 28, 1986

SUBAPPENDIX A37

SSER-10 REVIEW

1.0 Definition of the Issue

SSER-10 describes the NRC Staff evaluation and resolution of technical issues relating to the mechanical and piping group (Reference 4.1). The four piping design related issues are:

1.1 Uncontrolled Weld Repairs by Plug Welding

The SSER indicated that a plan is required for sampling inspection of plug welds in CPSES for cable tray supports, pipe supports, and base plates. A bounding analysis is required to assess the ranging effects of uncontrolled plug welds on pipe supports, cable tray supports, and base plates to serve their intended functions. A report documenting the results of the assessment is required.

1.2 Installation of Main Steam Line Pipes - Unit 1, Loop 1

The SSER indicated that Tasks 4.5.1 through 4.5.8 in SSER-10, which include stress assessment and nondestructive examination of Loop 1 main steam (MS) and feedwater (FW) lines, must be performed. Results of analysis, examinations, and reviews are required to be documented in a report.

1.3 Isolation of Seismic Category I Piping from Nonseismic Piping

The SSER indicated that an analysis shall be performed and documentation shall show that piping systems such as MS, FW, and auxiliary steam lines routed from seismic Category I to nonseismic Category I buildings are in conformance with the licensing commitments.

1.4 As-Built Verification of Type 2 Skewed Welds on NF Supports

The SSER indicated that confirmation is required that the Type 2 skewed welds on pipe supports are not undersized. This may be accomplished through the verification of previous weld inspections or through reinspection.

2.0 Issue Resolution

2.1 Uncontrolled Weld Repairs by Plug Welding

SWEC-PSAS reviewed the Comanche Peak Response Team (CPRT) Action Plan V.d Results Report (Reference 4.2) and concluded that since the unauthorized repair of plug welds does not compromise the structural integrity of the components, there is no impact of plug weld repairs on the validation of pipe supports at CPSES.

2.2 Installation of Main Steam Line Pipes - Unit 1, Loop 1

The CPRT Action Plan V.e Results Report (Reference 4.3) was reviewed by SWEC-PSAS and, based on the main steam and feedwater pipe stress analysis, which incorporated bounding parameters, it was concluded that no deleterious effects resulted from the sequence of events associated with Unit 1, Loop 1, main steam and feedwater (FW) lines hydrostatic tests.

2.3 Isolation of Seismic Category I Piping from Nonseismic Piping

This topic is addressed in Subappendix A34.

2.4 As-Built Verification of Type 2 Skewed Welds on NF Supports

Pipe support welds at CPSES are inspected in accordance with Inspection Procedure QI-QAP-11.1-28 (Reference 4.4). However, since Type 2 skewed welds are typically found on the weld of the trunnion to the pipe, inspection procedures for Type 2 skewed welds were included in the piping weld inspection Procedure QI-QAP-11.1-26 (Reference 4.5). CPRT Action Plan V.a Results Report (Reference 4.6) confirmed that inspections were performed in accordance with QI-QAP-11.1-26, and that skewed welds are not undersized. Pipe support weld inspection Procedure QI-QAP-11.1-28 has since been revised to include inspection procedures for Type 2 skewed welds.

3.0 Corrective and Preventive Action

- No additional issue was discovered during the review and resolution of this issue.

- Pipe support modifications resulting from resolution of isolation of Seismic Category I piping from nonseismic piping has been determined reportable under the provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72). No modifications were required as a result of the resolution of the issues discussed in Sections 1.1, 1.2, and 1.4.

- The corrective action to resolve the issue of the isola-tion of Seismic Category I piping from nonseismic piping has been accomplished through the implementation of criteria provided in CPPP-7, Attachment 4-10, during the design validation.

  The corrective action to resolve the issue of the installation of main steam line piping was accomplished through implementation of CPSES Construction Procedure CP-CPM-1.2 (Reference 4.7) and SWEC-PSAS Procedure CPSP-30 (Reference 4.8), which requires engineering to evaluate the installed piping and pipe support configuration including the proper design of temporary supports prior to a piping system hydrostatic test to assure the integrity of the installed safety-related piping and pipe supports.

The corrective action for the issue of uncontrolled plug weld repair was accomplished through enhanced pipe support installation and inspection criteria.

The corrective action for the issue of verification of Type 2 skewed welds on NF supports was accomplished through the revision of Weld Inspection Procedure QI-QAP-11.1-28 to include inspection procedures for Type 2 skewed welds.

- The preventive action for this issue is specified in Appendix C.

4.0 References

4.1 NUREG-0797, Supplement No. 10, Safety Evaluation Report related to the operation of CPSES Units 1 and 2, USNRC, Docket Nos. 50-445 and 50-446, April 1985

4.2 CPRT Action Plan V.d Results Report, Plug Welds, Revision 1, December 18, 1986

4.3 CPRT Action Plan V.e Results Report, Installation of Main Steam Pipes, Revision 1, October 15, 1986

4.4 CPSES Quality Assurance Procedure QI-QAP-11.1-28, Fabrication and Installation Inspection of Safety Class Component Supports

4.5 CPSES Quality Assurance Procedure QI-QAP-11.1-26, Piping and Equipment Installation Inspection

4.6 CPRT Action Plan V.a Results Report, Inspection for Certain Types of Skewed Welds in NF Supports, Revision 1, October 22, 1986

4.7 CPSES Construction Procedure CP-CPM-1.2, Construction Activities for Systems and/or Areas Accepted and/or Controlled by TU Electric Plant Operations, Revision 5, March 4, 1987

4.8 SWEC-PSAS Project Procedure CPSP-30, Processing TU Electric Requests for Temporary Hangers, Revision 0, October 7, 1987

SUBAPPENDIX A38

SSER-11 REVIEW

1.0 Definition of the Issue

SSER-11 (Reference 4.1) describes the NRC Staff TRT position on the evaluation and resolution of technical questions and allegations relating to the QA/QC Group.

The issues identified by SSER-11 in the design process that are related to piping design are as follows:

1.1 As-Built Inspection Program (Allegations AQ-50, AQ-21, AQ-22, and AQ-119, Reference 4.1)

As-built issues were classified into hardware, procedural, as-built, and weld-related categories. Specifically, six pipe support construction issues in Unit 1 were listed as follows:

1.1.1 Excessive snubber spherical bearing clearance.

1.1.2 Missing strut and snubber load pin locking devic[illegible]

1.1.3 Pipe clamp halves not parallel.

1.1.4 Snubber adapter plate bolts not fully engaged.

1.1.5 Hilti-Kwik bolts installed with less than minimum embedment.

1.1.6 Absence of locking devices for threaded fasteners on NF supports.

1.2 Isolation Anchors

The issue was that isolation anchors were not always used in the design of seismic-to-nonseismic piping. The isolation anchor must be designed to withstand the combined loading imposed by both seismic Category I and nonseismic piping (Allegation SRT-13, Reference 4.2).

1.3 Main Steam Loop Hydro

The issue was that the design of the main steam lines in Unit 1 did not take into account the stresses caused by repositioning of the line after flushing and by the settling of temporary supports (Reference 4.1).

1.4 Girth Welds

The issue was that radial shrinkage of girth welds in thin-walled stainless steel pipe was not always adequately analyzed (Allegations AQ-50, Ref. 4.1; and AW-52, AW-59, AW-62, Ref. 4.2).

2.0 Issue Resolution

2.1 As-Built Inspection Program

The issue of the as-built QC verification of supports at CPSES was also identified in Subappendixes A39 and B3. The resolution of this issue and the corrective and preventive actions associated with this issue are addressed in Subappendixes A39 and B3.

2.2 Isolation Anchors

The isolation anchor issue was also identified in SSER-10 (Reference 4.2) and is discussed in Subappendixes A34 and A37. The resolution of this issue and the corrective and preventive actions associated with this issue are addressed in Subappendixes A34 and A37.

2.3 Main Steam Loop Hydro

The Unit 1 main steam loop hydro issues were also identified in SSER-10 and are discussed in Subappendix A37. The resolution of this issue and the corrective and preventive actions associated with this issue are addressed in Subappendix A37.

2.4 Girth Welds

The effects of radial shrinkage of girth welds on the pipe stress analysis were analyzed in accordance with CPPP-7, Attachment 3-15.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- Pipe support modifications resulting from resolution of the issue of isolation anchors and girth weld shrinkage have been determined reportable under the provisions of 10CFR50.55(e) (see Subappendix B2, SDAR-CP-86-72). Pipe support modifications resulting from resolution of the issue of as-built verification of pipe supports have been determined reportable under the provisions of 10CFR50.55(e) (see Subappendix B3, SDAR-CP-86-63).

- The corrective action to resolve the girth weld issue was accomplished through the implementation of the criteria specified in Attachment 3-15 of CPPP-7 during the design validation.

- The corrective actions to resolve the issues of the as-buil inspection program, the isolation anchors, and the main steam loop hydrostatic test are discussed in Subappendixes A39, A34, and A37, respectively.

- The preventive actions for these issues are specified in Attachment C.

4.0 References

4.1 NUREG-0797, Supplement No. 11, Safety Evaluation Report related to the operation of CPSES Units 1 and 2, USNRC, Docket Nos. 50-445 and 50-446, May 1985

4.2 NUREG-0797, Supplement No. 10, Safety Evaluation Report related to the operation of CPSES Units 1 and 2, USNRC, Docket Nos. 50-445 and 50-446, April 1985

SUBAPPENDIX A39

CPRT QUALITY OF CONSTRUCTION REVIEW ON PIPING AND PIPE SUPPORTS

1.0 Definition of the Issue

Evaluation Research Corporation (ERC) was contracted by CPRT to perform the Quality of Construction (QOC) sample inspection of the safety-related components installed in CPSES, including piping and pipe supports. This task was implemented in accordance with CPRT Action Plan VII.c, and the results were discussed in Section 5.2.5 of the CPRT Action Plan VII.c Results Report (Reference 4.1).

ERC inspection covered approximately 82,500 inspection points for piping and pipe supports. ERC evaluated the results and recommended corrective action on the adverse trends and construction deviations on the piping components, gaps, locking devices, pipe clamp spacers, pipe clamps, cotter keys, and angularity offsets.

The recommended corrective actions on the adverse trends and construction deviations of the pipe supports identified in the CPRT-QOC Results Report are summarized as follows:

	Construction Work Category	CPRT Action Plan VII.c Results Report Recommendations
1.1	Small Bore Piping Configuration	Reinspect flow elements to verify that they are oriented in the proper direction
1.2	Small Bore Piping Configuration	Verify existing piping clearance criteria and walkdown on all small bore piping with insulation installed
1.3	Small Bore Piping Configuration	Reinspect safety-related piping expansion joints
1.4	Small Bore Piping Configuration	Verify the accuracy and consistency of linear and locating dimensions in piping isometrics
1.5	Pipe Bend Fabrication	Verify by Ultrasonic Testing (UT) that installed pipe bends meet the minimum wall thickness requirement

	Construction Work Category	CPRT Action Plan VII.c Results Report Recommendations
1.6	Pipe Bend Fabrication	Revise QC Procedure QI-QAP-11.1-26 to require that wall thickness after bending be verified by Ultrasonic Testing (UT) and recorded
1.7	Pipe Welds and Materials	Reinspect butt welds in Schedule 80 or thinner stainless steel piping made prior to 1982 that are replacement welds and/or have received extensive repairs
1.8	Small Bore Pipe Supports	Inspect gaps and verify adequate clearance between pipe welds and pipe support
1.9	Small Bore Pipe Supports	Inspect and install suitable locking devices on all vendor-supplied components that do not have high-strength bolting; install locking devices on all high-strength bolting that is not torqued to an acceptable preload
1.10	Small Bore Pipe Supports	Verify that the fasteners have been secured for all vendor-supplied components (sway struts, snubbers, and spring cans) during plant startup and preoperation using a complete and detailed procedure and checklist provided and verified by QC

2.0 Issue Resolution

The Post-Construction Hardware Validation Program (PCHVP) (Reference 4.2) is the portion of TU Electric's Corrective Action Program (CAP) which validates the final acceptance attributes for safety-related hardware.

The input to the Post-Construction Hardware Validation Program (PCHVP) is contained in the installation specifications. Final acceptance inspection requirements identified in the validated installation specifications were used to develop the Post-Construction Hardware Validation Program (PCHVP) attribute matrix. This matrix is a complete set of final acceptance attributes identified for installed hardware. The Post-Construction Hardware Validation Program (PCHVP), by either physical validations or through an engineering evaluation methodology, assures that each of the attributes defined in the attribute matrix is validated.

SWEC-PSAS developed the Field Verification Method (FVM) CPE-SWEC-FVM-PS-081 (Reference 4.3) to coordinate the Unit 1 and Common piping and pipe support inspection validation activities.

Piping inspections are performed and documented by Quality Control (QC) personnel to assure that applicable inspection attributes are acceptable. The piping inspection attributes are as below:

- Equipment and piping configuration
- Piping wall thickness at shop/field bends
- Radial weld shrinkage at stainless steel piping joints
- Equipment anchoring
- Remote valve operators
- Branch connections
- All pressure boundary items installation/base metal defects
- Valve orientations
- Pipe/sleeve details
- Permanent pipe support installation (no temporary or voided supports)
- Verify location (span) dimensions/tolerances
- Applicable dielectric insulating sleeves over bolts/studs
- Linear dimensions of piping segments and in-line components

The hardware validation of pipe supports assures that the removable items on a pipe support are installed as required by the design documentation. The hardware validation is implemented by Quality Control (QC) personnel in compliance with the validated support drawing. Quality Control personnel verify and document that all applicable hardware attributes listed on the hardware validation checklists are acceptable. The following pipe support hardware validation checklists are used, as applicable:

- Adjacent Weld Checklist
- Bolted Connection Checklist
- Hilti Bolt Checklist
- Pipe Clamp Checklist
- Richmond Insert Checklist
- Snubber Checklist
- Support Checklist
- Sway Strut Checklist
- Through Bolt/Embedded Bolt Checklist
- U-Bolt/Bolted U-Guide Checklist
- Variable/Constant Spring Checklist

In addition to the hardware validation pipe support inspections, Quality Control (QC) personnel also conduct inspections for pipe support configuration attributes as below:

- Material acceptability
- Support configuration compliance with validated design drawing, including dimensions

Support overhang length/tolerance
Support projection length/tolerance
Sway strut/snubber pin-to-pin dimension/tolerance
Alignment and circumferential deviation of shear lugs
Hilti bolt size/embedment
Weld length of structural member on base plate
Welded connection in accordance with validated drawing
Edge distance for structural members and base plates
Slope of bolted part with bolt head or nut
Shim size/weld

SWEC-PSAS developed the Field Verification Method (FVM) CPE-SWEC-FVM-PS-080 (Reference 4.4) to assure that sufficient clearance exists around the validated piping. Clearance is required to permit those anticipated piping displacements that could occur under plant operating conditions without any impediment to those displacements. An impediment is defined as any structure, pipe, conduit, cable tray, or equipment that encroaches on the envelope of anticipated pipe displacement.

This field verification effort is performed by the SWEC-PSAS engineering personnel. SWEC-PSAS has established clearance criteria and is responsible for training the clearance walkdown teams, evaluating clearance problems, and issuing design changes to correct any clearance violations.

The physical validation of mechanical piping attributes (e.g., flow element orientation and expansion joint installation) is performed by SWEC mechanical discipline PCHVP as discussed in the SWEC Mechanical Project Status Report (Reference 4.5).

These corrective actions also envelop the resolution of issues in Subappendixes A29, A30, A38, and B3. The quality of construction requirements for piping and pipe supports in the PCHVP were incorporated into the construction and QC inspection procedures to serve as the preventive action.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- The quality of construction of pipe support installation issue was determined to be reportable under the provisions of 10CFR50.55(e) (see Subappendix B3, SDAR-CP-86-63).
- The corrective action to resolve this issue is accomplished through the implementation of the Post-Construction Hardware Validation Program.
- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 CPRT Action Plan VII.c Results Report, Construction Reinspection/ Documentation Review Plan, Revision 0, June 11, 1987

4.2 TU Electric Engineering and Construction Procedure EC-9.04, Post Construction Hardware Validation Program, July 17, 1987

4.3 SWEC-PSAS Comanche Peak Field Verification Method, Hardware Validation and Supplemental Inspection Programs, CPE-SWEC-FVM-PS-081, Revision 0, July 29, 1987

4.4 SWEC-PSAS Comanche Peak Field Verification Method, Clearance Walkdown, CPE-SWEC-FVM-PS-080, Revision 0, July 28, 1987

4.5 TU Electric, CPSES Unit 1 and Common, Mechanical Project Status Report, Revision 0

APPENDIX B

INTRODUCTION

This appendix describes the details of resolutions of issues identified during the performance of the piping Corrective Action Program (CAP). Included in this appendix are the piping-related Significant Deficiency Analysis Reports (SDARs) initiated by TU Electric.

Each of the five issues listed below is described in an individual sub-appendix which includes discussions of resolution methodology and corrective and preventive actions.

Issue No.	Issue Title
B1	SDAR-CP-86-33, Stiffness Values for Class 1 Stress Analysis
B2	SDAR-CP-86-72, Small Bore Piping and Supports
B3	SDAR-CP-86-63, Pipe Support Installations
B4	SDAR-CP-86-67, Preoperational Vibration Test Criteria
B5	SDAR-CP-86-73, ASME Snubber Attachment Brackets

SUBAPPENDIX B1

SDAR-CP-86-33, STIFFNESS VALUES FOR CLASS 1 STRESS ANALYSIS

1.0 Definition of Issue

TU Electric identified a deficiency in the stiffness values of pipe supports for ASME Section III Class 1 piping stress analysis (Reference 4.1). The pipe support stiffness values used in the previous Westinghouse stress analysis of ASME Section III Code Class 1 piping in Unit 1 were based on input from the existing design. These pipe support stiffness values changed with implementation of the corrective actions from the pipe stress and pipe support validation program, thus rendering the previous results of ASME Section III Class 1 pipe stress analysis in Unit 1 inconsistent with the pipe stress and pipe support validation program.

Appropriate ASME Section III Code Class 1 pipe support stiffness values that incorporated corrective actions and modifications resulting from the pipe stress and pipe support validation program must be used in the validated ASME Section III Code Class 1 pipe stress analysis.

2.0 Issue Resolution

The calculations of the stiffness values for the pipe supports for the ASME Section III Code Class 1 pipe stress analysis packages were completed and these results were transmitted to Westinghouse in accordance with Section 7.5.7 of project procedure CPPP-6 (Reference 4.2) and SWEC-PSAS Project Memorandum PM-130 (Reference 4.3). Westinghouse reanalyzed these stress problems and issued revised support loads for pipe support validation.

TU Electric determined that this issue was reportable under the provisions of 10CFR50.55(e) and submitted reports (References 4.1 and 4.4) to the NRC Staff on May 28, 1986, and October 17, 1986. The small bore pipe support modifications and hardware validation status is being updated under 10CFR50.55(e) via SDAR-CP-86-36 (Subappendix B2).

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.
- This issue was determined to be reportable under the provisions of 10CFR50.55(e).
- The corrective action to resolve this issue was accomplished by the validation of the ASME Section III Code Class 1 pipe stress analysis by Westinghouse and by the SWEC-PSAS validation of the pipe supports in accordance with Sections 3.10.8 and 4.3.2.2, and Attachment 4-18 of CPPP-7.

- The preventive action for this issue is identified in Appendix C.

4.0 References

4.1 TU Electric Letter No. TXX-4831, W. G. Counsil to E. H. Johnson, Director, Division of Reactor Safety and Projects, U.S. Nuclear Regulatory Commission, Stiffness Values for Class 1 Pipe Stress Analysis, May 28, 1986 (SDAR-CP-86-33 - Interim Report).

4.2 SWEC-PSAS Project Procedure CPPP-6, Pipe Stress/Support Requalification Procedure - Unit 1, Revision 4, April 8, 1987

4.3 SWEC-PSAS Project Memorandum PM-130, Transmittal of Requalification Results to Westinghouse, December 19, 1986.

4.4 TU Electric Letter No. TXX-6025, W. G. Counsil to E. H. Johnson, Director, Division of Reactor Safety and Projects, U.S. Nuclear Regulatory Commission, Stiffness Values for Class 1 Pipe Stress Analysis, October 17, 1986 (SDAR-CP-86-33 - Final Report).

SUBAPPENDIX B2

SDAR-CP-86-72, SMALL BORE PIPING AND PIPE SUPPORTS

1.0 Definition of Issue

Impact of CPRT and external issues tabulated in Subappendixes A1 through A35 on the adequacy of the piping and pipe support design and installation processes is significant.

2.0 Issue Resolution

SWEC-PSAS was contracted to validate the piping and pipe supports at CPSES. Modification of certain pipe supports provided expedient acceptance for the expanded requirements. Support modifications are categorized as follows:

1.1 Prudent - Supports in this category may have been technically acceptable; however, more time and expense would have been involved in the detailed analysis than that required to physically modify the support and qualify the modification.

1.2 Recent Industry Practice - Modifications implemented to eliminate snubbers to enhance plant maintainability, reduce inservice inspection, and minimize worker radiation exposure during operating plant conditions.

1.3 Adjustment - Minor modifications (such as retorquing or shimming) implemented to meet installation criteria contained in the resolution of the CPRT and external issues.

1.4 Cumulative effects - Modifications that are required due to the combined effect of previous issues.

The implementation of the physical modifications of pipe supports is being performed by TU Electric Construction and is being validated by the PCHVP.

TU Electric determined that this issue was reportable under the provisions of 10CFR50.55(e) and submitted the initial Significant Deviation Analysis Report No. SDAR-CP-86-72 (Reference 4.1) on October 15, 1986. Periodic status reports are being submitted to the NRC Staff.

3.0 Corrective and Preventive Action

- No additional issues have been discovered during the review and resolution of this issue.
- This issue was determined to be reportable under the provisions of 10CFR50.55(e).

- The corrective action to resolve this issue is accomplished through the piping and pipe supports CAP.

- The preventive actions for this issue are described in Appendix C.

4.0 References

4.1 TU Electric Letter No. TXX-6042 dated October 15, 1986, W. G. Counsil to E. H. Johnson, Director, Division of Reactor Safety and Projects, U.S. Nuclear Regulatory Commission, Small Bore Piping and Supports, SDAR-CP-86-72 (Interim Report)

SUBAPPENDIX B3

SDAR-CP-86-63, PIPE SUPPORT INSTALLATIONS

1.0 Definition of the Issue

On September 4, 1986, a deficiency was identified involving a broken cotter pin on a snubber (Reference 4.1).

2.0 Issue Resolution

The piping CAP includes the PCHVP that will validate cotter pin installation in accordance with field verification method CPE-SWEC-FVM-PS-081 (Reference 4.2).

3.0 Corrective and Preventive Action

See Section 3.0 of Subappendix A39.

4.0 References

4.1 TU Electric Letter No. TXX-6027, W. G. Counsil to E. H. Johnson, Director, Division of Reactor Safety and Projects, U.S. Nuclear Regulatory Commission, Pipe Supports, SDAR-CP-86-63 (Interim Report), November 3, 1986

4.2 SWEC-PSAS Comanche Peak Field Verification Method, Hardware Validation and Supplemental Inspection Programs CPE-SWEC-FVM-PS-081, Revision 0, July 29, 1987

SUBAPPENDIX B4

SDAR-CP-86-67, PREOPERATIONAL VIBRATION TEST CRITERIA

1.0 Definition of the Issue

TU Electric identified a deficiency (Reference 4.1) in the preoperational vibration test criteria. The CPSES criteria document, Preoperational Vibration Test Program, Issue 1, June 1980, was reviewed, and it was found that the mathematical formulas used to determine stress endurance limits, allowable deflections, and flexibility characteristics of certain piping systems may not have been accurate. Vibration calculations and test results were evaluated to determine the validity of the original calculations.

The evaluation yielded the following results:

1. Two test data points (from a total of 21 system tests) were found to exceed the allowable deflection limits.

2. The measured direction of deflection movement was not clearly identified in all instances.

3. The test deflections were measured in only one direction in some cases.

2.0 Issue Resolution

As a result of the piping Corrective Action Program (CAP) and extensive modifications to the piping systems, TU Electric will repeat the preoperational vibration testing. SWEC-PSAS has established Project Procedure CPPP-25, Unit 1 Piping Vibration Test Procedure (Reference 4.2), for the management and assessment of piping system vibration as required by the CPSES FSAR Section 3.9.B.2. This preoperational vibration test procedure is based on information contained in NRC Regulatory Guide 1.68 (Reference 4.3) and Section 3.9 of NUREG-0800 (Reference 4.4). SWEC-PSAS will provide technical services to the testing program.

TU Electric determined that this issue is reportable under the provisions of 10CFR50.55(e) and submitted SDAR-CP-86-67 on February 19, 1987.

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- This issue was determined to be reportable in accordance with the provisions of 10CFR50.55(e).

- The corrective actions to resolve this issue will be implemented by repeating the preoperational piping vibration testing by a new test procedure to resolve the concerns.

- Preventive action for this issue is identified in Appendix C.

4.0 References

4.1 TU Electric Letter No. TXX-6072 dated October 27, 1986, W. G. Counsil to U.S. Nuclear Regulatory Commission, Attention: Document Control Desk, SDAR-CP-86-67 Preoperational Vibration Test Criteria

4.2 SWEC-PSAS Project Procedure CPPP-25, Piping Vibration Test Procedure, Revision 0, December 8, 1986

4.3 USNRC Regulatory Guide 1.68, Initial Test Programs for Water-Cooled Nuclear Power Plants, Revision 2, January 1978

4.4 USNRC Standard Review Plan NUREG-0800, Section 3.9.2, Revision 2, July 1981

SUBAPPENDIX B5

SDAR-CP-86-73, ASME SNUBBER ATTACHMENT BRACKETS

1.0 Definition of the Issue

TU Electric identified a deficiency (Reference 4.1) involving restriction of the snubber swing angle by the snubber rear brackets. Rear brackets on safety-related snubbers have the potential to cause restricted movement and binding due to the use of the incorrect rear bracket.

2.0 Issue Resolution

A drawing review of ASME Section III, Code Class 1, 2, and 3 snubbers was conducted to verify the adequacy of swing clearances, and identified 1063 snubbers as having attachment brackets. As a result of field examination, the number of snubbers requiring evaluation has been reduced to 165.

2.1 These 165 supports were evaluated by comparing the field verified swing angle data with the predicted movements. The results are as follows:

- 83 supports were determined to have sufficient field verified swing angle to accommodate the predicted pipe movement.
- 15 supports were determined to be unnecessary in a previously initiated pipe support validation effort (and are being deleted).
- 33 supports are being modified as a res f the pipe support validation effort (but not as a result of this deficiency).
- 31 supports have been identified as having less clearance than required by analysis and are being modified to correct the situation.
- 3 supports have no safety-related function and do not impair the safety-related function of other components and therefore require no further evaluation for safety significance.

2.2 TU Electric determined that this issue was reportable under the provisions of 10CFR50.55(e) and submitted Significant Deficiency Analysis Report SDAR-CP-86-73 (Reference 4.1).

3.0 Corrective and Preventive Action

- No additional issues were discovered during the review and resolution of this issue.

- This issue was determined to be reportable under the provisions of 10CFR50.55(e).

- The corrective action to resolve the snubber rear bracket issue is being accomplished through the implementation of CPSES Construction Procedure CP-CPM-9.10A, paragraph 3.6 and CPSES Quality Control Procedure Nos. CP-QAP-12.1 and QI-QAP-11.1-28, which require a check for binding on the rear bracket. Additionally, a backfit inspection was implemented in accordance with Field Verification Method TNE-FVM-PS-038.

- The preventive actions are identified in Appendix C.

4.0 References

4.1 TU Electric Letter No. TXX-6104, W. G. Counsil to E. H. Johnson, Director, Division of Reactor Safety and Projects, U.S. Nuclear Regulatory Commission, Snubber Rear Brackets, SDAR-CP-86-73, November 19, 1986

APPENDIX C - PREVENTIVE ACTIONS

The preventive actions are embodied in the procedures developed and used for the Corrective Action Program. These procedures resolve all CPRT and external issues as well as all issues identified during the performance of the CAP. Implementation of the preventive actions will assure that the design and hardware for CPSES Unit 1 and Common can continue to comply with the licensing commitments throughout the life of the plant as described in Section 5.4. The particular preventive actions preclude the recurrence of the issues identified in Appendixes A and B as summarized below in Sections 1.0 and 2.0, respectively.

1.0 APPENDIX A ISSUES - PREVENTIVE ACTION

A1. Richmond Inserts

Attachment 4-5 of CPPP-7 (Reference C.1) provides requirements and instructions for the inclusion of bending stress in the analysis of bolting used in Richmond inserts with tube steel, the proper modeling of Richmond insert to tube steel connections, length limits of tube steel members used with two or more Richmond inserts, and evaluations of spacing between inserts. Attachment 4-13 of CPPP-7 provides procedures for the evaluation of local stresses due to nuts bearing on tube steel walls. SWEC-PSAS Project Memorandum PM-141 (Reference C.2) provides procedures to check the potential unequal shear loading when the tube steel connection is anchored by two or more Richmond inserts. Additionally, Quality Assurance Procedure QI-QAP-11.1-28 (Reference C.3) was revised to include inspection for proper thread engagement.

A2. Local Stress in Piping

Attachments 4-6A, 4-6B, and 4-6C of CPPP-7 provide requirements and instructions for the evaluation of local run pipe stresses due to integral welded attachments (4-6A), and support bearing loads (4-6B and 4-6C).

The use of zero-gap box frames, the evaluation of pipe support stiffnesses and the evaluation of local stresses in pipe support members are discussed in the preventive actions of Subappendixes A4, A5, and A21, respectively.

A3. Wall-to-Wall and Floor-to-Ceiling Supports

Attachment 4-19 of CPPP-7 provides procedures for the inclusion of the effects of differential seismic displacements and the long-term effects of concrete creep on supports which span wall-to-wall and floor-to-ceiling.

A4. Pipe Support/System Stability

Section 4.2.4 and Attachment 4-9 of CPPP-7 provide requirements for the modification of potentially unstable pipe support configurations.

A5. Pipe Support Generic Stiffness

Section 3.10.8 of CPPP-7 provides baseline stiffness values for rigid pipe supports, anchors, and snubbers. Section 4.3.2.2 of CPPP-7 outlines the approach to be used in determining pipe support stiffnesses and Attachment 4-18 is a tabular/graphic compilation of support component and standard support subassembly.

A6. Uncinched U-Bolt Acting as Two-Way Restraint

Section 4.2.5.2 and Attachment 4-3 of CPPP-7 provide requirements and instructions for the proper application and evaluation of uncinched U-bolts used as two-way restraints. Section 4.3.2.2 and Attachment 4-18 of CPPP-7 provide the stiffness values for uncinched U-bolts used as two-way restraints.

A7. Friction Forces

Section 4.7.3 of CPPP-7 requires that the effects of friction forces acting on pipe supports be included in the design for all noncyclic loads. Attachment 4-7 of CPPP-7 provides the methods of implementing this requirement.

A8. AWS Versus ASME Code Provisions

Section 4.4 and Attachment 4-2 of CPPP-7 provide guidance for the design/qualification of skewed joint welds.

The angular limits of skewed, T-joint welds requires no preventive action since CPSES weld procedures are qualified by testing, which overrides the AWS angle limitations.

A9. A500, Grade B Tube Steel

Section 4.7.2.1 of CPPP-7 specifies the design criterion of pipe supports using A500, Grade B tube steel.

A10. Tube Steel Section Properties

Section 4.3.2.1 of CPPP-7 requires the use of the 8th Edition of the AISC Manual of Steel Construction (Reference C.4) in the selection of section properties for support design/qualification to preclude the use of inappropriate section properties for tube steel.

Specification No. 2323-MS-100 (Reference C.5) has been revised to assure that an effective throat of $t_e = t - 1/16$ in. is achieved for welds on all tube steel sizes for any new design in the future.

Section 4.4 and Attachment 4-2 of CPPP-7, Revision 3, as amended by SWEC-PSAS Project Memorandum PM-140 (Reference C.6), specifies effective throat dimensions for flare bevel welds which meet the criteria of AWS. The revised guidelines of PM-140 will be followed for any future weld evaluation to preclude the recurrence of inadequate effective throat size.

A11. U-Bolt Cinching

Section 4.2.5.1 of CPPP-7 deleted the use of cinched U-bolts/crosspiece supports with struts/snubbers.

A12. Axial/Rotational Restraints

Sections 3.10.6.2 and 4.6.3, and Attachments 3-11 and 4-8 of CPPP-7 establish the procedure for the analysis of axial and rotational restraints.

A13. Bolt Hole Gap

Attachments 4-4 and 4-5 of CPPP-7 and SWEC-PSAS Project Memorandum PM-141 provide procedures for the design and evaluation of base plate bolt holes. Specification No. MS-46A (Reference C.7) and Quality Assurance Procedure QI-QAP-11.1-28 specify the design requirements and QA inspection tolerance of the bolt hole diameters.

A14. OBE/SSE Damping

Section 3.0 of CPPP-7 requires the use of OBE/SSE damping values that are consistent with Regulatory Guide 1.61 (Reference C.8) as modified by ASME Code Case N-411.

A15. Support Mass in Piping Analysis

Section 3.10.4, Attachment 3-4, and Attachment 3-11 of CPPP-7 provide guidance for the determination of pipe support mass and require the inclusion of this mass in the piping stress analysis.

A16. Programmatic Aspects and Quality Assurance, Including Iterative Design

Project Procedures CPPP-1, (Reference C.9) CPPP-6, (Reference C.10) and CPPP-7 control the validation of the piping and pipe supports. This is an integrated effort within one organization and assures proper interface between piping analysis and pipe support design. Additionally, personnel involved in the validation process receive training in the proper application of the requirements.

I erface with Westinghouse for Class 1 stress analysis is discussed i. Subappendix B.1.

A17. Mass Point Spacing

Section 3.10.6.1 and Attachment 3-7 of CPPP-7 provides guidelines for the proper location of mass points in pipe stress analyses.

A18. High-Frequency Mass Participation

Section 3.10.6.8 of CPPP-7 specifies the criteria to account for high frequency mass participation in stress analyses. Use of computer program NUPIPE-SW (V04/L02) has been revised to automatically account for high frequency mass corrections.

A19. Fluid Transients

Project Procedure CPPP-10 (Reference C.11) describes the procedure by which fluid transient events are identified for applicable systems for inclusion in the pipe stress analyses.

Section 3.4.5.5 and Attachment 3-1 of CPPP-7 provide requirements and instructions for the inclusion of these load conditions in the stress analyses.

A20. Seismic Excitation of Pipe Support Mass

Attachment 4-21 of CPPP-7 specifies the requirements for inclusion of the effects of pipe support self-weight excitation in the support evaluation.

A21. Local Stress in Pipe Support Members

Attachment 4-13 of CPPP-7 establishes the requirements to evaluate local stresses which may occur in pipe support members.

A22. Safety Factors

The technical and design control procedures assure that the piping systems are designed in accordance with the CPSES design criteria, and therefore, they will perform their safety-related function.

A23. SA-36 and A307 Steel

Section 2.0 of CPPP-7 lists the applicable governing codes to be used to assure that the proper allowable stresses (determined from the minimum material yield strengths) are used in the design. Section 4.2.5.1 of CPPP-7 deletes the use of cinched U-bolts/crosspiece supports with struts/snubbers. Attachment 4-5 of CPPP-7 establishes the requirement for the reduced allowables of high strength bolts used with A563 Grade A nuts.

A24. U-Bolt Twisting

Section 4.2.5.1 and Attachment 4-8 of CPPP-7 provides guidance for the modification of U-bolt trapeze supports. Cinched U-bolts used with struts or snubbers are deleted from CPSES.

A25. Fisher/Crosby Valve Modeling/Qualification

The validation process requires a conservative 55/45 flow distribution ratio on the outlet configuration.

Section 7.4.3 of CPPP-6 establishes the requirements for assuring that valves are properly qualified to the as-built loadings.

Section 3.10.6.5 of CPPP-7 addresses the proper valve yoke modeling of flexible valves.

A26. Piping Modeling

Section 3.0 of CPPP-7 provides direction and requirements for the proper modeling of piping systems.

A27. Welding

Section 4.4 and Attachment 4-2 of CPPP-7 provide requirements for the design and analysis of welded joints.

A28. Anchor Bolts/Embedment Plates

Attachment 4-4 of CPPP-7 provides guidance and requirements for the evaluation of anchor bolt embedded depths and edge distances.

Project Procedure CPPP-6 provides controls to assure that reaction loads on embedded plates, attachment spacing between embedded plates, and as-built loads for through-bolts are transmitted to responsible groups for evaluation.

A29. Strut/Snubber Angularity

Section 4.2.6 of CPPP-7 specifies requirements to assure that force components resulting from off-axis loading of struts and snubbers is included in the support design.

Specification No. 2323-MS-100, Construction Procedure CP-CPM-9.10A (Reference C.12), and Quality Assurance Procedure QI-QAP-11.1.28 have been revised to incorporate the resolutions of the items related to this issue.

A30. Component Qualification

Sections 3.4.5 and 4.2 of CPPP-7 delineate the requirements to assure that piping movements due to system design conditions are considered in the evaluations of frame gaps, swing angles, and spring and snubber travel.

Quality Assurance Procedures QI-QAP-11.1-28 and CP-QAP-12.1 (Reference C.13) have been revised to include inspections for the existence and tightness of all locking devices on pipe supports.

A31. Structural Modeling for Frame Analysis

Section 4.3.2.1 of CPPP-7 requires the use of AISC Manual of Steel Construction, 8th Edition for the selection of the member properties used in the analysis, including values for torsional resistance.

Attachment 4-5 of CPPP-7 provides the modeling technique used for the Richmond insert/tube steel connection.

Attachment 4-18 of CPPP-7 provides procedures for the proper modeling of the connection stiffness for use in the frame analysis.

A32. Computer Program Verification and Use

Section 5.0 of CPPP-7 identifies the computer programs acceptable for use in the validation of piping and pipe supports. This list assures that only those programs verified in accordance with SWEC standard QA program requirements for verification, technical adequacy, and appropriate version are used in the validation program.

A33. Hydrotest

Sections 3.6.2.4 and 4.7.2 of CPPP-7 provide guidance for the evaluation of piping and supports for hydrotest loading.

A34. Seismic/Nonseismic Interface

Attachment 4-10 of CPPP-7 provides requirements and instruction for the design of safety-related piping attached to nonseismic piping.

A35. Other Issues

CPPP-6 and CPPP-7 provide technical and administrative procedures to address the concerns described in the 51 DIRs referenced in Subappendix A35.

A36. SSER-8 Review

Resolution of this issue requires no preventive action, since design allowables for Richmond inserts and anchor bolts are based on the actual strength of concrete at CPSES.

A37. SSER-10 Review

No preventive action is required for the uncontrolled plug welding issue. As concluded by the CPRT Action Plan V.d Results Report (Reference C.14), the current procedures and practices for the repair of mislocated holes are adequate to preclude the recurrence of undocumented plug welds.

TU Electric Construction Procedure CP-CPM-1.2 (Reference C.15) and Project Procedure CPSP-30 (Reference C.16) provide procedures for the evaluation of the installed piping and pipe support configuration including the proper design of temporary supports prior to a piping system hydro to assure the integrity of the installed safety-related piping and pipe supports.

Project Procedure CPPP-28 (Reference C.17) and Attachment 4-10 to CPPP-7 provide direction and requirements for the identification and evaluation of interface anchors between seismic and nonseismic piping to assure isolation of Category I systems from non-Category I systems.

Quality Assurance Procedure QI-QAP-11.1-28 has been revised (Revision 30) to include acceptance criteria and measurement techniques for the inspection of Type 2 skewed welds.

A38. SSER-11 Review

Attachment 3-15 to CPPP-7 provides the procedure to analyze girth welds.

Quality Control Procedures QI-QAP-11.1-28 and CP-QAP-12.1 have been revised to assure that the items related to the QA Inspection Program have been addressed.

A39. CPRT Quality of Construction Review on Piping and Pipe Supports

TU Electric instituted the Post-Construction Hardware Validation Program (PCHVP) (Reference C.18) to validate that the as-built hardware complied with the design for Unit 1 and Common safety-related piping and pipe supports. The quality of construction requirements for pipe supports in the PCHVP were incorporated into Quality Assurance Procedures QI-QAP-1.11-28 and CP-QAP-12.1.

2.0 APPENDIX B ISSUES - PREVENTIVE ACTION

B1. SDAR-CP-86-33, Stiffness Values for Class 1 Stress Analysis

Project Procedure CPPP-6 requires that support stiffness values for pipe supports for Class 1 lines be computed and provided to Westinghouse for use in the stress analysis of Class 1 lines.

B2. SDAR-CP-86-72, Small Bore Piping and Supports

Design Basis Documents (DBD) (References C.19, C.20, and C.21) for small bore piping and the supports have been established. These documents delineate the applicable specifications, detailed technical procedures, and construction and QC inspection procedures, required to maintain the validated design.

B3. SDAR-CP-86-63, Pipe Support Installation

The as-built verification procedure, CPSP-12 (Reference C.22), and the Pipe Stress/Support Final Reconciliation Procedure, CPPP-23 (Reference C.23), combined with those Quality Assurance inspection procedures identified in the DBD-CS-067 (Reference C.18) provide assurance that pipe support installations will meet the requirements of the design.

B4. SDAR-CP-86-67, Preoperational Vibration Test Criteria

The results of the preoperational vibration testing will be reviewed by SWEC-PSAS to assure that the results satisfy the design criteria.

No further preventive action is required because preoperational vibration testing is a one-time event, which will not be repeated following the issuance of an operating license.

B5. SDAR-CP-86-73, ASME Snubber Attachment Brackets

Quality Assurance Procedure QI-QAP-11.1-28 has been revised to inspect for the incorrect use of the correct attachment brackets for snubbers.

REFERENCES:

C.1 SWEC-PSAS Project Procedure CPPP-7, Design Criteria for Pipe Stress and Pipe Supports, Revision 3, February 27, 1987

C.2 SWEC-PSAS Project Memorandum PM-141, Unequal Shear Loading Effect on Richmond Insert and Threaded Rods Used in Conjunction with Tube Steel, Revision 0, March 25, 1987

C.3 CPSES Quality Assurance Procedure QI-QAP-11.1-28, Fabrication and Installation Inspection of Safety Component Supports, Revision 35, January 8, 1987

C.4 AISC Manual of Steel Construction, 8th Edition, 1980

C.5 CPSES Piping Erection Specification No. 2323-MS-10C, Revision 9, August 17, 1987

C.6 SWEC-PSAS Project Memorandum PM-140, Flare Bevel Groove Welds, Revision 1, May 1, 1987

C.7 CPSES Nuclear Safety Class Pipe Hangers and Supports Specification No. 2323-46A, Revision 7, May 7, 1987

C.8 NRC Regulatory Guide 1.61, Damping Values for Seismic Design of Nuclear Power Plants, October 1973

C.9 SWEC-PSAS Project Procedure CPPP-1, Management Plan for Project Quality (Piping System Qualification/Requalification), Revision 7, March 25, 1987

C.10 SWEC-PSAS Project Procedure CPPP-6, Pipe Stress/Support Requalification Procedure, Revision 4, April 8, 1987

C.11 SWEC-PSAS Project Procedure CPPP-10, Procedure for Review of Plant Operating Mode Conditions, Revision 1, April 1, 1986

C.12 CPSES Construction Procedure CP-CPM-9.10A, Installation of Vendor Supplied Component Supports Catalog Items, Revision 1, August 15, 1985

C.13 CPSES Quality Assurance Procedure CP-QAP-12.1, Mechanical Component Installation and N-5 Certification, Revision 18, January 12, 1987

C.14 CPRT Action Plan V.d Results Report, Revision 1, Plug Welds, December 18, 1986

C.15 CPSES Construction Procedure CP-CPM-1.2, Construction Activities for Systems and/or Areas Accepted and/or Controlled by TU Electric Plant Operations, Revision 5, March 4, 1987

C.16 SWEC-PSAS Project Site Engineering Procedure CPSP-30, Processing TU Electric Requests for Temporary Hangers, Revision 0, October 7, 1987

C.17 SWEC-PSAS Project Procedure CPPP-28, Procedure for Identification and Evaluation of Interfaces Between Seismic and Nonseismic Piping, Revision 0, February 20, 1987

C.18 TU Electric Engineering and Construction Procedure EC-9.04, Post Construction Hardware Validation Program, July 29, 1987

C.19 TU Electric Design Basis Document DBD-CS-065, ASME Class 1 Piping Analysis (Draft), August 14, 1987

C.20 TU Electric Design Basis Document DBD-CS-066, ASME Class 2 and 3 Piping Analysis, Revision 0, July 31, 1987

C.21 TU Electric Design Basis Document DBD-CS-067, ASME Class 1, 2, and 3 Pipe Support Design, Revision 0, July 31, 1987

C.22 SWEC-PSAS Project Site Engineering Procedure CPSP-12, As-Built Verification (Piping), Revision 0, November 12, 1986

C.23 SWEC-PSAS Project Procedure CPPP-23, Pipe Stress/Support Final Reconciliation Procedure, Revision 0, March 2, 1987

Errata
Small Bore Piping and Pipe Support
PSR

PSR Page	Item/Line No.	Correction
5-22	31	Delete "Piping Erection"
5-28	35	Change "23 audits" to "24 audits"
5-30	19-20	Change "have verified" to "verify" and "were" to "are" and "identified a trend" to "have identified a trend"
5-29 5-30	1 34	Change "16" to "17"
FIGURE 5-1	-	Change "SPEC. 2323-MS200A (Ref. 41)" to "SPEC. 2323-MS200 (Ref. 41)"
TABLE 5-6	1	Change "Piping Erection" to "Field Fabrication and Erection of Piping and Pipe Supports"

Errata
Small Bore Piping and Pipe Support
PSR

PSR Page	Item/Line No.	Correction
TABLE 5-6	9	Change "CPSES Quality Assurance Procedure QI-QAP-11.1-26, Piping and Equipment Installation Inspection (Reference 42)" to "CPSES ASME Quality Procedure, AQP-11.2, Fabrication and Installation Inspection of Pipe and Equipment (Reference 60)"
TABLE 5-9	SWCL No. 1	Change "02/21/85" to "02/21/86"
"	Project No. 5	Change "CPO-746, 04/03/86" to "CPO-881, 04/16/86"
"	SWCL No. 2	Change "CPI-3557, 08/12/86" to "CPO-1901, 07/18/86 and CPO-2002, 07/28/86"
"	Project No. 13	Change "12/01/86-12/05/86" to "12/03/86-12/22/86"
"	Project No. 14	Change "03/06/87" to "03/27/87" and under the Audit Response Transmittal column, change "EMD File 16.1.2(016)" to "CPI-8657, 05/08/87"

Errata
Small Bore Piping and Pipe Support
PSR

PSR Page	Item/Line No.	Correction
TABLE 5-9	Project No. 15	Change "03/27/87" to "03/31/87"
"	Project No. 17	Change "08/14/87" to "08/04/87"
"	Site No. 5	Change "06/22/87" to "06/20/87"
"	New	Add: "Project No. 18, at CH, 08/17/87-08/28/87, IOM-EA-1965/CPI-8073, No Response Required
6-3	32	Change "Revision 0, November 21, 1986" to "Revision 1, October 23, 1987"
6-3 C-9	38 C.5	Change "Piping Erection" to "Field Fabrication and Erection of Piping and Pipe Supports"

Errata
Small Bore Piping and Pipe Support
PSR

PSR Page	Item/Line No.	Correction
6-3	42	Change "CPSES Quality Assurance Procedure QI-QAP-11.1-26, Piping and Equipment Installation Inspection, Revision 0" to "Deleted. Superseded by Reference 60."
6-4	49	Change "August 30, 1987" to "August 28, 1987"
6-5	60	Change "Revision 0, July 10, 1987" to "Revision 1, August 31, 1987"
6-5	62	Change "Reactor Coolant Loop Piping and Support Design" to "Reactor Coolant Loop Piping Stress Analysis and Support Design"
6-5	73	Change "October 15, 1987" to "October 15, 1986"
A4-5	4.4	Change "J. B. George" to "J. W. Beck"

Errata
Small Bore Piping and Pipe Support
PSR

PSR Page	Item/Line No.	Correction
A5-4	4.8	Change "Pipe Support Generic Stiffness Study" to "Pipe Support Stiffness Study"
A11-2	4.4	Change "U-bolt Support Assembly Finite Element Analysis" to "U-bolt Piping Support Assembly Finite Element Analysis"
A13-3	4.5	Change "July 6, 1987" to "May 12, 1987"
A20-1	4.2	Change "February 14, 1983" to "February 15, 1983"
A28-3	4.2	Change "Revision 4" to "Revision 1"
A37-3	4.8	Change "Processing TU Electric Requests for Temporary Hangers" to "Processing Requests for Temporary Hangers" and "October 7, 1987" to "October 1, 1987"
A39-5	4.2	Change "July 17, 1987" to "July 29, 1987"

Errata
Small Bore Piping and Pipe Support
PSR

PSR Page	Item/Line No.	Correction
B3-1	4.1	Change "Pipe Supports" to "Pipe Support Installations" and "November 3, 1986" to "October 16, 1986"
B5-2	4.1	Change "Snubber Rear Brackets" to "ASME Snubber Attachment Brackets"
C-9	C.3	Change "Fabrication and Installation Inspection of Safety Component Supports" to "Fabrication and Installation Inspection of Safety Class Component Supports" and "January 8, 1987" to "January 12, 1987"
"	C.7	Change "May 7, 1987" to "May 12, 1987"
C-10	C.19	Change "(Draft), August 14, 1987" to "Rev. 0, October 1, 1987"

NC
9/18/87

CYGNA ENERGY SERVICES

2121 N. California Blvd., Suite 390, Walnut Creek, CA 94596 415/934-5733

September 16, 1987
84056.119

Mr. W. G. Counsil
Executive Vice President
TU Electric
Skyway Tower
400 N. Olive St., L. B. 81
Dallas, TX 75201

Subject: Pipe Stress Review Issues List - Rev. 4
Comanche Peak Steam Electric Station
Independent Assessment Program - All Phases
Job No. 84056

Dear Mr. Counsil:

Enclosed is Revision 4 of the Pipe Stress Review Issues List (RIL). All changes are indicated by a revision bar in the right margin.

All technical issues associated with this discipline have been closed; however, Cygna is still waiting for a copy of Stone & Webster calculation No. 15454-NZ(B)-GENX-035, Rev. 2, to verify completion of commitments associated with RIL 11. Any procedural control issues associated with Cygna's original pipe stress reviews of Gibbs & Hill are being addressed as part of the ongoing design control assessments.

If you have any questions or require further information, please contact Cygna at your convenience.

Very truly yours,

N. H. Williams

N. H. Williams
Project Manager

Enclosure
NHW:rlr

cc: Mr. J. Redding
Mr. L. Nace
Mr. W. Counsil
Mr. J. Muffett
Mr. D. Pigott
Ms. A. Vietti-Cook
Mr. C. Grimes
Mr. E. Siskin
Mr. R. Klause

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SEP 17 1987
WILLIAM G. COUNSIL

PIPE STRESS
Review Issues List

1. Mass Participation/Mass Point Spacing

References: 1. R.E. Ballard (G&H) letter to J.B. George (TUGCO), "Mass Participation," GTN-69454, September 14, 1984.

2. N.H. Williams (Cygna) letter to J.B. George (TUGCO). "Phase 3 Open Items - Mass Participation," 84042.017, September 21, 1984.

3. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Phase 3 Open Items - Mass Participation," 84042.019, October 2, 1984.

4. L.M. Popplewell (TUGCO) letter to N.H. Williams (Cygna) "Cygna Potential Finding Report, Mass Participation, and the Mass Point Spacing Error in Problem AB-1-61A," December 7, 1984.

5. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Phase 3 Open Items - Mass Participation and Mass Point Spacing," 84042.021, February 8, 1985.

6. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PI-00-05, and PFR-01.

7. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO), "Cygna Questions/Comments on the CPRT Plan", 84056.085, October 6, 1985.

8. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13 and 14, 1986 - On Resolution of Cygna concerns.

9. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

10. Conference Report of Cygna Audits at SWEC offices, March 17 and 18, 1987 (Cherry Hill, N.J.) and March 19, 1987 (Boston, MA), Job No. 84056 - Audit to Review Stone & Webster Pipe Stress and Pipe Support Reconciliation Procedures.

PIPE STRESS
Review Issues List

11. W.G. Council (TU Electric) letter to N.H. Williams (Cygna), TU Log No. TXX-6280, Dated February 18, 1987, Attachment A.

12. Generic Technical Issues Report, TUCGO/SWEC, Revision 0, Status Date June 27, 1986, Appendices Q&R, Both Revision 0.

13. Transcript of meeting between TUGCO/Cygna/SWEC/Impell/Ebasco at Glen Rose, TX, March 24 and 25, 1987-on Conduit Supports, Cable Trays, Pipe Stress and Pipe Supports (Volume II of II).

Summary: The pipe stress seismic analyses did not include sufficient modes to comply with the FSAR, which requires that the inclusion of additional higher order modes should not increase system response by more than 10%. In addition, the mass point spacing for the dynamic analyses did not always meet the project criteria.

Status: This issue is closed based on Cygna's review of Reference 11 and the discussion of Reference 10 that lead to the conclusion that SWEC's methods give reasonable results. Cygna's concern, as documented in Reference 8, was that the SWEC method of combining modal responses between the ZPA and the seismic analysis cutoff frequency of 50Hz may lead to incorrect results for the seismic analysis. SWEC completed a study using problems that were selected because they had the lowest frequencies at which the response spectrum returns to the ZPA value. A comparison of the results, determined by applying the missing mass correction at 50 Hz as opposed to the ZPA frequency, showed negligible differences.

2. Incorrect Pipe Schedule Used for Calculation of Nozzle Allowables

Reference: 1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PI-02-05

Summary: Cygna noted one instance in which the nozzle allowables were calculated using an incorrect wall thickness.

PIPE STRESS
Review Issues List

Status: This issue is closed, based on an expanded review to include the pumps on the diesel generator system.

3. Finite Element Model Error in Flued Head Analysis

Reference: 1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PI-03-01

Summary: The flued head finite element model was found to contain a geometry error due to improper generation of some elements.

Status: This issue is closed, based on review of 15 of the remaining 18 flued head analyses.

4. Inclusion of Fluid and Insulation Weight at Valves and/or Flanges

Reference: 1. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PI-00-04 and Section 5.1., Page 5-6

2. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO), "Cygna Questions/Comments on the CPRT Plan", 84056.085, October 6, 1985.

3. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

Summary: Cygna found that it was Gibbs & Hill's standard practice not to include fluid and insulation weight at valves and flanges.

Status: This issue is closed for the CCW system, based on a Gibbs & Hill study which demonstrated that the effect is minor. Cygna has reviewed the SWEC criteria (Ref. 3) and finds that this issue is properly addressed. Therefore, this issue is closed for all systems.

5. Discrepancies in Pipe Support Loads Between Analyses and Support Design

References: 1. Cygna Phase 3 Final Report, TR-84042.01, Revision 1, Observation PI-00-06

2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated August 29, 1984

PIPE STRESS
Review Issues List

3. R.E. Ballard (Gibbs & Hill) letter to J.B. George (TUGCO), GTN-69233, dated July 10, 1984

4. Communications Report between J. Finneran (TUGCO), N. Williams and J. Minichiello (Cygna) dated 7/13/84, 2:45 p m.

Summary: Cygna found that, in some instances, the latest support loads were not used in the pipe support design calculations.

Status: This issue is closed, except as a procedural question which is addressed in the Design Control RIL.

6. Snubbers on Fisher Valves

References:

1. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PI-00-07 and PFR-02

2. L.M. Popplewell (TUGCO) letter to N.H. Williams (Cygna) dated July 9, 1984

3. L.M. Popplewell (TUGCO) letter to N.H. Williams (Cygna) dated August 29, 1984

4. L.M. Popplewell (TUGCO) letter to N.H. Williams (Cygna) dated October 2, 1984.

5. Communications Report between R. Manvelyan (Gibbs & Hill) and J. Minichiello (Cygna) dated 6/15/84, 10:30am.

6. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

Summary: The snubbers on the Fisher valve operators were not qualified for the as-built loads. This issue led to questioning whether the valve itself was capable of transmitting these loads and still maintaining operability.

PIPE STRESS
Review Issues List

Status: This issue is closed, based on TUGCO's requalification of all affected valves and snubbers. Cygna has reviewed the SWEC criteria (Ref. 6) and has found that this issue is properly addressed. However, the procedural interface remains as an open issue to be addressed in the Design Control RIL.

7. Snubbers Close to Equipment Nozzles

Reference:

1. Cygna Phase 4 Pipe Stress Walkdown Checklists (not issued).
2. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13 and 14, 1986 - On Resolution of Cygna concerns.
3. Stone & Webster's Pipe Stress/Support Requalification Procedure for CPSES Unit 1, CPPP-6, Ref. 2.
4. Design criteria for Pipe Stress and Pipe Supports, Stone & Webster Engineering Corporation, CPPP-7, Revision 2, April 25, 1986.
5. W.G. Counsil (TUGCO) letter to N.H. Williams (Cygna) Log No. TXX-6133, December 4, 1986, "TUGCO Commitments, from November 13, and 14, 1986 'Resolution of Cygna Concerns' Meeting", Enclosure A.
6. Conference Report of Cygna audits at SWEC Offices, March 17 and 18, 1987 (Cherry Hill, N.J.) and March 19, 1987 (Boston, MA), Job No. 84056 - Audit to Review Stone and Webster Pipe Stress and Pipe Support Reconciliation Procedures.
7. Transcript of Meeting between TUGCO/Cygna/SWEC/Impell/Ebasco at Glen Rose, TX, March 24 and 25, 1987 - on Conduit Supports, Cable Trays, Pipe Stress and Pipe Supports.

Summary: Cygna noted several snubbers on the Component Cooling Water System (CCW) which were located close to equipment nozzles. Due to their proximity to a rigid attachment point, the dynamic displacements at these locations will be very small, such that the snubbers may not perform their intended

PIPE STRESS
Review Issues List

function.

Status: This issue is closed based on Cygna's review of calculations in Reference 6. Cygna's concern was that SWEC lacked a specific criteria for snubber elimination. SWEC does not have a specific criteria for snubbers close to equipment nozzles since each stress problem is reviewed by an experienced pipe stress engineer and an experienced pipe support engineer before the stress analysis is performed. This review is documented in a Piping System Review Documentation (PSRD) calculation, which is very detailed and comprehensive and includes guidance as to the elimination of snubbers proximate to nozzles and rigid restraints. Cygna audited three calculations to assess guidance given concerning proximate snubbers, and in all cases Cygna concurred with the guidance given.

8. Lack of Traceability for ANSYS/Relap Runs

Reference:

1. Communications Report between S. Lim (Gibbs & Hill) and L. Weingart (Cygna) dated 3/8/84, 8:45 a.m.
2. Communications Report between H. Mentel (Gibbs & Hill) and J. Minichiello (Cygna) dated 3/13/84, 3:00 p.m., Revision 1
3. Communications Reports between S. Lim (Gibbs & Hill) and L.Weingart (Cygna) dated 3/15/84, 8:15 a.m.

Summary: There are four programs utilized by Gibbs & Hill in performing a steam hammer analysis:

1. RELAP
2. GHFORCE - provides imbalance loads
3. Program to convert to ANSYS format
4. ANSYS

Sufficient documentation did not exist to provide cross referencing of the four runs for a particular Main Steam loop.

Status: This finding was closed technically; however, it remains open from a procedural standpoint. This issue is being addressed as part of Cygna's design control RIL.

9. Inclusion of Support Mass In Pipe Stress Analysis

References:

1. Communications Report between G. Krishnan (Gibbs & Hill SSAG) and J. Minichiello (Cygna) dated 3/19/84, 8:30 a.m.

2. Gibbs & Hill letter GTN-68852 dated April 25, 1984

3. Communications Report between H. Mentel (Gibbs & Hill), G. Grace (EBASCO), N. Williams and L. Weingart (Cygna) dated 5/24/84, 10:00 a.m.

4. Prefiled Testimony of Nancy H. Williams, Response to Doyle Question No. 4, April 12, 1984

5. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Pipe Stress Checklist General Note 1

6. Communications Report between D. Wade (TUGCO) and N. Williams (Cygna) dated 10/11/84, 4:00 p.m.

7. N.H. Williams (Cygna) letter to V. Noonan (USNRC), 84042.022, dated January 18, 1985 "Open Items Associated with Walsh/Doyle Allegations"

8. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO), "Cygna Questions/Comments on the CPRT Plan", 84056.085, October 6, 1985.

9. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

10. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13 and 14, 1986 - On Resolution of Cygna concerns.

Summary: The weight of the pipe supports was included in the stress analyses for the Main Steam Inside Containment only. In Reference 1, Cygna requested justification for this practice. Gibbs & Hill responded in Reference 2 by pointing out that the supports associated with the Main Steam lines were

PIPE STRESS
Review Issues List

relatively massive and, as such, a judgement was made to include their mass in the stress analysis. For other systems, a judgement was made that the effects would be negligible. Per Reference 4, the effect of this omission on support loads was shown to be as high as 24% on the RHR system.

Status: This issue is closed. Cygna has reviewed the SWEC criteria (Ref. 9). SWEC has considered the effects of support mass in the piping reanalysis effort. Per the commitment made in Ref. 10, SWEC will notify Cygna if the eccentric mass effect is implemented by changes to the mass/stiffness matrices as opposed to modeling of the eccentric support members (see Pipe Stress RIL Item 19).

10. Stress Intensification Factors (SIFs)

References:

1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PI-00-01
2. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PI-00-01
3. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO), "Cygna Questions/Comments on the CPRT Plan", 84056.085, October 6, 1985.
4. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.
5. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13 and 14, 1986 - On Resolution of Cygna concerns.
6. Transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, TX, December 15 and 16, 1986.
7. Conference Report of Cygna audits at SWEC offices, March 17 and 18, 1987 (Cherry Hill, N.J.) and March 19, 1987 (Boston, MA), Job No. 84056 - Audit to Review Stone & Webster Pipe Stress and Pipe Support Reconciliation Procedures.
8. Generic Technical Issues Report, TUGCO/SWEC, Revision 0,

PIPE STRESS
Review Issues List

Status Date June 27, 1986, Appendix Z, Revision 0.

9. Transcript of Meeting between, TUGCO/Cygna/SWEC/Impell/Ebasco at Glen Rose, TX, March 24 and 25, 1987 - on Conduit Supports, Cable Trays, Pipe Stress and Pipe Supports.

10. Controlled Memo to Project File No. 038, Job No. 84056, May 18, 1987 - SIF for Weld Neck Flanges.

Summary: Cygna found numerous instances where Gibbs and Hill either neglected to input the required SIF into the stress analysis (References 1 & 2) or miscalculated the SIF (Reference 2).

Cygna has reviewed the SWEC criteria (Reference 4) and as documented in Reference 5, is reviewing SWEC's code reference for their exclusion of SIF's at weld neck flanges.

Status: This issue is closed based on Cygna's review of Reference 10 for weld neck flanges. The values used by SWEC are acceptable.

11. Welded Attachments

References:
1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PI-00-02, PI-02-03, and PI-02-04.

2. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observations PI-00-02 and PI-06-01.

3. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO), "Cygna Questions/Comments on the CPRT Plan", 84056.085, October 6, 1985.

4. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

5. Stone & Webster's Piping and Pipe Support Requalification Program, CPSES Unit 1, Large Bore Piping Final Report, dated 11/7/86.

6. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13 and 14, 1986 - On Resolution of Cygna concerns.

PIPE STRESS
Review Issues List

7. Transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, TX. December 15 and 16, 1986.

8. Conference Report of Cygna audits at SWEC offices, March 17 and 18, 1987 (Cherry Hill, N.J.) and March 19, 1987 (Boston, MA), Job No. 84056 - Audit to Review Stone & Webster Pipe Stress and Pipe Support Reconciliation Procedures.

9. Conference Report of Cygna audits at SWEC offices, December 30, 1986 (Boston, MA), Job No. 84056 - Audit to Review Stone & Webster Procedure for Local Pipe Stress Evaluation.

10. Controlled Memo to Project File No. 036, Job No. 84056, April 21, 1987 - Use of MNS to Calculate Run Pipe Stress at Welded Attachments.

11. Generic Technical Issues Report, TUGCO/SWEC Revision 0, Status Date June 27, 1986, Appendix B, Revision 0.

12. Transcript of Meeting between TUGCO/Cygna/SWEC/Impell/Ebasco at Glen Rose, TX, March 24 and 25, 1987 - on Conduit Supports, Cable Trays, Pipe Stress and Pipe Supports.

Summary: Cygna found several problems with Gibbs and Hill's treatment of welded attachments:

- An increased allowable was used in the evaluation of local stresses for upset and emergency combinations (Reference 1).
- Thermal expansion loads were used rather than load ranges for evaluation of local stresses (Reference 1).
- Local stresses were not considered in break exclusion zones (Reference 2).
- Combined effects of two supports at a single welded attachment were not considered (Reference 2).

Status: This issue is closed contingent upon Cygna's review of SWEC

PIPE STRESS
Review Issues List

Calculation No. 15454-NZ(B)-GENX-035, Revision 2 which evaluates the effects of pressure on pad weld stresses (see Reference 8, p. 11 and Reference 12, Volume II of II, p. 3). Cygna has reviewed the SWEC criteria (Ref. 4) and Large Bore Piping Final Report (Ref. 5) and has determined that all of the above concerns are properly addressed. Cygna's need for clarification of the procedures provided in Attachment 4-6A to Reference 4 was addressed in Reference 9.

12. Use of Incorrect Pipe Wall Thickness

Reference: 1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PI-01-01

Summary: Cygna found two piping segments which were input to the stress analysis with the incorrect wall thickness.

Status: This problem is considered isolated and closed, based on Cygna's recalculation of the pipe stresses.

13. Inclusion of Appropriate Response Spectra

References: 1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PI-02-01

Summary: Cygna noted that stress analysis problem AB-1-70 did not consider all the appropriate response spectra from all buildings.

Status: This issue is closed, based on an evaluation of the omitted spectra and an expanded review to determine if this situation occurred in other stress problems.

14. Support Location Discrepancy

References: 1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PI-02-02

2. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Checklist PI-09, Item 14

Summary: Supports were modeled at locations outside of allowable

PIPE STRESS
Review Issues List

tolerances. The Reference 1 observation was closed based on an evaluation of the pipe stresses and an assessment that these occurrences were sufficiently isolated. The Reference 2 discrepancy was noted and evaluated by Gibbs & Hill in their QA binder.

Status: This issue is closed.

15. Use of Incorrect Damping in Seismic Analyses

Reference:

1. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PI-00-03.
2. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO), "Cygna Questions/Comments on the CPRT Plan", 84056.085, October 6, 1985.
3. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

Summary: Cygna noted that Gibbs & Hill did not consider the lower damping response spectra in some systems with both large and small bore piping.

Status: This issue is closed, based on Cygna's expanded review. Cygna has reviewed the SWEC criteria (Ref. 3) and finds that this issue is properly addressed.

16. Combination of Safety/Relief Valve Thrust and Seismic Loads

Reference:

1. Cygna Phase 3 Final Report, TR-84042-01, Revision 0, Observation PI-06-02
2. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

Summary: In pipe stress problem AB-1-23B, the stresses/loads due to safety/relief valve thrust were not combined with those due to SSE for the emergency case. In the other three Main Steam lines outside containment, the two effects were combined. While not specifically required by the FSAR, Cygna believes it is appropriate to combine the two effects.

PIPE STRESS
Review Issues List

Status: This issue is closed. TUGCO has filed an amendment to the CPSES FSAR which eliminates SSE from any emergency load combination. However, as stated in Ref. 2, SSE and SRV thrust loads are being combined and compared to a faulted allowable.

17. Force Distribution in Double Ported Safety Valves

Reference:

1. Communication Report between H. Mentel (Gibbs & Hill) and J. Minichiello (Cygna) dated 3/12/84, Item 2b.
2. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO), "Cygna Questions/Comments on the CPRT Plan", 84056.085, October 6, 1985.
3. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13 and 14, 1986 - On Resolution of Cygna concerns.
4. Generic Technical Issues Report, TUGCO/SWEC, Revision 0, Status Date June 27, 1986, Appendix Y, Revision 0.
5. Conference Report of Cygna audits at SWEC offices, March 17 and 18, 1987 (Cherry Hill, N.J.) and March 19, 1987 (Boston, MA), Job No. 84056 - Audit to Review Stone & Webster Pipe Stress and Pipe Support Reconciliation Procedures.
6. Communication Report Between H. Mentel (G&H), G. Grace (Ebasco) adn L. Weingart, N. Williams (Cygna) dated May 24, 1984, Item 4.
7. R.E. Ballard (Gibbs & Hill) Letter to J.B. George (TUGCO), "Responses to Cygna Questions dated March 12, 19 and 21, 1984", GTN - 68852, April 25, 1984 - Item 2b, responses to Cygna telecopied questions March 12, 1984, 9 a.m.
8. Transcript of Meeting between TUGCO/Cygna/SWEC/Impell/Ebasco at Glen Rose, TX, March 24 and 25, 1987 - on Conduit Supports, Cable Trays, Pipe Stress and Pipe Supports.

Summary: By assuming a 55/45 split in the flow, instead of the 60/40

PIPE STRESS
Review Issues List

suggested by Crosby Valve as general practice, the torque on the Main Steam pipe is halved.

Status: This issue is closed based on Cygna's review of a mainsteam calculation (Reference 5) with loads and stresses adjusted for the 60/40 flow split. SWEC's calculations are based on a 55/45 flow split but a 60/40 split will double the torsion on the pipe. The pipe stresses and the pipe support loads are still within the allowables even with the more conservative 60/40 flow split.

18. Fisher Valve Modeling

Reference:

1. Communication Report between H. Mentel (Gibbs & Hill) and J. Minichiello (Cygna) dated 3/12/84, Item 1c
2. Communication Report between Krishnan/Ray (Gibbs & Hill) and Minichiello (Cygna) dated 6/12/84
3. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO), "Cygna Questions/Comments on the CPRT Plan", 84056.085, October 6, 1985.
4. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

Summary: Cygna has questions on the modeling of "flexible" valves (Fn $<$ 33 cps). In the review, Cygna found that valves noted in Reference 2 (other than Fisher valves) were the only "flexible" valves within the Gibbs & Hill scope. Cygna determined that the valve accelerations for those valves were acceptable; however, Cygna did not address the modeling of the Fisher valve yoke, which is laterally supported at the end. If the yoke is modeled much stiffer than it actually is, this may affect the analysis results.

Status: This issue is closed. Cygna has reviewed the SWEC criteria (Ref. 4) and finds that this issue is properly addressed.

19. Eccentric Mass and Its Effect on Piping and Welded Attachments

Reference:

1. Communication Report between G. Krishnan (Gibbs & Hill) and J. Minichiello (Cygna) dated 3/21/84, Item 1

PIPE STRESS
Review Issues List

2. R.E. Ballard, Jr. (Gibbs & Hill) letter GTN-68852 to J.B. George (TUGCO) dated 4/25/84

3. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO), "Cygna Questions/Comments on the CPRT Plan", 84056.085, October 6, 1985.

4. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

5. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13 and 14, 1986 - On Resolution of Cygna concerns.

Summary: In modeling the masses of the supports in the Main Steam lines inside containment, Gibbs & Hill did not consider the eccentricity of the mass from the pipe centerline. In their response in Reference 2, Gibbs & Hill showed that the seismic effects were small on the overall pipe cross-section. They also showed that the local effects at the welded attachment were not significant for a 1.0g load. Further Cygna review showed that the seismic accelerations were on this order. Cygna's review did not consider the effect of fluid dynamic accelerations, nor other systems.

Status: This issue is closed. Cygna has reviewed the SWEC criteria (Ref. 4). Per Ref. 5, SWEC has modeled any eccentric support members. SWEC has committed to notify Cygna if the eccentric mass effect is accounted for by modifying the mass and stiffness matrices.

20. ANSYS Steam Hammer Analyses

Reference:

1. Communication Report between H. Mentel (Gibbs & Hill) and J. Minichiello (Cygna) dated 3/13/84, Item 2

2. Communication Report between G. Krishnan (Gibbs & Hill) and J. Minichiello (Cygna) dated 3/21/84, Item 3

3. R.E. Ballard, Jr. (Gibbs & Hill) letter GTN-68852 to J.B. George (TUGCO) dated 4/25/84

4. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO), "Cygna Questions/Comments on the CPRT Plan", 84056.085,

PIPE STRESS
Review Issues List

October 6, 1985.

5. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

6. Transcript of meeting between SWEC/TUGCO/CYGNA at Cherry Hill, New Jersey, dated November 13 and 14, 1986 - On Resolution of Cygna concerns.

7. Communication report between H. Mentel (G&H), G. Grace (Ebasco) and L. Weingart, N. Williams (Cygna) dated May 24, 1984, Items 29, 30 and 32.

8. W.G. Counsil (TU Electric) letter to N.H. Williams (Cygna), TU Log No. TXX-6280, dated February 18, 1987, Attachment B.

9. Conference Report of Cygna audits at SWEC offices, March 17 and 18, 1987 (Cherry Hill, N.J.) and March 19, 1987 (Boston, MA), Job No. 84056 - Audit to Review Stone & Webster Pipe Stress and Pipe Support Reconciliation Procedures.

10. Transcript of Meeting between, TUGCO/Cygna/SWEC/Impell/Ebasco at Glen Rose, TX, March 24 and 25, 1987 - on Conduit Supports, Cable Trays, Pipe Stress and Pipe Supports.

11. Generic Technical Issues Report, TUGCO/SWEC, Revision 0, Status Date June 27, 1986, Appendix S, Revision 0.

Summary: In reviewing the ANSYS model, Cygna questioned the mass point spacing and time step size used. Gibbs & Hill supplied the results of a sensitivity study in Reference 3. In addition, Cygna questioned the load output in two axial restraints, since they were less than the load input. Gibbs & Hill explained why the results were reasonable in Reference 3. Prior to the Reference 3 response, however, Cygna did not find any documentation indicating that either a sensitivity study had been done or that the ANSYS results had been reviewed for "reasonability".

As part of the Stone & Webster piping reanalysis effort, all fluid transient analyses were redone. Cygna has reviewed

PIPE STRESS
Review Issues List

the SWEC criteria (Ref. 5). Based on this review, Cygna has the following concerns, as documented in Ref. 6:

1. Mass point spacing is based upon bending mode frequencies up to 50 Hz. The timehistory analysis may include frequencies up to 200 Hz.

2. Attachment 3-1 to Ref. 5 requires timehistory analyses to include 80%, or more, of the piping system mode shapes. As documented in Ref. 6, Cygna is concerned with the acceptability of using more than 50% of the total number of modes.

3. Attachment 3-1 to Ref. 5 does not provide a clear explanation of how the predominant frequency of the input forcing function i determined and what corresponding analytical techniques are applied to calculate the Δt used in the timehistory analysis.

4. Attachment 3-1 to Reference 5 directs the analyst to determine the cutoff frequency based on á "Recognizable" support force. The term "Recognizable" must be quantified to assure that convergence is achieved.

Status: This issue is closed based on SWEC's commitment to issue a Project Memorandum modifying Attachment 3-1 to Reference 5, which will address Cygna's concerns:

1) Fluid transient analyses will be required to include all modes up to a minimum of 100 Hz;

2) The analyst will be required to "Recognize" at least 90% of the input step function value for support(s) "at or near" elbows. "At or near" means within approximately 1/2 the calculated mass point spacing of the line.

21. <u>Valve Acceleration and Flange Load Generic Studies</u>

Reference:
1. Cygna Phase 2 Final Report, TR-83090-01, Revision 0, Checklist PI-01, Notes 3 and 4

2. Communication Report between G. Krishnan (Gibbs & Hill) and J. Minichiello (Cygna) dated 3/19/84, Item 7

PIPE STRESS
Review Issues List

3. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO), "Cygna Questions/Comments on the CPRT Plan", 84056.085, October 6, 1985.

4. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

5. Stone & Webster's Pipe Stress/Support Requalification Procedure for CPSES Unit 1, CPPP-6, Rev. 2.

Summary: In Phases 1 and 2, Cygna found that Gibbs & Hill did not check valve accelerations or flange loads in every pipe stress calculation. Instead, Gibbs & Hill used a sampling process, which was reasonable, to determine the worst valves or flanges. They then showed, through two general studies, that all valves met the Specification allowables and that all flanges met Code allowables. In Phase 3, however, Cygna found one safety valve with an acceleration slightly above (2%) the allowable. This indicates that the sampling method may not be sufficient to address all valves or flanges.

Status: This issue is closed. Cygna has reviewed the SWEC criteria and procedures (Refs. 4 and 5) and finds that this issue is properly addressed.

22. LOCA Load Cases

References: 1. R.E. Ballard (Gibbs & Hill) letter to J.B. George (TUGCO) "Responses to Cygna Energy Services", GTN-70737, October 17, 1985.

Summary Westinghouse supplied Gibbs & Hill with the displacements at the steam generator nozzle during a LOCA event. Two sets of displacements were provided. The first set consisted of the displacements which result from a primary side break in the same loop as the main steam line being analyzed. This was called the "broken loop" case. The second set consisted of the displacements associated with a primary side break on a different loop. This was called the "unbroken loop" case.

Review of the main steam inside containment analyses noted the following:

PIPE STRESS
Review Issues List

a. Two LOCA load cases were run: unbroken and broken loop.

b. Unbroken loop loads and stresses were included in the emergency combination, while broken loop was used in the faulted combination.

c. Broken loop loads and stresses were always higher than unbroken loop loads (as would be expected).

d. The CPSES FSAR does not specifically require LOCA loads to be considered for the emergency condition.

Status: This issue is closed. Per Reference 1, the stress analyst initially assumed that the main steam was an essential system. The CPSES FSAR states that essential systems must meet a faulted allowable stress of 1.8S (normally the emergency allowable). Hence, unbroken loop LOCA was included in the emergency combination. After the stress analyst came to the understanding that the main steam was a non-essential system, the unbroken load case was no longer run.

23. Line Lists, Modes of Operation and Valve Lists.

References:

1. Communications Report between Manu Patel (Gibbs & Hill) and J. Oszowski (Cygna) dated 8/1/85.

2. Communication Report between T. Hawkins (Gibbs & Hill) and R. Hess (Cygna) dated 6/7/84, 11:00am.

3. Communications Report between T. Hawkins (Gibbs & Hill) and R. Hess (Cygna) dated 6/7/84, 3:00pm.

4. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO), "Information Requests - Pipe Stress Analyses," 84056.086, October 9, 1985

5. Stone & Webster's Procedure for Review of Plant Operating Mode Conditions for CPSES Units 1 & 2, CPPP-10, Rev. 1.

6. Stone & Webster's Pipe Stress/Support Requalification Procedure for CPSES Unit 1, CPPP-6, Rev. 2.

PIPE STRESS
Review Issues List

Summary: Review of Gibbs & Hill Project Guide PG-25, dated 3/1/83, "Procedure for Preparation and Design Review of Line Lists, Modes of Operation and Valve Lists," indicates that line lists are to be generated on the form included as Exhibit 1 of that procedure. Cygna did not find evidence of this during the reviews conducted at the CPSES site. Instead, computer listings apparently were used which did not have all of the information indicated on Exhibit 1 of PG-25. Additionally, Cygna could not determine which procedure, if any, controlled the issuance of the computer listings.

Status: This issue is closed. Cygna has reviewed SWEC's procedures (Refs. 5 & 6) and finds that a procedure has been set up for review of operating modes and conditions and that these operating conditions are transmitted to the Lead Pipe Stress and Support Analysis Group Engineer.

24. Support Orientation Tolerance

References:
1. R.E. Ballard (Gibbs & Hill) letter to J.B. George (TUGCO), "Responses to Cygna Energy Services," GTN-70737, October 17, 1985.
2. Stone & Webster's Field Walk Procedure for CPSES Unit 1, CPPP-5, Rev. 2.
3. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

Summary: Cygna could not determine what tolerance, if any, was used for support orientation, (i.e., angle) when performing the as-built stress analysis.

Per Reference 1, an angular tolerance of five degrees was used, based on the manufacturers' permissible misalignment or angular motion. This tolerance was not documented. Instead, it was communicated verbally to all as-built analysis group leaders, as well as to the individual analysts, by the responsible job engineer.

Status: This issue is closed. Cygna has reviewed the SWEC criteria (Ref. 3) which, in Section 3.10.6.11, requires the as-built configuration to be modeled in the analysis. Any deviations must be justified in the pipe stress calculations. The SWEC

PIPE STRESS
Review Issues List

walkdown procedure (Ref. 2) allows for a maximum support orientation deviation of ±°, from the as-built drawings.

25. Hydrotest Loads

References

1. N.H. Williams (Cygna) letter to J.W. Beck (TUGCO) 84056.064, dated 4/23/85. "Review Issue List Transmittal". Cygna Pipe Support Review Issues List, Item No. 14, Revision 1
2. Gibbs & Hill Specification 2323-MS-200, Revision 3
3. Communication Reports between J. Minichiello (Cygna) and D. Rencher (TUGCO), dated 3/20/84, 2:00 p.m., Project 84042
4. . M. Popplewell (TUGCO) letter to N.H. Williams (Cygna), dated 4/9/84
5. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO), "Pipe Stress Review Questions," 84056.093, October 28, 1985
6. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

Summary: While reviewing the Cygna pipe stress data base and TUGCO's response to Cygna's comment on Hydrotest Loads (Reference 4), it was necessary to identify under which plant condition "hydrotest load" is considered. Gibbs & Hill Specification 2323-MS-200, Section 5.2.1, states that "testing conditions" are excluded from the Normal Plant Operating Conditions. In Section 5.2.5a, the specification states that "testing conditions" are considered as a normal plant operating condition.

In addition to this discrepancy, Cygna could not determine how the pipe stress and support designs accounted for the hydrotest load condition.

Status: This issue is closed. Cygna has reviewed the SWEC criteria (Ref. 6) and finds that this issue is properly addressed.

PIPE STRESS
Review Issues List

Section 3.4.5.2 required a hydrotest load case to be analyzed for all steam piping and Table 3.5-1 defines the load combination in which this load case is to be used.

26. Pipe Stress Review of Welded Attachments

References: 1. N.H. Williams (Cygna) letter to J.W. Beck (TUGCO) 84056.064, dated 4/23/85. "Review Issue List Transmittal". Cygna Pipe Stress Review Issue List, item No. 11, Revision 1

2. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO), "Pipe Stress Review Questions", 84056.093, October 28, 1985

3. Stone & Webster's Pipe Stress/Support Requalification Procedure for CPSES Unit 1, CPPP-6, Rev. 2.

Summary: Based on Cygna's understanding that no formal process was established to allow the pipe stress analyst to review the pipe support designs, it was not possible to determine by which procedure welded attachments were identified for evaluation by the pipe stress analysts.

Status: This issue is closed. The SWEC requalification procedure (Ref. 3) requires that the assigned pipe stress engineer review the pipe support drawings in each package. The same procedure also directs integral attachments to be requalified by one of the methods identified in the piping criteria, CPPP-7.

27. Pipe Wall Thickness Below Code Minimum

References: 1. Stone & Webster Design Criteria for Pipe Stress and Pipe Supports for CPSES Units 1 and 2, CPPP-7, Revision 3, February 23, 1987.

2. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13 and 14, 1986 - On Resolution of Cygna Concerns.

3. Transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, Texas, dated December 15 and 16, 1986 - On Resolution of Cygna Concerns.

PIPE STRESS
Review Issues List

4. Conference Report of Cygna audits at SWEC offices, March 17 and 18, 1987 (Cherry Hill, N.J.) and March 19, 1987 (Boston, MA), Job No. 84056 - Audit to Review Stone & Webster Pipe Stress and Pipe Support Reconciliation Procedures.

5. Transcript of Meeting between, TUGCO/Cygna/SWEC/Impell/Ebasco at Glen Rose, TX, March 24 and 25, 1987 - on Conduit Supports, Cable Trays, Pipe Stress and Pipe Supports.

Summary: The Stone & Webster procedure for evaluating pipe wall thinning (Ref. 1) allows the pipe wall thickness to be less than the ASME code mimimum in certain situations.

Status: This issue is closed based on SWEC's commitment, during Cygna's Audit (Reference 4), to write a Project Memorandum deleting the provisions for piping minimum wall violations from Reference 1. Any Code required minimum wall violations will be forwarded to the Options Review Committee for evaluation and Cygna will be notified as well.

28. <u>Design of Seismic/Non-Seismic Interface Anchors</u>

References: 1. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Untis 1 & 2, CPPP-7, Revision 2.

2. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13 and 14, 1986 - On Resolution of Cygna Concerns.

Summary: Attachment 4-10 to Reference 1 provides the procedure for the design of seismic/non-seismic interface anchors. This procedure considers the three global directions separately when determining limiting loads due to plastic hinges. As documented in Reference 2, Cygna feels that piping can supply full plastic bending moment or close to plastic bending moment and close to full plastic torsional moment simultaneously.

Status: For resolution of this issue, see Pipe Support RIL No. 45.

CYGNA
ENERGY SERVICES
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September 18, 1987
84056.120

Mr. W. G. Counsil
Executive Vice President
TU Electric
Skyway Tower
400 N. Olive St., L. B. 81
Dallas, TX 75201

Subject: Pipe Support Review Issues List - Rev. 4
Comanche Peak Steam Electric Station
Independent Assessment Program - All Phases
Job No. 84056

Dear Mr. Counsil:

Enclosed is Revision 4 of the Pipe Support Review Issues List (RIL). All changes are indicated by a revision bar in the right margin.

All technical issues associated with this discipline have been closed. Any procedural control issues associated with Cygna's original pipe support reviews of Gibbs & Hill are being addressed as part of the ongoing design control assessments.

If you have any questions or require further information, please contact Cygna at your convenience.

Very truly yours,

N. H. Williams

N. H. Williams
Project Manager

Enclosure
NHW:rlr

cc: Mr. J. Redding
Mr. L. Nace
Mr. [redacted]
Mr. J. Muffett
Mr. D. Pigott
Ms. A. Vietti-Cook
Mr. C. Grimes
Mr. E. Siskin
Mr. R. Klause

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PIPE SUPPORTS
Review Issues List

TABLE OF CONTENTS

PIPE SUPPORTS
Review Issues List

TABLE OF CONTENTS
(Continued)

PIPE SUPPORTS
Review Issues List

TABLE OF CONTENTS
(Continued)

PIPE SUPPORTS
Review Issues List

1. Box Frames With 0" Gap

References:

1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Box Frames with 0" Gap", 84042.023, dated 1/28/85
2. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/19/84, Item 2
3. L. M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 4/19/84
4. L. M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna), Attachment B, dated 6/8/84
5. "Affidavit of John C. Finneran, Jr. Regarding Consideration of Local Displacement and Stress"
6. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2
7. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna concerns

Summary: The original support calculations did not consider the effect of the box frame and pipe interaction (Reference 2).

In addition, later TUGCO calculations (References 4 and 5) used unconservative temperature and frame stiffness assumptions and did not include the effects of Cygna comments.

Status: This issue is closed. Cygna's concerns on zero gap boxed frames are resolved by Stone & Webster Engineering Corporation's (SWEC) commitment in the CPSES pipe support requalification effort to eliminate/modify all zero gap boxed frames (Sheets 106 and 107 of Reference 7). Details of the proposed modifications are provided in Section B, Attachment 4-9, of Reference 6.

PIPE SUPPORTS
Review Issues List

2. Design of Welded/Bolted Connections

References:

1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Design of Welded/Bolted Connections," 84042.024, dated 1/28/85
2. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/21/84, Item 1.c.
3. L. M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 4/19/84
4. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PS-06
5. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2
6. Transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, Texas, dated December 15 and 16, 1986 - On Resolution of Cygna concerns
7. Cygna/SWEC Meeting Agenda, December 15 and 16, 1986, Glen Rose, Texas. (Item A, Exhibit 1 to Reference 6)

Summary: Cygna found no evidence that welded/bolted connections are designed in accordance with paragraph XVII-2442 of Section III of the ASME B&PV Code.

Status: This issue is closed. This issue has been adequately addressed by SWEC in their pipe support requalification effort in the following manner: Per Section 3.1.3 of Attachment 4-2 in Reference 5, all the shear loads will be designed to be carried by the weld alone. In response to Cygna's question (Item A of Reference 7), SWEC further clarifies that for baseplate with welded/bolted connections, the baseplate will be modeled by finite element techniques which include the appropriate stiffness values of bolts/plates/welds. This methodology will properly account for the tension load distributions in the connection. (Sheet 8 of Reference 6). Designs based on the above approach will satisfy the requirements of paragraph XVII-2442 of Section III, Division 1 of the ASME B&PV Code.

PIPE SUPPORTS
Review Issues List

3. Richmond Insert Allowables

References:

1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Richmond Insert Allowables and Bending Stresses," 84042.025, dated 1/31/85
2. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/16/84, Item 2
3. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/30/84, Item 1
4. L. M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 5/2/84
5. L. M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 5/8/84
6. Communications Report between Bezkor (Gibbs & Hill) and Minichiello (Cygna) dated 6/12/84, Item 4
7. "Affidavit of John C. Finneran, Jr., Robert C. Iotti, and R. Peter Deubler Regarding Design of Richmond Inserts and their Application to Support Design"
8. Cygna/SWEC Meeting Agenda, December 15 and 16, 1986, Glen Rose, Texas. (Exhibit 1 to Reference 9)
9. Transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, Texas, dated December 15 and 16, 1986 - On Resolution of Cygna concerns.
10. SWEC Generic Technical Issues Report for CPSES, Revision 0, dated 5/8/86.
11. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

PIPE SUPPORTS
Review Issues List

12. Gibbs & Hill Specification 2323-SS-30, Revision 1, Feb. 10, 1984 - Structural Embedments - Appendix 3, "Design Criteria for Screw Anchors"

13. Comanche Peak Response Team Program Plan and Issue-Specific Action Plans, Revision 3.

14. R.L. Cloud Report RLCA/P142/01-86/008, Revision 0, dated 9/10/86 - Richmond Insert/ Structural Tube Steel Connection, Design Interaction Equation for Bolt/Thread Rod.

15. SWEC Calculation No. 15454-NZ(S)-G1, Revision 2 - General Calculation for Richmond Insert/Tube Steel Connections Design Modifcations.

16. SWEC Technical Report 15454.05-N(C)-002, dated May, 1986 - Interaction Relation for a Structural Member of Circular Cross Section.

17. Richmond Screen Anchor Co. Catalog - Bulletin No. 6. "Inserts/Anchorages for Concrete Construction". 1978.

18. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES, Units 1 & 2, CPPP-7, Revision 3. (Attachment 4-5)

Summary: Based on Cygna's original independent design review of the pipe support design at CPSES, there are some concerns on Richmond Insert identified as follows:

- o Justification for single insert allowables based on test concrete strength.
- o Justification for bolt loads due to "axial torsion" of the tube steel.
- o Interaction results from STRUDL analyses.
- o Bending stresses in bolts.

Subsequent to Cygna's review TUGCO commissioned SWEC to perform a pipe stress and pipe support requalifi-

PIPE SUPPORTS
Review Issues List

cation effort for the CPSES Units 1 and 2. After reviewing SWEC's design criteria (Reference 11) and proposed method of resolution (Reference 10), Cygna requested responses to some specific questions and provisions of some related backup documents (see Reference 8). A meeting was held between SWEC/TUGCO/Cygna at Glen Rose, Texas (Reference 9), in which SWEC provided responses to some of the questions. Subsequently, SWEC provided additional backup documents as requested by Cygna.

Status: This issue is considered closed based on the following disposition. This issue basically covers two sub-issues. One is the issue of basic allowables and the other is Richmond insert/tube steel design. The issue of Richmond insert basic allowables, which include the following concerns:

- The use of factor of safety less than the code required minimum.
- Justification for single insert allowables based on test concrete strength.
- Representativeness of the reinforcement patterns used in the test specimen versus those existed at the plant.
- Allowables for Richmond inserts in cluster and in beam sides (See Cygna Cable Tray RIL Issue 3E(2) for more details).

The above issue of basic allowables has been transferred to the Cygna Civil-Structural Review Issues List (RIL Item No. 1) as of May 4, 1987. This transfer is due to the fact that structural anchorages are being addressed under the Civil/Structural scope of work. Therefore, the resolution of this issue will be addressed in the Cygna Civil Structural Review Issues List.

With respect to the issue of Richmond Insert/Tube Steel designs. Subsequent to the SWEC/TU Electric/Cygna meeting at Glenn Rose (Reference 9), Cygna reviewed the backup documents (Reference 14, 15 and 16) provide by SWEC and found the approach/methodology acceptable. Based on the SWEC design criteria, proposed method of resolution and clarifications (References 9, 10, 11, 14, 15, 16, and 18) and proper implementation of these commitments, Cygna

PIPE SUPPORTS
Review Issues List

concurs that the SWEC piping and pipe support requalification effort will have adequately addressed the concerns of Richmond Insert Tube Steel design on: proper modeling; bolt bending stress and interaction equation; effects of prying and torsional load on insert/bolt design. Furthermore, SWEC has committed to generate a project memorandum to limit the length of tube steel based on the effect of thermal expansion (Section 3.1 of Reference 10).

4. Punching Shear (U-Bolt - Tube Steel Design)

References:

1. N. H. Williams (Cygna) letter to J. B. George (TUGCO), "Phase 4 Open Items - Punching Shear," 84056.053, dated 1/31/85
2. Communications Report between Finneran (TUGCO) and Minichiello (Cygna) dated 10/4/84
3. TUGCO Calculations dated 10/11/84, received by Cygna 10/18/84
4. Communications Report between Finneran (TUGCO) and Minichiello (Cygna) dated 10/30/84
5. J.B. George (TUGCO) letter to N.H. Williams (Cygna) dated 11/8/84
6. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Phase 4 Open Items - Punching Shear" 84056.058, dated 3/12/85
7. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.
8. Transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, Texas, dated December 15 and 16, 1986 - On Resolution of Cygna concerns.
9. Cygna Conference Report of Audits at SWEC offices, March 17 and 18, 1987 (Cherry Hill, N.J.), March 19, 1987 (Boston, MA), Job No. 84056 - Audit to Review

PIPE SUPPORTS
Review Issues List

Stone & Webster Pipe Stress and Pipe Support Reconciliation Procedures.

10. SWEC Project Memorandum for CPSES, PM-076, dated July 7, 1986 - Local Stress Check in Tube Section.

11. SWEC Project Memorandum for CPSES, PM-108, dated September 9, 1986 - Local Stress Evaluation Procedure.

12. SWEC Project Memorandum for CPSES, PM-109, dated September 8, 1986 - Local Member Stress Induced by Nuts Bearing Against Tube Steel Wall.

13. Cygna telecon between A. Chan, W. Evans, S. Ali. and F. Ogden (SWEC), and S. Tumminelli and N. Williams (Cygna), dated 4/30/87 (10:30 a.m.) Job No. 84056.

14. Cygna telecon between A. Chan, S. Ali, F. Ogden, and B. Dykstra (SWEC), and S. Tumminelli (Cygna), dated 5/11/87 (10:00a.m.) Job No. 84056.

15. SWEC Generic Technical Issues Report (GTI) for CPSES, Revision 0. (Appendix U, dated June 26, 1986).

16. "Hollow Section Joints", by J. Wardenier, Delft University Press 1982.

Summary: Cygna has not found evidence that the stresses in the tube steel or coverplate in support MS-1-002-005-S72R near the U-bolt hole were evaluated. Cygna has found that this absence of supporting calculations is typical for this type of design.

Status: This issue is closed. This issue is titled Punching Shear, however in essence, it is an issue dealing with pipe support member local stress in general.

During the December 15 and 16 meeting at Glen Rose, SWEC presented, briefly, the methodology employed by SWEC for the evaluation of member local stresses (Sheets 42 through 44, 81 through 84 and M1 through M3 of Reference 8). A decision was made in the meeting that Cygna would perform an audit on the issue at Stone & Webster's office. Cygna reviewed the SWEC documents on local stress evaluation (i.e., Attachment

PIPE SUPPORTS
Review Issues List

4-13 of CPPP-7, Reference 7; Appendix U of GTI, Reference 15, PM-076, Reference 10; PM-108, Reference 11 and PM-109, Reference 12) and performed audits at SWEC's office (Reference 9).

Subsequent to the reviews, Cygna had some specific questions which were clarified by SWEC. They are:

- For the allowable loads given in Tables 4-13.7n, Attachment 4-13 of CPPP-7, shear stress might be limiting since no specific check was indicated -- SWEC indicated that shear stress had been addressed in SWEC calculation GENX-23 (see Reference 14).
- To clarify the statement in the first paragraph of Section 4.5, Attachment 4-13 of Reference 7, whether additional local stress evaluation around the bolt hole will be performed on a case-by-case basis -- SWEC stated that by the use of the beam analysis procedure, no additional evaluation of local stress was needed (since the beam analysis procedure was conservative). See Reference 14.
- The allowable loads for Shear Lug-to-Tube Steel Bearing given in the attachment of PM-108 (Reference 11) SWEC indicated that they were based on the equation $F = s_k (B + 5t_c)t_c$ (see Sheet M-2 of Reference 16). Cygna requested clarification on why s_k = 36 ksi = s_y was used, since side wall buckling might control the value of s_k (Reference 13) -- SWEC performed a detailed side wall buckling evaluation on a worst case sample a . concluded that buckling was not a problem (see Reference 14).

Based on the review of SWEC Procedures and the cl rifications provided by SWEC, the issues of punching hear (member local stress) is considere to be adequat y addressed.

5. <u>Mass Participation/Mass Point Spacing</u>

References: 1. N. H. Williams (Cygna) letter to J. B. George (TUGCO), "Mass Participation/Mass Point Spacing," 84042.021, dated 2/8/85

2. R. E. Ballard (G&H) letter to J. B. George (TUGCO), "Mass Participation," GTN-69454, dated 9/14/84

3. N. H. Williams (Cygna) letter to J. B. George (TUGCO), "Phase 3 Open Items - Mass Participation," 84042.017, dated 9/21/84

4. N. H. Williams (Cygna) letter to J. B. George (TUGCO), "Phase 3 Open Items - Mass Participation," 84042.019, dated 10/2/84

5. L.M. Poppelwell (TUGCO) letter to N. Williams (Cygna), "Cygna Potential Finding Report Mass Participation and the Mass Point Spacing Error in Problem AB-1-61A," dated 12/7/84

Summary: Due to the detailed nature of this subject, please see Reference 1.

Status: This issue is considered closed for pipe supports. The concerns on Mass Participation/Mass Point Spacing are covered under Cygna Pipe Stress Issue, Item 1. The effect of this issue on pipe supports is mainly due to the potential increase in pipe support loads. Since SWEC is performing a pipe support requalification effort, any load increases due to pipe stress changes will be evaluated by the SWEC requalification program.

6. Stability of Pipe Supports

References: 1. N. H. Williams (Cygna) letter to J. B. George (TUGCO), "Stability of Pipe Supports," 84042.035, dated 2/19/85

2. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/20/84, Item 3

3. L. M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 4/19/84

4. Communications Report between Rencher/Grace

PIPE SUPPORTS
Review Issues List

(TUGCO) and Minichiello/Wong (Cygna) dated 5/24/84, Item 15

5. L. M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 7/12/84

6. "Affidavit of John C. Finneran Jr. Regarding Stability of Pipe Supports and Piping Systems"

7. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Appendix J, General Note 12, and Appendix G, Observation PS-02

8. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

9. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna concerns.

10. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 14, 1986 - On Resolution of Cygna concerns.

11. Transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, Texas, dated December 15 and 16, 1986 - On Resolution of Cygna concerns.

12. SWEC's Generic Technical Issue Report (GTI) for CPSES, Appendix D, Revision 0 - Pipe Support/System Stability.

13. SWEC Procedure CPPP-6, Revision 2 - Pipe Stress/Support Requalification Procedure, CPSES, Unit 1.

14. SWEC Procedure CPPP-8, Revision 1 - Piping and Support System Engineering Walkdown Procedure, CPSES Unit 1.

15. Letter from W.G. Council (TUGCO) to E.H. Johnson (NRC), Dated October 17, 1986 - CPSES Large Bore Piping and Supports; SDAR: CP-86-36 (Interim Report).

PIPE SUPPORTS
Review Issues List

Summary: The issue of support stability is quite detailed. Please see Reference 1 for a discussion of Cygna's concerns.

Status: This issue is closed.

The issue of potentially unstable support configurations are resolved by SWEC's proposed actions contained in CPPP-7 (Attachment 4-9, Reference 8) and Appendix D (Reference 12). These proposed actions are briefly discussed as follows:

- For Zero - Clearance Box Frames supported by struts, SWEC has committed to eliminate/modify all of these zero gap box-frames according to the details provided in Section B, Attachment 4-9, of Reference 8 and Section 3.0 of Appendix D, Reference 12. (Also see Pipe Support RIL No. 1).

- For uncinched U-bolts, SWEC has committed to replace the U-bolt assembly with a pipe clamp (Section B, Attachment 4-9 of Reference 8). Modification 1 under Item 2 of Section B is eliminated, since SWEC/TUGCO has committed to eliminating all Cinched U-bolt designs for pipe supports (See Pipe Support RIL No. 7). And with respect to stability bumper, SWEC stated that the stability bumpers have been removed. (Sheets S-5 and 141 of Reference 9).

- For the various configurations of support with cinched U-bolts, SWEC has committed to eliminate all of the cinched U-bolt designs (Sheets G-4, and 88 of Reference 11). By eliminating cinched U-bolt designs, Cygna interprets that SWEC will replace the eliminated support with a support of a stable design, if a support is still required at the original location for the requalification of the piping system.

- For trapeze support with U-bolts, SWEC stated that all of them will be redesigned according to the modifications as described in Appendix L of Reference 12. (Also see Sheets 139 through 141 and S-5 of Reference 9).

With respect to piping system stability, SWEC has

PIPE SUPPORTS
Review Issues List

established and committed to meet two conditions such that system stability will be assured:

- o Each installed support is individually qualified to be stable.

- o The system integrity is analyzed for dead weight, thermal, applicable occasional loads, and seismic excitation in three orthogonal directions to be within code allowables. (Sheet E-2, E-3, and 47 of Reference 11).

  In addition, SWEC stated that for piping systems requalified by SWEC, the lowest frequency observed for the first mode is 1.8 hertz (Sheet 111 of Reference 11), therefore rigid body mode is not a concern.

In parallel with analysis, SWEC has performed system review of all piping systems (sheet 48, Reference 11) in accordance with Section 7.3 of CPPP-6 (Reference 13) to ensure the existing supporting system can physically perform its intended function. Furthermore, SWEC also has experienced pipe stress and support engineers to perform field walkdown of selected large bore piping systems (Sheet 48, Reference 11) in accordance with the procedure in CPPP-8 (Reference 14), specifically, system stability, support function and support rigidity are evaluated. (Item 11, 14 and 15 of Attachment 4, Reference 14).

Based on the above SWEC actions and commitments, the issue of piping system stability are considered to be adequately addressed.

7. Cinching of U-Bolts

References:

1. N.H. Williams (Cygna) letter to J.W. Beck (TUGCO), "Cinching of U-Bolts," 84042.036, dated 3/25/85

2. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/19/84, Item 5

3. L.M. Poppelwell (TUGCO) letter to N.H. Williams

PIPE SUPPORTS
Review Issues List

(Cygna) dated 4/19/84

4. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna), Attachment C, dated 6/8/84

5. "Affidavit of Robert C. Iotti and John C. Finneran, Jr., regarding Cinching Down of U-Bolts" (received 7/12/84)

6. Westinghouse Electric Corp. Report EQ&T-EQT-860, Revision 0, "Comanche Peak Steam Electric Station U-Bolt Support/Pipe Test Program" (received 7/12/84)

7. Westinghouse Electric Corp. Report entitled "Comanche Peak Steam Electric Station U-Bolt Finite Element Analysis", dated 6/12/84 (received 7/12/84)

8. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "U-Bolt Cinching Test/Analysis Program - Phase 3 Open Item," 84042.015, dated 8/23/84

9. Transcript of Meeting between Cygna Energy Services and Texas Utilities Generating Company and Ebasco Services, Inc., dated 9/13/84

10. R.C. Iotti (Ebasco) letter to N.H. Williams (Cygna), "Additional Information as Follow-Up to Meeting of 9/13/84," 3-Z-17 (6.2), ETCY-1, dated 9/18/84

11. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Status of Cinched U-Bolt Testing and Analysis Program," 84042.018, dated 10/1/84

12. J.B. George (TUGCO) letter to N.H. Williams (Cygna), "Cinched U-Bolt Testing and Analysis Program - Additional Information," dated 11/1/84

13. J.B. George (TUGCO) letter to N.H. Williams (Cygna), "Cinched U-Bolt Testing and Analysis Program - Additional Information," dated 11/16/84

PIPE SUPPORTS
Review Issues List

14. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna concerns.

15. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 14, 1986 - On Resolution of Cygna concerns.

16. Transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, Texas, dated December 15 and 16, 1986 - On Resolution of Cygna concerns.

Summary: Please see Reference 1 for details.

Status: This issue is closed. During the November 13, 1986 meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, Stone & Webster indicated that all cinched U-bolts for pipe supports on piping with NPS larger than 6 inches will be eliminated/modified (Reference 14, Sheet 168 and Sheet S-6). A subsequent meeting was held in Glen Rose, Texas (see Reference 16) in which SWEC/TUGCO had committed to eliminate all cinched U-bolt designs for pipe supports. This commitment has eliminated the cinched U-bolt issue.

8. Richmond Insert Allowable Spacing

References:

1. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/10/84, Item 1

2. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/12/84

3. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2

4. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna concerns

5. Transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, Texas, dated December 15 and 16, 1986 - On Resolution of Cygna concerns

PIPE SUPPORTS
Review Issues List

6. Cygna/SWEC Meeting Agenda, December 15 and 16, 1986, Glen Rose, Texas (Item B of Exhibit 1 to Reference 4)

7. Pipe Stress/Support As-Built Procedure, CPSES, Unit 2, CPPP-9, Revision 2

8. Pipe Stress/Support Requalification Procedure, CPSES Unit 1, CPPP-6, Revision 2.

Summary: Cygna had asked TUGCO how the designers ensured that the allowables they used for pipe support attachments correspond to the installed Richmond Insert spacing. TUGCO responded by stating that their designers used minimum allowables, unless a walkdown was performed to ensure that larger spacings existed, thereby permitting the use of increased allowables. There was no written procedure documenting this direction to the designers.

While Cygna could not find evidence that this unwritten procedure was not followed, Cygna has no assurance that conservative allowables were always used.

Status: This issue is considered closed technically. However, the procedural aspects of this issue remain open and are addressed in the Design Control RIL. (Also see Cable Tray Review Issue 3.E).

During the SWEC/TUGCO/Cygna meeting at Cherry Hill, New Jersey, SWEC stated that the actual insert spacing from the structural drawing will be used and the allowables reduced accordingly (Reference 4, Sheet 135). Furthermore, SWEC clarified that the verification of Richmond Insert as-built spacing violation would be implemented by Item 5 under Base Plates/Richmond Inserts in Reference 7, Attachment 9-9. (Note: Similarly in CPPP-6 for Unit 1, Reference 8). Based on the above commitments, the issue of Richmond Insert allowable spacing will be adequately addressed by SWEC in the pipe support requalification program.

9. <u>Embedment Attachment Spacing</u>

PIPE SUPPORTS
Review Issues List

References:

1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Pipe Support Review Questions," item 5, 84056.13, dated 7/31/84
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 8/24/84
3. Communications Report between Purdy (Brown & Root) and Minichiello (Cygna) dated 3/4/85
4. Brown & Root Procedure CCP-45, Revision 1, dated 8/18/80
5. Brown & Root Procedure QI-QAP-11.1-28, Revision 24, dated 4/18/84
6. Brown & Root Procedure QI-QAP-11.1-28, Revision 29, dated 1/25/85
7. Communications Report between Warner (TUGCO) and Williams/Minichiello/Russ (Cygna) dated 2/27/85
8. CPSES Procedure QI-QP-19.5-1, "Separation Inspection for Unit 1 and Common Buildings"
9. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna concerns
10. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 14, 1986 - On Resolution of Cygna concerns
11. Letter from W.G. Counsil (TUGCO) to E.H. Johnson (NRC), dated August 22, 1986 - Welded Attachments to Embedded Strip Plates

Summary: Cygna has found two pipe support base plates welded to embedded plates with less than 12" required spacing between the edges of the support base plates (per Reference 4). This was not a CPSES inspection item at the time of the Cygna review (Reference 5); however, the Brown & Root procedure was revised to include the proper checks for pipe supports (Reference 6). Since this affects all hardware

PIPE SUPPORTS
Review Issues List

attached to embedded plates (HVAC, raceway, and pipe supports), not just a single discipline, and since it was not an inspection item in other discipline procedures (per References 7 and 8), this item has generic implications.

Status: This issue was transferred and identified as Item No. 2 in the Cygna Civil-Structural Review Issues List as of May 4, 1987. This is due to the fact that structural attachments and anchorages proximity violations are being addressed under the Civil/Structural scope of work. Refer to Civil-Structural RIL No. 2 for further details and resolution.

10. Thru-Bolts and Concrete Acceptability

References:

1. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/30/84, Item 2
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 5/2/84
3. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 6/8/84 item 9 and Attachment D
4. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.
5. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna concerns.
6. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 14, 1986 - On Resolution of Cygna concerns.

Summary: Cygna is concerned that the loads on the walls may not be acceptable. Although Gibbs & Hill has walked down several highly loaded areas per Reference 3, there is no written procedure documenting the transmittal of as-built loads on concrete structures to the structural group. Thus there is no assurance that each area, particularly near free edges, is acceptable.

PIPE SUPPORTS
Review Issues List

Status: The issue was transferred and identified as Item No. 3 in the Cygna Civil-Structural Review Issue List as of May 4, 1987. This is due to the fact that structural anchorages and concrete structures are being addressed under the Civil/Structural scope of work. Refer to Civil-Structural RIL No. 3 for further details and resolution.

11. Bolt Spacing

References:

1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Pipe Support Review Questions," item 3, 84056.14, dated 8/6/84
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 8/11/84
3. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2
4. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna concerns
5. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 14, 1986 - On Resolution of Cygna concerns
6. Cygna conference report of audits at SWEC offices, March 17 and 18, 1987 (Cherry Hill, N.J.), March 19, 1987 (Boston, MA.), Job No. 84056 - Audit to Review Stone & Webster Pipe Stress and Pipe Support Reconciliation Procedures.

Summary: In certain base plate designs in Phase 4 (CC-2-019-715-A43K, for example), the bolt hole dimensions are detailed as "1-1/2 MIN TYPE" from the edge of the plate. In some cases, this could result in a dimension from 1-1/2 to 3-1/2 inches. While this may have little effect on the bolt load, it does affect the maximum plate stresses by as much as 15% for a strut, spring, or snubber with a 5^{0} offset.

PIPE SUPPORTS
Review Issues List

Status: This issue is closed based on an audit (Ref. 6) by Cygna on a bounding analysis performed by SWEC. The bounding analysis was to establish the effects of the anchor bolt edge distance tolerance on base plate design. The bounding analysis included a sample of nineteen (19) large bore base plates out of a total of 120 base plates surveyed by TUGCO (i.e., 60 large bore and 60 small bore base plates). The nineteen (19) base plates were selected based on the highest bolt interaction ratios and on the largest variations in "as-built" vs. "as-designed" edge distances. The results, based on the as-built dimensions, indicated that the maximum increase in interaction ratio was 5% and there was no increase in plate stress. This sample study showed that the effect due to edge distance variation was not significant.

12. Support Self Weight Excitation During a Dynamic Event

References:

1. Communications Report between Rencher/Finneran (TUGCO) and Minichiello (Cygna) dated 3/10/84
2. TUGCO memo CPP-9977
3. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Appendix J, Note 7
4. N.H. Williams (Cygna) letter to V. Noonan (USNRC), "Open Items Associates with Walsh/Doyle Allegations," 84042.022, dated 1/18/85
5. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.
6. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna concerns.
7. SWEC Project Memorandum for CPSES, PM-100, dated August 20, 1986 - Additional Direction for Self-Weight Computer Input.

Summary: TUGCO has not considered the loads due to the support dynamic excitation in the pipe support designs.

PIPE SUPPORTS
Review Issues List

Status: This issue is closed. In Section 4.2.4.4 of CPPP-7 (Reference 5), it specifies that the effect of seismic acceleration of pipe support mass shall be considered. The detailed methodology is delineated in Attachment 4-21 of CPPP-7. SWEC has committed to include the effect of pipe support self-weight excitation for all frame type supports on seismic systems in the requalification program.

13. Support Stiffness

References:

1. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Appendix J, Note 8

2. N.H. Williams (Cygna) letter to V. Noonan (USNRC), "Open Items Associated with Walsh/Doyle Allegations," 84042.022, dated 1/18/85

3. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

4. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna concerns.

5. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 14, 1986 - On Resolution of Cygna concerns.

6. SWEC Calculation No. 15454.05-N(C)-003, September 1986 - Generic Pipe Support Stiffness Values for Piping Analysis.

7. SWEC Calculation No. 15454.05-NP(c)-GENX-036, Revision 0 - Application of Generic Stiffness Criteria to the Analysis of the Piping Systems.

8. SWEC Calculation No. 15454-NP(c)-GENX-117, Revision 0 - Application of Generic Stiffness Criteria to the Analysis of the Piping Systems (TENERA Selected Problems).

PIPE SUPPORTS
Review Issues List

9. Cygna Memo to project file, No. 037, May 4, 1987, Review of "Generic Approach" to Pipe Support Stiffness Values (Support RIL No. 13).

Summary: In designing Class 2 and 3 supports, TUGCO has used a deflection criteria for support stiffness. For supports with low design loads, this can result in very flexible supports. This could affect the stress analysis results and redistribute support loads.

In the piping and pipe support requalification program, SWEC developed the "Generic Approach" to support stiffness. Based on three simple piping models, generic stiffness values (Kg) were developed so that piping system frequencies were near the flat region on the pipe frequency vs. support stiffness curves. The flat region is that portion of the curve where the support stiffness no longer affects system frequency. Then minimum stiffness values (Km) were derived such that the maximum reduction of frequency from that using the generic values would be no more than 10 percent for any of the three simple piping models. These two stiffness values (Kg and Km) were implemented in production as follows:

1. If a support stiffness is greater than Km, use Kg.

2. If a support stiffness is less than Km, use the actual stiffness.

3. If a support stiffness is less than 20% of Km, consider that support for removal.

Then, to verify the procedure SWEC studied the responses of five problems analyzed using the production rules above and reanalyzed using the actual stiffness values for all supports.

Status: This issue is closed based on a review of References 6, 7, and 8 and a comparison of the results of References 7 and 8 (this comparison is detailed in Reference 9). This comparison showed a very good statistical agreement between the five problems SWEC selected to evaluate this approach and the five different problems TENERA selected to verify

PIPE SUPPORTS
~~Review~~ Issues List

SWEC's generic approach.

14. Hydrotest Support/Stress Design

References:
1. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/20/84, Item 1
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 4/19/84 with TUGCO Instructions CP-EI-4.0-30, Revision 1, attached
3. D.G. Eisenhut (USNRC) letter to M.D. Spence (TUGCO), Item V.E., dated 11/29/84
4. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

Summary: Cygna did not find any evidence in either the support design calculations or the pipe stress analyses that hydrostatic test loads had been considered. TUGCO responded with a copy of their procedure which addresses the design of temporary supports.

Status: This issue is closed since SWEC is implementing a pipe support requalification program. Specifically, a test load condition is considered in Table 4.7.2-1 of CPPP-7 (Reference 4), and for verification/design of integral attachments in Section 4.6, Hydrotest load is clearly identified as a separate loadcase.

Note: Cygna understands that the TRT (NRC) has specific concerns regarding Hydrotest effects on the installation of Main Steam Pipes (Reference 3). This NRC issue is outside of the Cygna scope.

15. Dynamic Pipe Movements in Support Design

References:
1. Communications Report between Wade (TUGCO) and Williams (Cygna) dated 9/28/83, Pipe Support Item 3
2. Communication report between Wade (TUGCO) and

PIPE SUPPORTS
Review Issues List

Williams (Cygna) dated 10/4/83, Pipe Support Item 3

3. Cygna Phase 1 and 2 Final Report TR-83090-01, Revision 0, Observation PS-09-01

4. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/20/84, Item 2

5. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 4/19/84

6. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2

7. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna concerns

8. SWEC Procedure CPPP-6, Revision 2 - Pipe Stress/Support Requalification Procedure CPSES Unit 1

9. SWEC Procedure CPPP-9, Revision 2 - Pipe Stress/Support As-Built Procedure, CPSES Unit 2

Summary: TUGCO does not include dynamic pipe movements in support design when checking frame gaps, swing angles, or spring travel. Cygna was concerned this could affect design adequacy, and received a response (Reference 2) which only addressed the seismic effects. Other dynamic loads such as steam hammer were not mentioned in the response.

Status: This issue is closed based on SWEC's commitments in the pipe support requalification effort (Sheets 154, 155, and S-10 of Reference 7). In Articles 7.5.1 and 7.5.2 of CPPP-6, Revision 2 (Reference 8), specific requirements for checking of pipe relative displacements against working ranges of component standard supports and clearances in the unrestrained direction for frame type supports are identified. In conjunction with this, a detailed pipe support analysis checklist (Attachments 9-10) is utilized to ensure checking of the item (Item 11 under Frames; Items 5

PIPE SUPPORTS
Review Issues List

and 8 under Spring Hanger; Items 6, 7, and 8 under Snubber Struts). Similar checklist items in Attachment 9-9 of CPPP-9 (Reference 9) will ensure that pipe movement requirements will be satisfied in the As-Built condition. Furthermore, Section 4.2.6 of CPPP-7 (Reference 6) has specific limits for control of swing angle/angularity which includes the effects of dynamic pipe movements. Proper implementation of the above requirements addresses Cygna's concern on this issue.

16. Dual Strut/Snubber Design

References:
1. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/22/84, Item 2.b
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 6/8/84
3. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PS-03
4. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Page 5-5
5. "Affidavit of Robert C. Iotti and John C. Finneran, Jr., Regarding Consideration of Force Distribution in Axial Restraints"
6. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Force Distribution in Axial Restraints - Phase 3 Open Item," 84042.014, dated 8/10/84
7. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2
8. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna concerns
9. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 14, 1986 - On Resolution of Cygna concerns

PIPE SUPPORTS
Review Issues List

10. Transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, Texas, dated December 15 and 16, 1986 - On Resolution of Cygna concerns

11. Cygna conference report of audits at SWEC offices, March 17 and 18, 1987 (Cherry Hill, N.J.), March 19, 1987 (Boston, MA), Job No. 84056 - Audit to review Stone & Webster Pipe Stress and Pipe Support Reconciliation Procedures.

12. SWEC's Generic Technical Issues Report (GTI) for CPSES. Revision 0. (Appendix L).

13. Letter from W.G. Council (TU Electric) to N.H. Williams (Cygna), dated February 18, 1987 - Resolution of Cygna Concerns Document Transmittal. (Log No. TXX-6280).

Summary: While most of the discussion on this subject has centered around axial restraints, Cygna is concerned about all types of dual restraint designs (trapezes, double trunnions, riser clamps with shear lugs). TUGCO has designed each restraint in these cases to take only 1/2 the total load. Also, Gibbs & Hill stated standard practice in local stress analysis assumes the trunnions equally share the load. Cygna finds this inconsistent with other design organizations, which usually assume one side takes more than 1/2 of the overall support load. This issue is being addressed in general by TUGCO via the CPRT Action Plan and the SWEC piping and Pipe Support requalification effort. Specifically, Appendix L of the GTI Report (Reference 12) and Attachment 4-8 of CPPP-7 (Reference 7) provide the detailed methodology and resolution for the requalification/re-design of axial, rotational, and trapeze restraints. The methodology includes consideration of modeling the offset, relative stiffness, modification and actual removal of support/component, etc.

Status: This issue is closed. Cygna has reviewed the SWEC methodology/resolution description in Attachment 4-8 of CPPP-7 and Appendix L of the GTI report for the requalification/re-design of axial, rotational, and trapeze restraints. Details of the requalification process and clarifications were further provided by SWEC during the

PIPE SUPPORTS
Review Issues List

December 15 and 16, 1986 meeting between TUGCO/Cygna/SWEC in Glen Rose, Texas (See Sheets 53 through 67 and Sheets G1 through G4 of Reference 10). In addition, TUGCO/SWEC had provided to Cygna the appropriate (Grinnell, NPSI) load capacity data sheets (LDC) and certified design reports (CDR's) for riser clamps (Attachments E and F of Reference 13) and explained how those allowable loads would be used. (Item 6 of reference 13). Proper implementation of the above requalification/re-design procedures will adequately address the concerns on dual strut/snubber design.

17. Hilti Kwik-Bolt Embedment Length References

References:

1. Communications Report between Wade (TUGCO) and Williams (Cygna) dated 9/28/83, Pipe Support Item 1
2. Communications Report between Wade (TUGCO) and Williams (Cygna) dated 10/4/83, Pipe Support Item 1
3. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 10/6/83, Item 1
4. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PS-02-01
5. Communication Report between J. Van Amerongen (TUGCO) and L. J. Weingart (Cygna), dated 9/27/85. Job 84042, "Pipe Support Questions"
6. H. C. Schmidt (TUGCO) letter to B. J. Youngblood (NRC), dated 4/2/84
7. N. H. Williams (Cygna) letter to W. G. Counsil (TUGCO), 84056.092, dated 10/30/85, "Pipe Support Review Questions"
8. Letter from W.G. Counsil (TUGCO) to R.J. Stuart (Cygna), dated 9/2/86 - Open Items -- Phase IV Report

PIPE SUPPORTS
Review Issues List

9. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES 1 & 2, CPPP-7, Revision 2

10. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna concerns

11. SWEC Project Memorandum for CPSES PM-064, Revision 1 - As-Built Verification of Baseplate Using Drilled-In, Expansion-Type, Hilti Anchors

Summary: Embedment lengths shown on the support drawings do not match those in the support calculations. This issue was previously closed, since there was no impact on the technical aspects of the design. However, TUGCO has committed to providing updated documentation for this review issue (References 6 and 7).

Status: This issue is closed. TUGCO has provided response to Reference 7, Item 10. TUGCO has clarified that the stated revision (i.e., minimum embedment length) is incorporated in paragraph 2.4.5 of Brown and Root Instruction, CEI-20, Revision 9 (Reference 8). A table of Hilti anchor minimum embedment length for installation is provided there.

Furthermore, in light of the development of the CPRT plan and the Stone & Webster Piping/Support requalification effort and commitments (Sheets 148 and S-7 of Reference 10), the requirements as stipulated in Section 4.3, Attachment 4.4 of CPPP-7 (Reference 9) and the additional requirements in PM-064 (Reference 11) will further assure that the actual minimum as-built embedment (or a conservative minimum value) will be used in the evaluation of pipe supports.

18. Incorrect Data Transmittal

References: 1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PS-10-01

Summary The displacement transmitted for support RH-1-064-001-S22R had an incorrect sign.

PIPE SUPPORTS
Review Issues List

Status: This issue is considered to be isolated and is closed except as a procedural question which is addressed in the Design Control RIL.

19. Incorrect Standard Component Allowables

References:
1. Communications Report between Wade (TUGCO) and Williams (Cygna) dated 9/28/83, Pipe Support Item 4
2. Communications Report Between Wade (TUGCO) and Williams (Cygna) dated 10/4/83, Pipe Support Item 4
3. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PS-12-01
4. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

Summary: The incorrect U-bolt allowables were used in the design of support RH-1-064-011-S22R (formerly RH-1-062-002-S22R).

Status: This issue is closed and isolated. Furthermore, guidance has been provided in Section 4.7.5 of CPPP-7 (Reference 4) for the SWEC pipe support requalification effort.

20. Input Errors in the Design of Support MS-1-001-006-C72K

References:
1. Communications Report between Grace (TUGCO) and Minichiello (Cygna) dated 5/22/84, Item 10
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 6/8/84 item (41)
3. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PS-01
4. Letter from N.H. Williams (Cygna) to W.G. Counsil (TUGCO), No. 84056.092, dated 10/20/85 - Pipe Support Review Questions.

PIPE SUPPORTS
Review Issues List

5. Letter from W.G. Counsil (TUGCO) to R.J. Stuart (Cygna), dated 9/2/86 - Open Items -- Phase IV Report.

Summary: Errors were found in the section properties and boundary conditions which will affect the STRUDL results. The STRUDL input was not checked or approved at the time of Cygna's review.

Status: TUGCO has provided Revision 7 of the support drawings for MS-1-001-006-C72K (Item 13, Reference 5) which indicates that members 5 and 6 (Section X-X, Items 22 and 34) have been modified to a box-section as described in the revised design calculation previously provided to Cygna.

This issue has been resolved technically, but remains as an open issue to be addressed in the Design Control RIL.

21. Undersized Fillet Welds

References:

1. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 5/16/84, Item 5
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 6/8/84 item (31)
3. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PS-04
4. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna concerns.

Summary: Two fillet welds were designed under the minimum size required by the ASME B&PV code, Table XVII-2452.1-1.

Status: This item is closed and isolated. Furthermore, SWEC states that minimum weld size check is no longer required per ASME III, Code Case N-413 (Sheet S-2 of Reference 4).

PIPE SUPPORTS
Review Issues List

22. Improper Weld Calculations for Three-Sided Welds

References:

1. Communications Report between Grace (TUGCO) and Minichiello (Cygna) dated 5/22/84, Item 1
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 6/8/84 item (32)
3. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PS-05
4. N.H. Williams (Cygna) letter to J.B. George (TUGCO) "Box Frames with 0" Gap," 84042.023, dated 1/28/85 item 3 of the Attachment
5. N.H. Williams (Cygna) letter to J.B. George (TUGCO) "Mass Participation and Mass Point Spacing," 84042.021, dated 2/8/85 pipe support review Item 5
6. Stone & Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.
7. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna concerns.

Summary. TUGCO does not always consider the eccentricity between the member center of gravity and the weld center of rigidity when determining weld loads to be used in the design.

Status: This issue is closed for the supports reviewed in Phases 3 and 4. In addition, SWEC has provided criteria (Section 3.1.2 of Attachment 4-2, Reference 6) and committed to properly consider weld eccentricity in the design of unsymmetric welds (Sheet S-2 of Reference 7) in the CPSES pipe support requalification program.

23. Improper Weld Calculation for Composite Sections

References:

1. Communications Report between Finneran (TUGCO) and Williams/Minichiello (Cygna) dated 7/11/84, Item 1

PIPE SUPPORTS
Review Issues List

2. Communications Report between Finneran (TUGCO) and Minichiello (Cygna) dated 7/11/84

3. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 7/12/84

4. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PS-07

5. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7,, Revision 2.

6. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna Concerns.

Summary: When welding cover plates to tubesteel or wide flanges to form composite sections, the method used for the weld design is not always correct, and all the loads are not always considered.

Status: This issue is closed based on additional calculations for the Phase 3 review scope. Furthermore, SWEC has provided specific criteria (Section 3.1.5 of Attachment 4-2, reference 5) to consider effect of shear flow in the design of cover plate.

24. Untightened Locknuts on Struts

References:

1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation WD-01-01

2. TUGCO Memorandum to M.R. McBay dated 6/9/83 from J.C. Finneran

3. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna Concerns.

Summary: During the Phase 1 Walkdown, Cygna noted one support on which the upper locknut on the strut was not tightened. This situation could lead to rotation of the strut and a

PIPE SUPPORTS
Review Issues List

subsequent redistribution of load among neighboring supports.

Status: This issue is closed based on previous identification of the deficiency by TUGCO (Reference 2) and proposed corrective and preventative actions. SWEC also stated that TUGCO pipe support Engineering under the Hardware Verification Program (HVP) will perform a 100-percent inspection and necessary rework of locking devices (sheets 156 & S-10 of reference 3). This will further assure the resolution of this issue.

25. Inverted Snubbers

References: 1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation WD-02-02

2. N. Williams (Cygna) letter to S. Burwell (USNRC), 83090.021, dated 11/6/84

Summary: During the Phase 1 walkdown, Cygna noted four supports in which the snubbers were installed 180 degrees from the configuration shown on the support drawing. These deviations have no actual design or safety impact. However, per Reference 1, this situation could be a potential violation of Quality Assurance requirements under Criterion III of 10 CFR 50, Appendix B. TUGCO must demonstrate that the required documentation existed for this deviation when the installation procedure CP-CPM 9.17, Revision 2 was issued and that the requirements of Criterion III were met (e.g. the installation procedure was reviewed and approved by engineering.)

Status: This issue is resolved with respect to technical considerations but remains open from a procedural standpoint and is addressed in the Design Control RIL.

26. Embedded Plate Design

References: 1. Communication Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/22/84, Item 1

2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 4/19/84, Page 11, Item 1

PIPE SUPPORTS
Review Issues List

3. Gibbs & Hill Specification 2323-MS-46A, Revision 5, Section 3, Appendix 9, "Specification 2323-SS-30 - Structural Embedments"

4. Cygna Phase 3 Final Report, TR-84042-01, Revision 0, Appendix J, General Note 13

5. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

6. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna Concerns.

Summary: In Paragraph 3.4 of Appendix 4 to Reference 3, Gibbs & Hill requires that all attachments to embedded plates shall be assumed to be "pin connections" (force transfer only). They further state that moment connections to the embedment require stiffening. As noted in Reference 2, however, Gibbs & Hill has not provided any guidelines for the stiffeners. As also noted in Reference 2, the pipe support design organization assumes that any attachment to the embedded plate will effectively stiffen the local area, but they did not cross-check this assumption with Gibbs & Hill.

Status: This issue was transferred and identified as Item No. 4 in the Cygna Civil-Structural Review Issue List as of May 4, 1987. This is in line with the scope of work that embedded plate designs are addressed under the Civil/Structural discipline. Refer to Civil-Structural RIL No. 4 for further details and resolutions.

27. Pipe Support Design Procedures

Reference: 1. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna Concerns.

2. Transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, Texas, dated December 15 & 16, 1986 - On Resolution of Cygna Concerns.

PIPE SUPPORTS
Review Issues List

3. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7,, Revision 2.

4. SWEC's project procedure CPPP-6, Revision 2- Pipe Stress/Support Requalification Procedure, CPSES Unit 1.

5. SWEC's project procedure CPPP-9, Revision 2 - Pipe Stress/Support As-Built Procedure, CPSES Unit 2.

6. SWEC's project procedure CPPP-11, Revision 1 - Administrative Control of Calculations.

7. SWEC's Generic Technical Issues Report (GTI) for CPSES, Revision 0.

Summary: The original designs of the pipe supports at Comanche Peak (CPSES) were performed by three separate pipe support design organizations, namely, ITT Grinnell, NPSI and PSE (TUGCO).

Even though they were all committed to the requirements of Gibbs and Hill Specification no. 2323-MS-46A-Nuclear Safety Class Pipe Hangers and Supports, and the CPSES FSAR, each organization has it's own engineering design guidelines/ standards. In order to complete Cygna's design process reviews, Cygna had requested these documents.

However, due to the creation of the CPRT plan and the implementation of the SWEC pipe support requalification program, the final design of the pipe supports are essentially following the design criteria (Reference 3) and procedural control (References 4 and 6) of Stone & Webster Engineering Corporation.

Since the final qualifications of the pipe supports at Comanche Peak are based on the SWEC criteria and procedure, this has eliminated the need to further review the engineering design guidelines/standards of ITT Grinnell, NPSI or PSE.

Status: This issue is closed conditional to the complete and satisfactory resolution of all the technical questions

PIPE SUPPORTS
Review Issues List

raised by Cygna with respect to the SWEC design criteria/ action plan/procedures. (References 1, 2, 3, 7) etc.

In addition, since this issue is procedural in nature, this issue will be assessed under Cygna's design control review for its significance or possible impact, if any (see the Design Control RIL).

28. Use of A563 Grade A Nuts With High Strength Bolting

References:

1. Communication Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/16/84, Item 1.
2. L. M. Poppelwell (TUGCO) letter to N. H. Williams (Cygna) dated 4/19/84, Item 1.
3. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7,, Revision 2.
4. Transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, Texas, dated December 15 & 16, 1986 - On Resolution of Cygna Concerns.
5. SWEC Project Memorandum for CPSES pm-110, dated Sept. 8, 1986 - Allowable loads for A193 grade B7 threaded rods.
6. Cygna conference report of audits at SWEC offices, March 17 and 18, 1987 (Cherry Hill, N.J.), March 19, 1987 (Boston, MA), Job No. 84056 - Audit to Review Stone & Webster Piping Stress and Pipe Reconciliation Procedures.
7. Transcript of meeting between TU Electric/Cygna/SWEC/Impell/Ebasco at Glen Rose, Texas, dated March 24 and 25, 1987 - Conduit Supports, Cable Trays, Pipe Stress and Pipe Supports, Volume II.
8. Transcript of meeting between TU Electric/SWEC/ Cygna/TUGCO/Ebasco at Glen Rose, Texas, dated April 21, 1987.

PIPE SUPPORTS
Review Issues List

9. W.G. Counsil (TU Electric) letter to N.H. Williams (Cygna), dated April 21, 1987. (Job No. 84042)

Summary: ASTM specification A563 recommends that Grade A nuts be used with A307 (low strength) bolting. However, as noted by TUGCO, their designers, when not using high strength nuts, will specify double nuts, with both nuts snugged. Cygna's scope of review confirmed this statement.

Status: This issue is closed. Cygna has reviewed PM-110 (Reference 5) and concurred with the use of a reduction factor of 0.6 when ASTM A-563 Grade A nuts are used with SA-193 Grade B7 bolt material since the same values of factor of safety are maintained. SWEC is aware of the use of A-563 Grade A nuts with high strength thru-bolts and revision 3 of CPPP-7 will incorporate modification to address the situation (Reference 6). Initially, TUGCO/SWEC has committed to perform a hundred percent verification that no galvanized A563 Grade A nuts were used in the plant. (See Sheet 7 of Reference 7). In a subsequent meeting on April 21, 1987, SWEC clarified that they had conducted a review of the purchase orders issued for pipe support specifications 2323-MS-46A and 46B and found that galvanized A-563 Grade A or A-307 nuts had not been purchased for pipe supports. Therefore, it was concluded that A-563 Grade A and A-307 galvanized nuts were not called for in the designs and would not have been installed. Further, SWEC issued project memo PM-146 to preclude the use of galvanized A-563 Grade A nuts in any future design modifications. With the above actions, the commitment to inspect for galvanized nuts in the HVP is no longer required. (See Reference 9).

The use of A-563 Grade A nuts with Civil Anchors/Grouted-In Anchors etc., if existed, will be addressed under the Civil Structural scope of work.

29. Friction Loads

References: 1. Cygna Phase 3 Final Report, TR-84042-01, Revision

PIPE SUPPORTS
Review Issues List

1, Appendix G., Pipe Support Observation PS-08.

2. Janita Ellis (CASE) Letter to Administrative Judge P.B. Bloch (ASLB) dated 6/13/85. "Further Clarification of CASE's Position Regarding Applicants' Use of 3 Sm".

3. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7,, Revision 2.

4. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna Concerns.

Summary: Loads due to friction were not included in the support design of pipe supports at CPSES when the piping thermal movement was 1/16" or less.

Status: This issue is closed. SWEC has committed to include friction loads (Section 4.7.3 of CPPP-7, reference 3; sheets 163 & S-12 of reference 4) for design in the CPSES pipe support requalification effort.

30. MS-1-003-007-C72K, Revision 10

Reference:
1. N.H Williams (Cygna) letter to J.B. George (TUGCO), 84056-013 dated 7/31/84. "Pipe Support Review Questions", Question No. 10.
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna), dated 8/30/84.
3. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna), dated 9/17/84.
4. Communications Report between Van Amerogen/Rencher/ Kerlin (TUGCO) and Minichiello (Cygna) dated 9/11/84. Item No. 1.
5. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7,, Revision 2.

PIPE SUPPORTS
Review Issues List

6. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna Concerns.

7. Letter from W.G. Counsil (TUGCO) TO R.J. Stuart (Cygna), dated 9/2/86 - Open Items -- Phrase IV Reports.

Summary: Due to insufficient dimensioning in the subject drawing (Section J-J), Cygna has concerns about the design of the connection and particularly about the plate stresses of items 35, 46 and the weld stresses between items 35, 46 and 22.

TUGCO's response to these questions indicates that a finite element analysis has been performed with revised design loads (i.e. conservatism in load combination is taken out). A design check indicates that the plate stresses are very close to the allowables (for upset and emergency conditions), based on actual tested material yield stress and ultimate stress (i.e. without the normal conservatism in design based on code allowable stress values).

Status: This issue is closed. SWEC has provided further assurance that all necessary design input is verified and missing information will be obtained in the SWEC requalification effort (sheet 165 of reference 6). However, this isolated occurrence basically falls under procedural concerns. The impact of these procedural concerns is addressed in the Design Control RIL.

31. <u>Potential Edge Distance Violation</u>

Reference:

1. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO) 84056.092, dated 10/30/85, "Pipe Support Review Questions."

2. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7,, Revision 2.

3. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna Concerns.

PIPE SUPPORTS
Review Issues List

4. Letter from W.G. Counsil (TUGCO) TO R.J. Stuart (Cygna), dated 9/2/86 - Open Items -- Phrase IV Reports.

5. SWEC Project Memorandum for CPSES PM-064, Revision 1. - As-Built Verification of Base Plate using Drilled-in, Expansion-type Concrete Anchors.

Summary: As noted in Cygna's Phase 4 pipe support walkdown, there are instances where pipe sleeve penetrations exist close to support baseplates but are not shown on the support drawing. It is not clear how the support designer can identify any potential anchor bolt edge distance violations. Cygna has not found any criteria defining the minimum edge distance for anchor bolts adjacent to pipe sleeve penetrations (e.g. CC-1-028-017-S33R, Revision 4; CC-1-028-022-S33K, Revision 7)

Status: This issue was transferred and identified as Item No. 5 in the Cygna Civil-Structural Review Issues List as of May 4, 1987. This is due to the fact that structural attachments and anchorages proximity violations are being addressed under the Civil/Structural scope of work.

Refer to Civil-Structural RIL No. 5 for further details and resolution.

32. Incorporation of CMC 88765 Into Drawing CC-1-019-012-A43K

Reference: 1. N.H. Williams (Cygna) letter to J.B. George (TUGCO) "Pipe Support Review Questions" 84056.017, dated 8/7/84 Item 2d.

Summary: The all around fillet weld specified in CMC 88765, Revision 1, does not match the weld shown in Section B-B of the subject drawing. The weld in the drawing is structurally acceptable.

Status: This issue is closed. This isolated discrepancy in documentation has no design impact.

PIPE SUPPORTS
Review Issues List

33. Sight Holes Covered By Paint

Reference: 1. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO), 84056.092, dated 10/30/85, "Pipe Support Review Questions".

2. Letter from W.G. Counsil (TUGCO) TO R.J. Stuart (Cygna), dated 9/2/86 - Open Items -- Phase IV Report.

3. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1985 - On Resolution of Cygna Concerns.

Summary: Cygna's walkdown noted that several sight holes of strut/snubber component supports are painted over; therefore, eye-rod full thread engagement cannot be checked via the sight hole.

Status: This specific issue is considered closed based on the implementation of the CPRT ISAP VII.c program and the commitment that items identified as trends will be reinspected and reworked as required during the Hardware Validation Program (sheets 166 & S-14 of Reference 3).

34. Hilti Kwik-Bolts Adjacent to Thru-Bolts

Reference: 1. N.H. Williams (Cygna) letter to J.W. Beck (TUGCO) 84056.092, dated 10/30/85, "Pipe Support Review Questions", Item No. 2.

2. Letter from W.G. Counsil (TUGCO) TO R.J. Stuar (Cygna), dated 9/2/86 - Open Items -- Phase IV Report.

3. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna Concerns.

4. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

PIPE SUPPORTS
Review Issues List

Summary: Cygna's walkdown noted several instances of Hilti Kwik-Bolts installed close to Thru-Bolt base plates, but not shown on the support drawings.

Status: This issue was transferred and identified as Item No. 6 in the Cygna Civil-Structural Review Issues List as of May 4, 1987. This is due to the fact that structural attachments and anchorage proximity violations are being addressed under the Civil/Structural scope of work.

Refer to Civil-Structural RIL No. 6 for further details and resolution.

35. Minor Discrepancies Identified During Pipe Support Walkdown

Reference:

1. N.H. Williams (Cygna) letter to W.G. Counsil (TUGCO) 84056.092, dated 10/30/85, "Pipe Support Review Questions".
2. Letter from W.G. Counsil (TUGCO) TO R.J. Stuart (Cygna), dated 9/2/86 - Open Items -- Phase IV Report.
3. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 14, 1986 - On Resolution of Cygna Concerns.
4. CPPP-5 Revision 2 (3/12/86) Field Walkdown Procedure, Unit 1
5. CPPP-8 Revision 1 (4/25/86) Piping and Support System Engineering Walkdown Procedure Unit 1.
6. HVP Revision 3 (4/18/86) Hardware Validation Program (For Unit 1 - Hardware related concerns).
7. SWEC Report J.O. No. 15454.05 Piping and Support System Engineering Walkdown Final Report. June 4, 1986 (Note: based on Procedure CPPP-8).

PIPE SUPPORTS
Review Issues List

8. CPPP-9 Revision 2 (4/18/86)
   Pipe Stress/Support As-Built Procedure, Unit 2.

9. CPPP-6 Revision 2 (4/18/86)
   Pipe Stress/Support Requalification Procedures, Unit 1.

10. CPRT Action Plan, ISAP VII.b.3 - Pipe Support Inspection, Revision 1.

11. CPRT Action Plan, ISAP VII.c - Construction Reinspection/Documentation Review Plan, Revision 1.

12. CPRT Action Plan, ISAP V.a - Inspection for Certain Types of Skewed Welds in NF Supports, Revision 2.

13. CPRT Results Report, ISAP V.a - Inspection for Certain Types of Skewed Welds in NF Supports, Revision 1.

Summary: During Cygna's walkdown, the following isolated discrepancies were identified. Further documentation and/or clarification are required from TUGCO.

A. CC-1-028-003-A33R, Revision 7. Component Support Traceability

   The sway strut on the west side has no tag. Cygna reviewed the Inspection Report (IR) package and noted an Inspection Report (12/27/83) requesting verification of the strut serial numbers. This IR states that the strut is from bulk stock and is stamped D5022 (i.e. the same serial number as the east strut). There is also a Certificate of Shop Inspection, which gives the Mark No. CC-1-028-003-S33R (rather than -A33R).

B. Hilti Anchor Bolts.

   1. CC-1-031-009-S33R, Revision 5, Base Plate Section C-C

PIPE SUPPORTS
Review Issues List

Hilti Super Kwik-bolts were specified on the drawing, whereas only regular Kwik-bolts were installed.

2. CC-1-019-003-A33R, Revision 2, Base Plate Section B-B

   Super Hilti Kwik-Bolts of 18" length were specified for all six bolts on the subject drawing. The installed lower right hand corner Super Hilti Kwik-bolt has a "W" marking, which indicates a length of 15".

C. Weld Discrepancies

1. MS-1-002-002-S72R, Revision 3 (sht 3 of 3)

   The bottom 3/8" horizontal fillet weld between the gusset plate (item 14) and the base plate is missing. Per Detail D1 of the drawing, there should be welds on both sides.

2. MS-1-004-004-S72R, Revision 2

   The flare bevel weld between items 16 and 17 at the top north face is undersized for a length of about 5-1/2" (i.e. the weld is not flush with the face of the tube steel).

   Also, the rear bracket is welded to the base plates on all four (4) sides rather than two (2) sides as indicated on the drawing. However, this is conservative.

3. MS-1-001-004-S72R

   The weld between items (4) and (5) is a flare bevel weld and is flush with the face of the tube. Per the AISC 8th Edition, the 5/16 weld size shown on the drawing is incorrect.

PIPE SUPPORTS
Review Issues List

D. Dimensional Discrepancies

1. CC-1-019-007-A33R, Revision 2

   The vertical dimension shown on the drawing for item 8 is 11' - 9-1/2" (approx.) instead of 12' - 3/4". This exceeds the 1" tolerance for work point dimension.

2. CC-1-019-010-A43K, Revision 4

   The dimension for item 7 (1/2" plate) is 10" x 10" instead of 7" x 7" as shown in Section B-B. However, it has no design impact.

Note: The following are discrepancies exceeding the 1/4" tolerance.

3. MS-1-002-002-S72R, Revision 3, Sht 3 of 3, Detail D1

   The horizontal dimension between the center line of the attachment and the gusset plate (item 15) is 2-1/2" instead of 1" as shown on the drawing.

4. CC-1-028-017-S33R, Revision 4, Section A-A

   The vertical edge distance of the lower right hand corner bolts is 2-1/2" instead of 2-7/8".

5. MS-1-002-005-S72R, Revision 6

   The as-built C-C dimension of the strut is 3' - 10-1/8" rather than 3' - 6-1/2" as shown on Section B-B.

6. MS-1-003-002-S72R, Revision 1

   The as-built C-C dimensions are 51-3/8" and 51" rather than 52" as specified on the drawing (i.e. 4'-4")

PIPE SUPPORTS
Review Issues List

7. CC-2-019-007-A43K, Revision 1

   The as-built C-C dimension of 25-3/16" differs from the 2' - 2-15/16" specified on the drawing. This discrepancy was identified in the Inspection Report Package, but the QC checklist for snubber installation was marked "SAT" without giving explanation or back-up documentation (9-27-83).

E. Miscellaneous Discrepancies

1. MS-1-002-005-S72R, Revision 6

   The U-Bolt threads are not upset as specified on the subject drawing (Sht 1 of 4).

2. MS-1-004-004-S72R, Revision 2

   The as-built support has double nuts on each leg of the U-Bolt. This conforms to the details shown on Revision 2 of the drawing in the Inspection Report package. The Revision 2 drawing in Cygna's possession shows only one nut on each side of the U-Bolt.

3. CC-1-028-701-A334, Revision 3

   There is a 1/2" thick plate welded to the base of each rear bracket. The two 1/2" plates are welded to item 15 and item 18, respectively. These plate connection details were not shown on the drawing. In addition, the U-Bolt jam nuts are not snug tight.

4. CC-2-019-707-A43S, Revision 2

   The cold load of the spring is set at 7,000 lbs. (approx.) rather than 6475 lbs., as specified on the drawing. The base plate is covered by grout in the floor recess. This condition is not reflected on the subject drawing.

PIPE SUPPORTS
Review Issues List

5. CC-1-050-700-A43K, Revision 3

For item #2, the AC and AH shown on the drawing should read CS and HS, respectively. (The AC and AH values would have to be 13-1/16" and 13", respectively).

Status: This issue is technically closed. The specific walkdown issues/discrepancies were adequately addressed, individually they are considered closed. Cygna has reviewed the various field walkdown and hardware validation documents - CPPP-5 (Reference 4), CPPP-8 (Reference 5), Hardware Validation Program (Reference 6), Piping and Support Engineering Walkdown Final Report (Reference 7) and the various CPSES inspection Action plans (References 10, 11, 12 & 13). Based on the review of these documents, it is obvious that a sampling approach is used to verify and address certain identified issues and hardware attributes, however, it is not clear whether a comprehensive as-built walkdown verification program will be performed as a result of the CPSES extensive re-qualification program for pipings and pipe supports. Therefore, in order to address the adequacy of the entire final as-built walkdown verification program, this RIL issue will be addressed as an open issue in the Design Control RIL but technically closed for pipings and pipe supports. A status summary is provided in the following section. TUGCO had provided responses to these walkdown questions (References 1 & 2), the status of each of the specific items identified in the summary section above was addressed as follows:

A. Component Support Traceability

The documentations (Item No. 4 of Reference 2) provided by TUGCO have clarified the fact that both sway struts were supplied by the vendor, ITT-Grinnell, at the same time and were assigned a common serial number. This has satisfactorily answered Cygna's question, since both struts were used as one support.

PIPE SUPPORTS
Review Issues List

B. Hilti Anchor Bolts

1. Response was provided by TUGCO via item 5a of Reference 2.

Based on the material verification checklist and a UT testing performed on November 24, 1985, the bolt in question was verified to be a Super Hilti. TUGCO confirms that the asterisk identifying Super Hilti had been inadvertently omitted. This has addressed the specific support in question.

TUGCO also identifies a Brown and Root corrective action program (CAR No. 058, reference NCR-M-18708), initiated in September 1985, to verify Super Hilti installed prior to March 1982. This has addressed the concern in general, Cygna considers this issue resolved.

2. TUGCO's response was contained in item 5b of Reference 2.

Based on the installation documentation and UT testing report, the six anchor bolts were confirmed to be 18" Long Super Kwik-bolt. This has addressed the discrepancy and the specific support is acceptable, nevertheless a bolt marking error does exist. However, out of the many support base plates Cygna has inspected, this is the only bolt length marking error identified, Cygna considers this an isolated case.

C. Weld Discrepancies.

1. Per item 6a of Reference 2, TUGCO confirms that the bottom 3/8" horizontal fillet weld is missing and was due to the incorporation of incorrect information in the Revision 3 drawing. This issue is considered closed since QC has issued NCR M-25,657N to address this discrepancy and the disposition will be overseen by Stone & Webster.

2. Per item 6b of Reference 2, TUGCO confirms the existence of undersized flare bevel weld between items 16 and 17 as identified by Cygna. QC has issued NCR

PIPE SUPPORTS
Review Issues List

#M-25,666 to document as-built condition and the disposition will be overseen by Stone and Webster as part of the requalification program. Based on the above actions, this issue is considered closed.

3. TUGCO provided response via item 6c of Reference 2.

   TUGCO's response is acceptable, it uses $t_e = t$ as the effective throat for flare bevel weld based on Figure 10.13.1.3B of AWS D1.1-79, Structural Welding Code for partial joint penetration of prequalified box connections. Furthermore, per subsection 2.7 of Attachment 4-2 of CPPP-7 (Revision 2), an effective throat value of $t_e = t_{min} - 1/16"$ is specified for the re-qualification effort.

D. Dimensional Discrepancies.

1. Per TUGCO's response (Item 7a of Reference 2) the work point dimension for item 8 was incorrectly incorporated from CMC-74,722. by engineering. QC has issued and dispositioned NCR #M 25,654N in response to Cygna's comment. The disposition was reviewed and approved by Stone and Webster. This discrepancy is resolved and there is no design impact.

2. Per Item 7b of Reference 2 TUGCO confirmed the discrepancy identified by Cygna. QC had issued and disposition NCR #M-25,655N there was no design impact. This item is considered resolved.

3. Per Item 7c of Reference 2 TUGCO confirmed that the dimensional discrepancy was due to drafting incorrectly incorporated the gusset plate dimension from CMC-56,502,R13. QC has issued NCR #M-25,657N to disposition the As-Built condition, this will be overseen by Stone and Webster. This item is considered resolved by the above action.

4. Per Item 7d of Reference 2 TUGCO field inspected the support and verified the edge dimension to be 2 3/4" for the bolt in question (rather than 2 1/2" as noted by Cygna), this dimension is within the 1/4" tolerance from the drawing dimension, therefore acceptable.

PIPE SUPPORTS
Review Issues List

Cygna's comment is considered invalid.

5. Per Item 7e of Reference 2 TUGCO's clarification is acceptable. The 1/4" allowable tolerance does not apply to the C-C dimension. Per QI-QAP-11.1-28, Revision 23, QC is not required to inspect C-C of strut (Article 6.4.2-d). Engineering calculates C-C dimensions based on working point dimensions. This item is, therefore, clarified.

6. Per Item 7f of Reference 2, this question is similar to item 7e above. TUGCO's clarification is acceptable.

7. Per Item 7g of Reference 2 TUGCO's clarification is acceptable. Per QI-QAP-11.1-28A, Revision 0, Article 5.6b, QC only requires to verify the cold setting, which is the controlling dimension. During Cygna's phase 4 walkdown, the snubber cold setting was verified to be correct. This item is, therefore, clarified.

E. Miscellaneous Discrepancies

1. Per Item 8a of Reference 2 TUGCO's response, as backed up by Multiple Weld Data Card #77588 and TUGCO field inspection, is acceptable. This may be oversight on Cygna's part due to the existence of paint. Cygna's comment is considered invalid.

2. Per Item 8b of Reference 2. Based on TUGCO's response Cygna reviewed the versions of revision 2 drawings in Cygna's possession and found that the revision 2 drawing with single nut on the threaded side did not have revision date and was only partially revised. This could have been an information only copy Cygna obtained while performing review at the Comanche Peak Site. The drawing was not vendor certified. Further review of the completed and vendor certified revision and drawings revealed that the use of double nut was part of the revision 2 changes. This confirms TUGCO's statement, that the revision 2 (completed) drawing correctly reflecting the as-built condition.

   This discrepancy is clarified based on Cygna's further review of the drawings.

PIPE SUPPORTS
Review Issues List

3. Per item 8c of Reference 2, TUGCO has clarified that the two 1/2" plates were supplied by the vendor as part of the rear brackets. As a part of the vendor supplied component, they need not be separately specified. This is acceptable.

   With respect to the U-bolt nuts, Cygna assumed TUGCO had field verified the snug tight condition of the double nuts and accepted TUGCO's statement that the nuts are snug tight. Cygna also understands that a Hardware Validation Program (HVP) is in place, and locking device for U-bolts is an attribute to be checked. Therefore further assurance is provided by the implementation of the HVP.

4. Per TUGCO's response, Item 8d (CC-2-019-707-A43S, Revision 2.) Reference 2, the spring cold setting is within 10% as permitted by start-up procedure #XCP-ME-10 Revision 3. Furthermore, there will be a Start-Up pre-service inspection to be performed for checking the cold setting. This clarification is acceptable.

   TUGCO indicates that QC had inspected the base plate and welds prior to the grouting, therefore, the only action required is to issue NCR to document as-built plate and grout/topping condition. QC has issued NCR #M-18930 R.1. Based on this action, the discrepancy is considered resolved.

5. Per TUGCO's response, Item 8e (CC-1-050-700-A43K, Revision 3) Reference 2, QC has issued NCR #M-25,656N to revise the drawing. This discrepancy is considered resolved.

36. Maximum Allowable Pipe Clearance

Reference:

1. Brown & Root Instruction QI-QAP-11.1-28, Revision 29 - "Fabrication and Installation Inspection of Safety Class Component Supports"

2. Letter from W.G. Counsil (TUGCO) TO R.J. Stuart (Cygna), dated 9/2/86 - Open Items -- Phase IV

PIPE SUPPORTS
Review Issues List

Report.

3. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

4. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna Concerns.

Summary: Per paragraph 3.3.4.1a of Reference 1 above, the maximum allowable total dimensional clearance on one side of a pipe is 1/8" + 1/16" (i.e. 3/16" gap between pipe and support restraining members). The industry standard is 1/8" maximum.

Cygna is concerned that this QC Inspection Criterion has not been reviewed/approved by Engineering.

Status: This issue is closed based on TUGCO/SWEC's commitments of adopting a 1/8" maximum clearance criteria for the CPSES pipe support design/requalification program (Item No. 17 of reference 2; sheets 167 & S-14 of reference 4)

37. Line Contact Stresses (Local Stresses)

References:

1. Pipe Stress Reviewed Issue List, Revision 1 dated 4/23/85, Item 11 - Welded Attachments.

2. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

3. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 13, 1986 - On Resolution of Cygna Concerns.

4. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, New Jersey, dated November 14, 1986 - On Resolution of Cygna Concerns.

5. Cygna conference report of audit at SWEC office (Boston), dated December 30, 1986, Job 84056 -

PIPE SUPPORTS
Review Issues List

Audit to Review Stone & Webster Procedures for Local Pipe Stress Evaluation.

6. Cygna conference report of audits at SWEC offices, March 17 and 18, 1987 (Cherry Hill, N.J.), March 19, 1987 (Boston, MA), Job 84056 - Audit to Review Stone & Webster Pipe Stress and Pipe Support Reconciliation Procedures.

Summary: Line Contact Stresses was originally covered under the pipe stress issue of welded attachment. Based on Cygna's reviews of SWEC's design criteria (Attachments 4-6B and 4-6C) there are some specific items that require clarification.

- Rationale for stating that the longitudinal bending stress s_l', is considered to be included in equation (6a) of Attachment 4-6B, Reference 2. (Ref. 4, Sheet 122)
- The bases for the use of the effective thickness ($t_e = t + t_p$ 3.2.4 of attachment 4-6B, CPPP-7) for the pipe wall in the local stress analysis. (Ref. 4, sheet 122)
- Rationale for the inclusion of clamp preload only in the term S^{***}_{pl} of section 3.1.1. of Attachment 4-6C, CPPP-7 (sheet 121, Revision 4)
- The applicability or bound of the load condition as used in equation 9 of section 3.2.2., Attachment 4-6C. Also provide the derivations of some of the equations in 3.2.3. & 3.2.4 of the same Attachment. (sheets 97 & 126, Ref. 4)

Status: This issue is closed. In order to address and resolve the questions raised by Cygna (Sheets 123 through 130 and S1 of Reference 3; Sheets 92 through 98, 121 through 122, 125 through 127, and Sheet 162 of Reference 4), Cygna performed two audits at SWEC's Boston office. The questions raised by Cygna were properly addressed in the audit (see Reference 6). In particular, SWEC will revise procedure CPPP-7 to maintain the use of $t_e = t + t_p$ for pipe stress calculation, but revising the allowable stress for the pad downward to 0.75 F_y based on the results of their finite element study. The data provided in the finite element study, RLCA/F1 & 2/ - 01-06/004, substantiated the validity of the procedures in Attachment 4-6C of CPPP-7 (Reference 2).

(Note that for the resolution of stresses in pipe due to welded attachment - i.e., Attachment 4-6A of CPPP-7 - see pipe stress RIL Numbers 11 and 26 for details.)

38. Thermal Lock-up

References:

1. SWEC Project Memorandum for CPSES PM-071, dated 6/25/86 - Local Stress Evaluation for Dual Trunnion Anchors
2. SWEC's Report on Evaluation of Generic Technical Issues, Appendix B: Local Stress-Piping, Revision 0.
3. Testimony of Nancy H. Williams in response to CASE questions of Feb. 22, 1984 to Cygna Energy Services.
4. Cygna/SWEC Meeting Agenda, December 15 and 16, 1986 Glen Rose, Texas. (Exhibit 1 to Reference 5)
5. Transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, Texas, dated December 15 and 16, 1986 - On Resolution of Cygna Concerns.

Summary: The effect of thermal lock-up in anchors which restrain pipe radial thermal growth was an ASLB hearing issue. This issue is addressed by SWEC in section 4.6.4.1 of CPPP-7, and Project Memo PM-071. After reviewing the above documents, Cygna has identified some detailed questions which require clarification from SWEC (see Item I, Reference 4). Based on SWEC's responses in the Cygna/SWEC meeting at Glen Rose Texas, Cygna's questions have been adequately addressed by SWEC. Furthermore, the proposition of using Finite Element Analysis on a case-by-case basis by the IWA group to refine the design is acceptable.

PIPE SUPPORTS
Review Issues List

Status: This issue is closed. The resolution proposed by SWEC has adequately addressed the issue.

39. Two-Bolt Baseplate Qualification Procedure

References:
1. SWEC Project Memorandum for CPSES PM-059, dated 6/18/86.
2. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.
3. Exhibit 1 to transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, Texas, dated December 15 and 16, 1986 - On Resolution of Cygna Concerns.
4. Cygna conference report of audits at SWEC offices, March 17 and 18, 1987 (Cherry Hill, N.J.), March 19, 1987 (Boston, MA), Job No. 84056 - Audit to Review Stone & Webster Pipe Stress and Pipe Support Reconciliation Procedures.
5. Transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, Texas Dated December 15 and 16, 1986 - On resolution of Cygna Concerns.

Summary: PM-059 (Ref. 1) provides a generic procedure for the Design/Qualification of Two-Bolt Baseplates for the SWEC re-analysis effort. However, in order for Cygna to evaluate the acceptability of the methodology, more detailed information is necessary.

Some major points are identified under item K of the Cygna/SWEC meeting agenda. (Ref. 3).

Status: This issue is closed. SWEC's response indicated that the procedure was based on the results of the parametric finite element study for bolt tension and plate stress equations were based on beam theory for the longitudinal direction and rigid plate theory for the lateral direction. Plate stresses developed in this manner were also benchmarked

PIPE SUPPORTS
Review Issues List

against the finite element analyses (Sheets 77 through 79 and Sheets K1, K2 and K3 of Reference 5). In order to attain a reasonable level of confidence in the procedure, Cygna performed an audit of the finite element study performed by SWEC. (See Sheets 104 and 105 of Reference 5; also Reference 4) in which sixteen plate geometries were analyzed with the F.E. base plate program "BAP." Cygna finds that he two-bolt base plate procedure provided in SWEC's PM-059 is acceptable.

40. NPSI Rear Bracket Sizes

References:

1. SWEC Project Memorandum for CPSES PM-080, dated 7/14/86. - Clarification of Attachment 4-2 of CPPP-7.

2. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7,, Revision 2.

3. Cygna Communication Report between D. Rencher (TUGCO) and J. Minichiello (Cygna) - Pipe Support Questions, Item 3 - dated 5/16/84. Job. No. 84042.

4. Cygna Communication Report between D. Rencher, G. Grace (of TUGCO) and J. Minichiello, C. Wong (of Cygna) - Pipe Support Questions and Status, Item Number 29 - dated 5/24/84, Revision 1, Job No. 84042.

5. Letter from L.M. Poppelwell (TUGCO) to N.H. Williams (Cygna), - TUGCO's Responses to Cygna's review questions, dated 6/8/84 (Job No. 84042).

6. Letter from N.H. Williams (Cygna) to J.B. George (TUGCO) - Phase 4 Pipe Support Questions, dated 7/31/84 (Job No. 84056)

7. Letter from L.M. Poppelwell (TUGCO) to N.H. Williams (Cygna) - TUGCO's response to Cygna's review questions, dated 8/11/84 (Job No. 84056).

PIPE SUPPORTS
Review Issues List

8. SWEC calculation No. 15454-NZ-(c)-GENX-073, Revision 0 - Evaluation of NPSI Rear brackets' Dimension for Design Calculation.

9. Cygna conference report of audits at SWEC offices, March 17 and 18, 1987 (Cherry Hill, N.J.), March 19, 1987 (Boston, MA), Job No. 84056 - Audit to Review Stone & Webster Pipe Stress and Pipe Support Reconciliation Procedures.

Summary: During Cygna's Phase 3 and Phase 4 Pipe Support Independent Design Review, Cygna has identified that documents giving different rear bracket sizes (dimensions) had been used in the design of ITT-Grinnell Strut/Snubber rear brackets (see references 3 through 7). It may have significant impact on the weld design of ' ` rear bracket attachment if an incorrect size were ed in the design. SWEC Project Memorandum No. 080 has identified that a similar conditio also existed for rear brackets supplied by NPSI. SWEC has generated a calculation, No. 15454-NZ(c)-GENX-073, based on the most conservative rear bracket dimensions and the results of this calculation will be used for the as-built verification of rear bracket welds and local stresses in pipe support members.

Status: This issue is closed. Cygna reviewed the NPSI rear bracket calculation (Reference 8) and found it acceptable. Furthermore, SWEC has committed to perform a similar calculation for the ITT-Grinnell rear brackets (See Reference 9). This issue is considered adequately addressed based on the above calculations and SWEC's commitment to use the most conservative rear bracket dimensions for the as-built verification of welds and local stresses in pipe support members.

(Note that the ITT-Grinnell issue was previously identified by TUGCO and a study was performed which concluded that all strut and rear bracket stresses were within their respective allowables. See Item 3 of Reference 5.)

41. Adoption of Later Code (ASME) Paragraphs

References: 1. SWEC Report - Documentation of ASME III NA-1140

PIPE SUPPORTS
Review Issues List

Review for Piping and Pipe Supports - for TUGCO CPSES, Units 1 & 2 15454-N(c)--007 (Dated 10/28/86)

2. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

3. Cygna Communication Report between A. Chan, W. Evans, S. Ali, F. Ogden (SWEC) and S. Tumminelli, N. Williams (Cygna) - Audit of SWEC Pipe Stress and Pipe Support Procedures - dated 4/30/87 (10:30 a.m.), Job No. 84056.

4. Cygna Communication Report between A. Chan et al (SWEC) and S. Tumminelli - Audit of SWEC Pipe Stress and Pipe Support Procedures - dated 5/11/87 (10:00 a.m.), Job. No. 84056.

5. Cygna Communication Report between R. Klause et al (SWEC), J. Muffet (TU Electric) and S. Tumminelli (Cgyna) - Inspection Requirements for Pipe Supports, Item 4, SWEC NA-1140 Report - dated 5/13/87 (2:30 p.m.), Job No. 84056.

6. Cygna Communication Report between R. Klause et al (SWEC) and S. Tumminelli - Inspection Requirements for Pipe Support, Item 4, SWEC NA-1140 Report - dated 5/14/87 (1:55 p.m.), Job No. 84056.

Summary: In the Stone & Webster's Pipe Stress and Pipe Support requalification effort for the Comanche Peak Steam Electric Station, Units 1 & 2, certain portions of codes later than the code of record are adopted for use in lieu of the original requirements in the code of record (i.e. for pipe supports, Section III, Division 1 of the ASME 1974 Edition, including the Winter 1974 Addenda). In order to adopt and use the later edition of a specific code provision, the code stipulates that all related requirements have to be met (Paragraph NA-1140(f) of the ASME Code).

Status: This issue is closed. Cygna reviewed the SWEC NA-1140 Report (Reference 1) and had requested clarifications on some of the items, they were items 3, 4, 5, 6 and 9.

PIPE SUPPORTS
Review Issues List

These items were addressed by SWEC as follows:

- Item 3d - Flexibility and Stress Intensification Factor.

  Cygna requested clarification on why these later code paragraphs were adopted. SWEC stated that the 1974 code edition is silent on run pipe intensification factors, whereas the 1983 code edition provides the additional information. (Reference 3).

- Items 4 and 5 - Through Thickness Tensile Stress.

  In the SWEC NA-1140 Report, SWEC adopted the Winter 1978 Addenda of the ASME code paragraphs for through-thickness tensile stress (Reference 1) which eliminated the requirement of reduced allowable tensile stresses. However, SWEC did not invoke the associated examination requirements under articles NF-4000 and NF-5000.

  Cygna felt that justification was required and requested clarification from SWEC (Reference 3). SWEC responded by indicating that the base metal inspection requirement of NF-5224 (W-82) was invoked from NF-4430 which specifically excluded piping supports (Reference 4). With respect to the NF-5200 inspection requirements, SWEC consulted with the ASME committee and stated that the inspection requirements were not added to address lamellar tearing and that pipe supports were exempted per NF-4431. Further, SWEC investigated the material requirements which remained unchanged from 1974 to 1984 (Reference 5). Based on the above reasons, SWEC has concluded that the inspection requirement is not a safety concern and it is not required per ASME. The inspections will not be performed.

- Item 6 - Butt and Grove Weld.

  SWEC will clarify this item by replacing it with Code Case N-413 - Minimum Size of Fillet Welds for Subsection NF Linear Type Supports. (Reference 4.)

- Item 9. - Bolted Joint Designs.

PIPE SUPPORTS
Review Issues List

Cygna noted that the adopted NF paragraphs utilizes the power interaction while AISC still uses the linear equations. SWEC clarified the question by referring to the AISC commentary section 1.6.3 which indicated that the power interaction equation also met the intent of AISC. (Reference 3.)

42. Allowables for Hilti Anchors Having Edge Distance Less than 5D

Reference:
1. SWEC Project Memorandum No. 099 - Allowables for Hilti Anchors Having edge Distance Less than 5D, (dated 8/20/86).
2. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2. (Section 4.5)
3. Transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, Texas, dated December 15 & 16, 1986 - On Resolution of Cygna Concerns.

Summary: In the SWEC pipe support requalification effort, Project Memorandum No. 099 provides a procedure to determine the Hilti Anchor bolt allowables when the concrete free edge distance is less than 5D but is greater than or equal to 3D or 2 $^1/_2$ inches. This procedure is acceptable for anchor bolts which are subject to predominantly tension loads. Cygna has requested clarification from SWEC to demonstrate whether consideration has been given to situation where the Hilti anchor is subject to predominantly shear loads.

Status: This issue was transferred and identified as Item No. 9 in the Cygna Civil-Structural Review Issues List as of May 4, 1987. This is due to the fact that structural anchorages are being addressed under the Civil/Structural scope of work.

43. Uncinched U-Bolt as a Two-Way Restraints

References:
1. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7,, Revision 2.

PIPE SUPPORTS
Review Issues List

2. Exhibit 1 to transcript of meeting between between SWEC/TUGCO/Cygna at Glen Rose, Texas, dated December 15 and 16, 1986 - On Resolution of Cygna Concerns. (Item F)

3. Cygna conference report of audits at SWEC offices, March 17 and 18, 1987 (Cheery Hill, N.J.), March 19, 1987 (Boston, MA), Job No. 84056 - Audit to Review Stone & Webster Pipe Stress and Pipe Support Reconciliation Procedures

4. SWEC Technical Report 15454.05-N(C)-002, May-1986 -Interaction Relation for Structural Member of Circular Cross Section.

Summary: The dynamic allowable loads, P_{max}, for NPSI U-bolts, as provided in Attachment 4-3 of reference 1, are much higher than the corresponding u-bolt allowable loads given in the NPSI catalog. However, the source or reference of these data are not indicated.

Status: This issue is closed. Further information was provided by SWEC as to the bases of the Dynamic P_{max} allowables, they are based on:

(a) NF allowable stress, (b) Detailed analysis with STRUDL model, (c) the use of circular section interaction equation for the checking of interaction ratio (See Sheets 52,53 of Reference 2, Reference 3 and 4). SWEC also noted that the NPSI catalog values were based on pre-NF design which were conservative. Cygna performed an approximate check of the P_{max} values and found that those values are reasonable.

44. <u>Location Tolerance for Modified Support</u>

Reference: 1. Stone & Webster's pipe stress and Pipe Support Design Criteria for CPSES Units 1 & 2, CPPP-7, Revision 2.

2. Transcript of meeting between SWEC/TUGCO/Cygna at Glen Rose, Texas, dated December 15 and 16, 1986 - On Resolution of Cygna Concerns.

PIPE SUPPORTS
Review Issues List

3. SWEC's project procedure CPPP-5, Revision 2 - Field Walk Procedure, CPSES Unit 1.

4. Welding Research Council Bulletin No. 316, July, 1986 Supplement to WRC Bulletin 300.

5. Transcript of meeting between TU Electric/Cygna/SWEC/Impell/Ebasco at Glen Rose, Texas, dated March 24 and 25, 1987 -Conduit Supports, Cable Trays, Pipe Stress and Pipe Supports, Volume II.

Summary: Stone and Webster's Design Criteria, CPPP-7 (Reference 1), section 3.10.6.11, states that "As-built piping configuration and support location shall be modeled in the analysis unless deviations are justified in the pipe stress calculations". In order to obtain an accurate understanding of the criteria, Cygna requested clarification on the location tolerance for modified supports (Item M of Exhibit 1 to Reference 2).

Status: This issue is closed. SWEC has responded by providing a table of pipe support location tolerances (sheets N-3 of Reference 2), which generally conforms to the PVRC position in WRC-316. Cygna reviewed SWEC's response and accepted these location tolerances based on the PVRC studies and recommendations (Reference 4 and Sheet 9 of Reference 5), since SWEC basically adopted/ conformed to the recommendations of WRC Bulletin No. 316.

(Note - Cygna understands that WRC Bulletin No. 316 was being reviewed by the NRC, consequently any comments or conclusions from the NRC on WRC Bulletin No. 316 might affect the SWEC position on support location tolerance with respect to NRC approval.)

45. <u>Design of Seismic/Non-Seismic Interface Anchors</u>

Reference: 1. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES Units 1 and 2, CPPP-7, Revision 2.

PIPE SUPPORTS
Review Issues List

2. Transcript of meeting between SWEC/TUGCO/Cygna at Cherry Hill, N.J. dated November 13 and 14, 1986 - On resolution of Cygna Concerns.

3. Letter from W.G. Council (TU Electric) to N.H. Williams (Cygna) - Resolution of Cygna Concerns Document transmittal, Dated February 18, 1987. (Attachment C - Justification for Applying Plastic Bending Moment and Plastic Torsional Moment Separately in the Design of Seismic/Non-Seismic Interface Anchors).

4. Cygna communications report of audits at SWEC offices, March 17 and 18, 1987 (Cheery Hill, N.J.), March 19, 1987 (Boston, MA), Job No. 84056 - Audit to Review Stone & Webster Pipe Stress and Pipe Support Reconciliation Procedures

5. Transcript of meeting between TU Electric/Cygna/SWEC/Impell/Ebasco at Glen Rose, Texas, dated March 24 and 25, 1987 - Conduit Supports, Cable Trays, Pipe Stress and Pipe Supports, Volume II.

6. Stone and Webster's Pipe Stress and Pipe Support Design Criteria for CPSES, Units 1 and 2, CPPP-7, Revision 3 (Attachment 4-10).

7. Communications Report between R. Klause et al (SWEC) and S. Tumminelli (Cygna), dated 4/3/87, 4:00 p.m., Job No. 84056.

8. Communications Reports between A. Chan et al (SWEC) and S. Tumminelli (Cygna), dated 4/10/87, 9:00 a.m., Job No. 84056.

9. Communications Report between A. Chan (SWEC) and S. Tumminelli (Cygna), dated 4/21/87, 1:30 p.m., Job No. 84056

Summary: Attachment 4-10 to Reference 1 provides the procedure for the design of seismic/non-seismic interface

PIPE SUPPORTS
Review Issues List

anchors. This procedure considers the three global directions separately when determining limiting loads due to plastic hinges. Cygna had some concerns on the criteria of load application on the non-seismic side (See Reference 2). SWEC had committed to provide justifications for not applying full plastic bending moment and full plastic torsional moment simultaneously.

Status: This issue is closed. Cygna received the response provided by SWEC (see Reference 3), which stated that the use of full plastic bending moment of straight pipe was a conservative approach and generally only a fraction of the full plastic torsion would be transmitted to the interface anchor due the existence of elbows and bends in piping systems. Subsequent to the review, discussions were held between SWEC and Cygna for further clarifications (References 7, 8 and 9). SWEC performed calculation (No. 15454-NZ(C) - 195) to compare Hilti bolt load interaction ratio for combined moment and torque vs. CPPP-7 procedure in order to come up with a cut-off value for anchor bolt interaction ratio (see References 7 and 8.) Based on the calculation, SWEC has determined that for any interface anchor where the anchor bolt interaction ratio (using CPPP-7 procedure) is greater than 0.60 will require further evaluation. This is based on a factor of safety of 2.0 for Hilti Kwik bolts. Furthermore, the pipe support would have sufficient ductibility when the design conforms to the CPPP-7 requirements. (See Reference 9.) Based on the above commitment and clarifications, Cygna concurred that the methodology for interface anchor design/qualification, as delineated in Attachment 4-10 of Reference 6, was acceptable.

COMANCHE PEAK RESPONSE TEAM

ACTION PLAN

DSAP IX

Title: Piping and Supports Discipline Specific Action Plan

Revision No.	0	1	2	
Description	Original Issue	Reflects Comments On Plan	Changes to Scope	
Prepared and Recommended by: Review Team Leader	[signature]	[signature]	[signature]	
Date	6/26/85	1/[illegible]/86	6/18/87	
Approved by: Senior Review Team	John W. Beck	John W. Beck	John W. Beck	
Date	6/26/85	1/24/86	6/18/87	

DSAP IX

PIPING AND SUPPORTS
DISCIPLINE SPECIFIC ACTION PLAN

1.0 PURPOSE

The purpose of this action plan is to develop reasonable assurance that CPSES piping and supports are designed in conformance to CPSES licensing commitments including appropriate codes and standards.

2.0 SCOPE

The scope of this action plan encompasses the assessment of design adequacy of all large bore ASME Section III Class 2 and 3 piping and the assessment, and requalification as necessary, of all large bore ASME Section III Class 1, 2 and 3 pipe supports. Additionally, the adequacy of small bore piping and supports will be demonstrated through verification of selected piping and supports. The implementation activities include reanalysis and requalification by the CPSES Project as well as third-party review of these activities. For further clarification of the scope, refer to Section B of Attachment 2 to this action plan.

3.0 BACKGROUND

In the area of piping and support design, a number of external source issues have been identified from the Independent Assessment Program (Cygna), ASLB proceedings (including documents originated by CASE), and NRC reviews (TRT, SIT and CAT, etc.).

To resolve all external source issues and further ensure that all ASME piping and supports are appropriately designed and qualified, Texas Utilities Generating Company (TUGCO) has committed to perform a comprehensive requalification program.

Stone and Webster Engineering Corporation (SWEC) has been retained by TUGCO to perform this reanalysis and requalification effort on behalf of the Project.

A third-party review of this effort will be conducted in order to provide reasonable assurance that the objectives of the Design Adequacy Program in the piping and supports area are achieved.

DSAP IX
(Cont'd)

4.0 CPRT ACTION PLAN

4.1 Project (SWEC) Actions

The objective of the Project (SWEC) actions is to conduct structural qualification of piping and supports to applicable ASME Code requirements and CPSES licensing criteria.

Details of the SWEC requalification effort are presented in Attachment 2 to this DSAP.

4.2 Third-Party Review Actions

The objective of the third-party review of the Project (SWEC) activities is verification of issue resolution, criteria, methodology, piping analysis and support qualification. The third-party review will be conducted as described in the following paragraphs. This review effort will provide reasonable assurance that the issues addressed in the SWEC document entitled Generic Technical Issues Report are adequately resolved and all other external source issues are resolved. It will also confirm that CPSES piping and supports are designed in conformance to CPSES licensing commitments including appropriate codes and standards such that there is reasonable assurance that there are no remaining technical issues.

4.2.1 Areas of Review

4.2.1.1 Issues

This area consists of third-party identification, review and tracking of external source identified issues which have been raised regarding pipe analysis and pipe support design. This effort will also include consideration of ISAP V.c, which addresses design considerations for piping between seismic category I and non-seismic Category I buildings. The criteria and methodology utilized by the Project (SWEC) for analysis of these systems will be reviewed by the third-party.

DSAP IX
(Cont'd)

4.0 CPRT ACTION PLAN (Cont'd)

The following is a description of the tasks included under this activity:

- Issue Identification

  This task involves the identification of all applicable issues through the review of selected documents such as NRC Review Reports (SIT, SRT, TRT, SSER, Region IV), ASLB proceedings (transcripts, exhibits, filings, motions, orders), Cygna Independent Assessment Program reports and letters, etc.

- Issue Review and Evaluation

  This task involves reviews of each issue, determination of the significance with respect to the requalification program, evaluation and review of resolutions and assessment of generic implications for the purpose of identifying potential problems in other design areas.

- Issue Tracking

  This task involves tracking the status of each issue to the point of satisfactory resolution and identifying the applicable activities under the requalification program which address the resolution of each issue.

4.2.1.2 Criteria and Standards

This activity involves the verification that commitments which establish piping and support-related design criteria and standards are adequately addressed in procedures and other project documents. The commitment sources include the FSAR, design specifications, and the ASME Code. For each criteria source and standard identified, the

DSAP IX
(Cont'd)

4.0 CPRT ACTION PLAN (Cont'd)

appropriate criteria and commitments will be summarized. These criteria will be used in the development of checklists for the review of specific program areas.

4.2.1.3 Review of Project (SWEC) Actions

The third-party review of Project (SWEC) Actions are separated into four areas:

- Procedure Review
- Small Bore Selection Review
- Analysis Review
- Construction/As-Built Review

Procedure Review

This activity involves the review of technical procedures developed by the Project (SWEC) for the performance of activities detailed in Attachment 2 to verify that they are adequate to achieve their intended purpose. This will include procedures developed for:

- Initial as-built verification
- ASME Class 2 & 3 large bore piping reanalysis
- ASME Class 1, 2 & 3 large bore pipe support requalification
- Small bore piping analysis and support qualification
- Special analysis or testing
- Final as-built verification

The focus of these review efforts will be to ensure that the procedures adequately address the following:

DSAP IX
(Cont'd)

4.0 CPRT ACTION PLAN (Cont'd)

- Compliance with Project licensing commitments, codes, and standards
- Resolution of externally-identified issues
- Ability to accommodate and resolve additional issues as needed
- Definition and verification of design input (including engineering as-built information)
- Interface control
- Implementation and verification of hardware installation/modification as necessary

Small Bore Selection Review

This activity includes an evaluation of the bases for selection of small bore piping and supports used by the Project (SWEC) to demonstrate the design adequacy. The third-party will also review the selected piping and supports for conformance with these bases. Finally, the basis established for the conclusions reached regarding the entire population of small bore piping and supports will be reviewed.

Analysis Review

This activity involves the review of selected piping analyses and support designs, using checklists, for compliance to established requirements. Specific information to be reviewed includes the following:

- Piping Analysis

  Input to analysis including drawings, support locations, modeling characteristics, transient loads, temperatures and pressures, equipment and insulation data, and seismic loads.

DSAP IX
(Cont'd)

4.0 CPRT ACTION PLAN (Cont'd)

- Analysis outputs (e.g., loads, displacements, and support functionality) to ensure consistency with the input and conformance to applicable code and specification acceptance criteria.

- Pipe Support Design

  Design input, calculations, reference drawings, and support sketches to ensure that the functionality and capacity requirements identified in the piping analysis are met and to ensure conformance to applicable code and specification acceptance criteria.

Construction/As-Built Review

This review will include an overview of Project (SWEC) activities associated with the verification of engineering as-built information to be utilized in the reanalysis and requalification program. Through an evaluation of SWEC procedures and selected verification of implementation, the reviews will ensure consistency between analysis/design assumptions and the resultant physical configurations and identify any critical configurations or physical relationships that may impact conclusions regarding overall design and acceptance.

4.2.2 Review Methodology

The conduct of the procedure and analysis review activities described above will be performed using checklists developed specifically for the review scope. The verification program will be subject to procedures applicable to other aspects of the Design Adequacy Program.

4.3 Third-Party Reporting

Third-party review activities will be documented in a Results Report that includes the following:

DSAP IX
(Cont'd)

4.0 CPRT ACTION PLAN (Cont'd)

- Scope of Activity

  This will be a detailed description of the activities reviewed including drawings, analyses, references, specific calculations, and procedures.

- Review Methods

  This will be a description of the methodology used in performing the reviews including applicable third-party procedures and checklists used.

- Evaluation

  This will be a discussion of conclusions and the bases for conclusions from which recommended actions will be determined. In addition the evaluation will address generic implications (if any) applicable outside the piping/supports discipline as well as the adequacy of actions taken to resolve external source issues.

- Description of Deviations

  This will be a detailed discussion of deviations or concerns encountered during the reviews including probable cause and potential impact.

- Recommended Action

  These will be recommended actions to alleviate the concerns or correct deviations.

- Follow up Requirements

  If required, additional review requirements will be identified to assure that potential concerns have been adequately addressed.

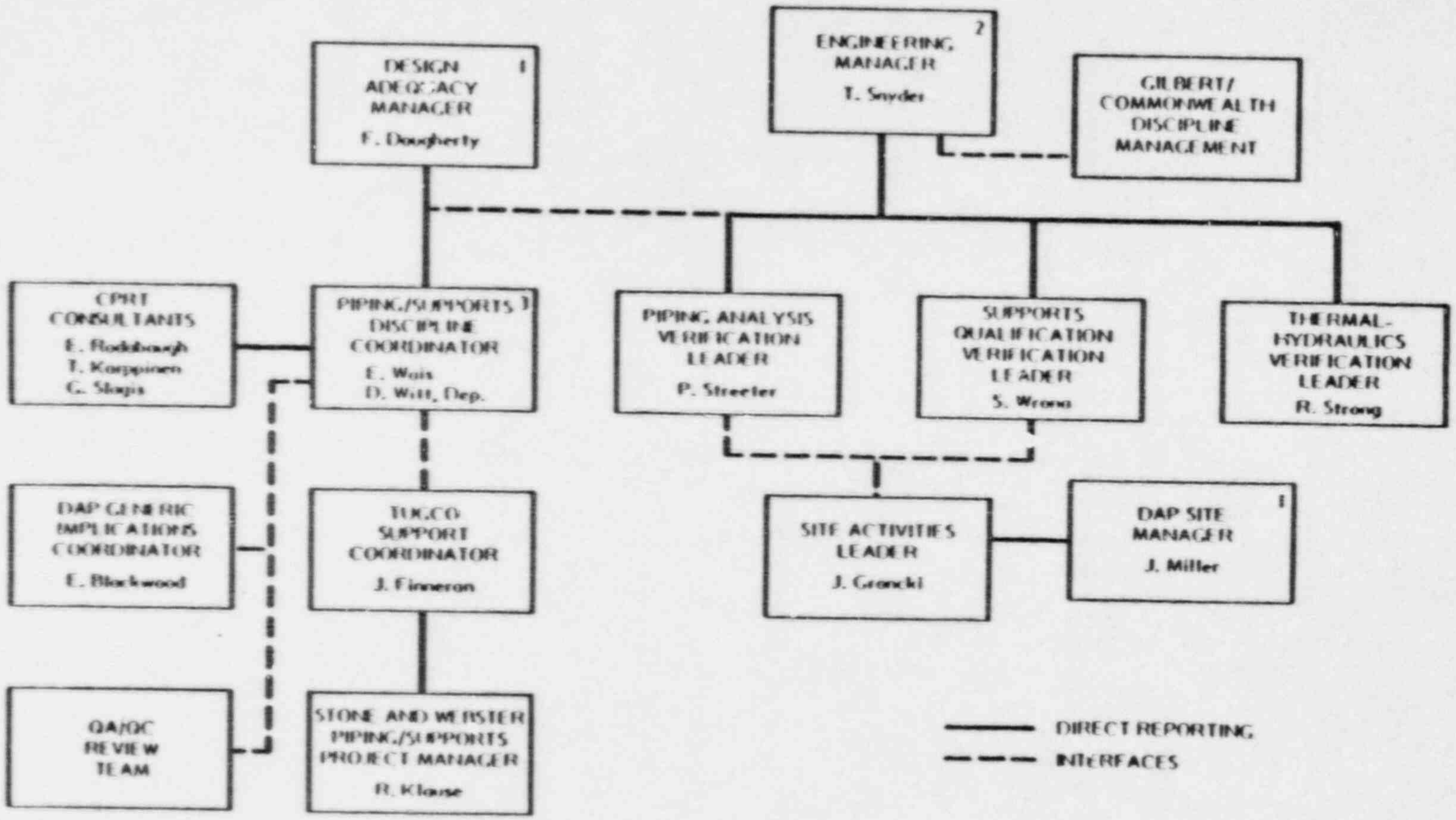
5.0 ORGANIZATION AND RESPONSIBILITIES

5.1 Third-Party Organization and Responsibilities

Third-party personnel are responsible for all review activities described in subsection 4.2 above. The organization chart for the piping and supports DSAP is shown as Attachment 1.

ATTACHMENT 1

ORGANIZATION
PIPING/SUPPORTS DISCIPLINE
CPRT DESIGN ADEQUACY PROGRAM



NOTES:

1. INCLUDES PROJECT MANAGEMENT AND TECHNICAL DIRECTION/APPROVAL.
2. LINE PROJECT MANAGEMENT DIRECTION, CONTROL.
3. TECHNICAL DIRECTION/APPROVAL TO GROUP LEADERS.

5/12/86

DSAP IX
(Cont'd)

ATTACHMENT 2

Pipe Stress and Pipe Support Qualifications

A. INTRODUCTION

This plan identifies Stone & Webster Engineering Corporation's (SWEC) actions to address technical concerns with the piping and pipe support designs in the Comanche Peak Steam Electric Station (CPSES). The action plan draws upon SWEC's experience, resources, and technical expertise in the qualification of piping and pipe support systems in modern nuclear power plants. This work will be accomplished in a controlled manner under the SWEC Corporate Quality Assurance Program which complies with 10CFR50, Appendix B and NRC Regulatory Guides.

Upon initiation of the project, the work will proceed without hold points for approval by outside parties. If new technical issues are raised in the area of piping and supports, SWEC will address them in parallel with the requalification production effort.

Complete implementation of this action plan will demonstrate the technical adequacy and compliance with all applicable licensing commitments of the piping and pipe support designs at the Comanche Peak Steam Electric Station. Approval of changes to the FSAR (e.g., ASME Code Cases, specific sections of the ASME III code of record, or other items as appropriate) may be requested by TUGCO for this requalification effort.

This effort will be overviewed by the TUGCO Project and the Comanche Peak Response Team (CPRT). This overview will not relieve SWEC of the responsibility for fully qualifying the piping and supports in their final modified condition.

B. OBJECTIVE AND SCOPE

SWEC is responsible for the structural qualification of piping and supports to the appropriate ASME Code requirements for the following scope:

- All piping and pipe supports within ASME III Code Class 2 and 3 large bore (larger than 2 inch pipe size) stress problem boundaries (including ASME Code Class 2 and 3 small bore and Class 5 piping and supports within these boundaries).

- All pipe supports within ASME III Code Class 1 stress problem boundaries (including all ASME III Code Class 1, 2 and 3 and Class 5 supports within these boundaries).

DSAP IX
(Cont'd)

ATTACHMENT 2
(Cont'd)

B. OBJECTIVE AND SCOPE (Cont'd)

- Selected ASME III Code Class 2 and 3 small bore piping and supports (including Class 5 piping and supports within the selected boundaries).

This effort will include the verification of structural and system input and output data to ensure complete integrity of the piping and support process.

Gibbs & Hill will remain the designer A/E of record for the piping systems with full responsibility for the system functional design.

The above program will adequately address special technical concerns raised by the NRC, Cygna, and CASE.

C. OUTLINE OF ACTION PLAN

The Stone & Webster Action Plan consists of the following six elements:

1. Development of Comanche Peak Pipe Stress and Pipe Support Design Criteria

2. Verification of As-Built Information

3. Review and Verification of System Design Input, Seismic Acceleration, and Fluid Transients

4. Verification of Existing Pipe Support Design Documents

5. Resolution of Special Technical Concerns

6. Requalification of Piping Systems and Pipe Support Designs. Any modifications required to supports will be controlled by the Repair Replacement activity of ASME Section XI.

Details of each element of the action plan are provided in the following section.

DSAP IX
(Cont'd)

ATTACHMENT 2
(Cont'd)

D. ACTION PLAN DETAILS

1. Development of Comanche Peak Pipe Stress and Pipe Support Design Criteria (Comanche Peak Project Procedure CPPP - 7)

   Existing SWEC technical guidelines and procedures for pipe stress analysis and pipe support design will be incorporated directly or by reference into a single Comanche Peak Pipe Stress and Pipe Support Design Criteria document (CPPP-7). Resolutions of the special technical concerns also will be incorporated as they become available. Furthermore, recent code cases and inquiries (e.g., Code Case N-411 on damping and Code Case 413 on minimum weld size) may be implemented if NRC approval is granted and if their implementation is considered appropriate. This document will be used on all pipe stress reanalysis and pipe support requalification on this project. The use of this criteria document will ensure uniformity of work and technical quality.

2. Verification of As-Built Information

   SWEC will perform a sample verification of existing as-built piping stress package documentation to ensure the validity and completeness of the physical dimensions to be used in the pipe stress reanalysis. Execution of this effort will follow the Field Walkdown Procedure CPPP-5 established for this project. Sample size will be determined from SWEC Quality Assurance Directive (QAD) 7.11, which is based on MIL-STD 105D.

3. Review and Verification of System Design Input and System Fluid Transients

   SWEC will review all ASME Class 2 and 3 piping drawings to ensure that all subsystems are evaluated. System design specifications will be reviewed to ensure that the FSAR commitments, the proper operating modes, system pressure and temperature, and the appropriate fluid transients are considered in the pipe stress analyses. An assessment will be made for each identified fluid transient to determine its effect on the piping. New fluid induced forces will be generated, if required, for the piping analysis. To the extent practical, the effects of the various fluid transients will be compared and enveloped to minimize the pipe stress reanalysis effort.

DSAP IX
(Cont'd)

ATTACHMENT 2
(Cont'd)

D. ACTION PLAN DETAILS (Cont'd)

4. Verification of Existing Pipe Support Design Documents

The SWEC requalification program will verify the adequacy of all pipe support designs. The requalification will be performed by either producing a complete new calculation or evaluating the existing project calculation. The evaluation method will fully review the existing calculation for technical adequacy and structural integrity for the new loads. Additional SWEC computations may include items not fully covered in existing calculations.

5. Resolution of Special Technical Concerns

Special technical concerns at the CPSES may be separated into three categories:

a.) Technical concerns which will be adequately addressed by existing SWEC technical procedures.

No further action is required since reanalysis using standard SWEC procedures will automatically resolve these technical concerns. Examples of these technical concerns are piping computer model mass point spacing, consideration of pipe support mass, significant modal contribution, damping values, frictional forces on supports, local stress, skewed fillet welds, and rotational restraint of axial supports.

b.) Technical concerns which must be addressed before finalizing the piping requalification effort.

These are special issues which will have a significant effect on the overall pipe stress analysis effort and are constraints to finalization of the piping reanalysis. Examples of these concerns are pipe support stiffness, stability of pipe supports, the effectiveness of U-bolt supports, and the effects of U-bolts on local stresses.

SWEC will establish a special task force(s) with experienced pipe stress and pipe support engineers to address these issues. The task force(s) will review all past project efforts expended for the resolution of these technical concerns and recommend to SWEC management further actions to close out the resolution effort. The review and recommendations will include

DSAP IX
(Cont'd)

ATTACHMENT 2
(Cont'd)

D. ACTION PLAN DETAILS (Cont'd)

document review and field walkdown by experienced pipe stress engineers to identify supports which are difficult to qualify, physical removal of the pipe supports, in situ or laboratory test/qualification of pipe supports, further analysis, or hardware modification.

As an option, some of the supports in question may be identified before stress reanalysis and an attempt made to delete them from the computer mod ... Upon successful completion of the reanalysis, such supports may be physically removed or modified to provide a technically sound resolution to the technical concerns raised even though the original design may be acceptable.

c.) Technical concerns which must be resolved before completion of the pipe stress and pipe support requalification effort.

These are technical concerns which specifically address the adequacy of some support designs. They have no effect on the pipe stress analysis effort and therefore need not be a constraint to the the pipe stress reanalysis effort. However, it is anticipated that substantial technical expertise is required to resolve these concerns and an approach similar to the one described in Item b above will be utilized to resolve these concerns. Examples of these concerns are cinched U-bolts, wall-to-wall supports, and Richmond inserts.

6. Requalification of Piping Systems and Pipe Support Designs

The pipe stress reanalysis effort will follow project procedure CPPP-6, "Pipe Stress/Support Requalification Procedure," and CPPP-7, "Design Criteria for Pipe Stress and Pipe Supports". The analysis will utilize the verified as-built and system design input discussed in Items (2) and (3) above. New seismic response spectra consistent with the Pressure Vessel Research Committee (PVRC) recommended damping value (WRC-300 and ASME Code Case N411) may also be used. Whenever judged appropriate by the pipe stress engineer, pipe support optimization will be performed to eliminate unnecessary snubbers and supports which are subject to the special technical concerns (e.g., stability) discussed in Item

DSAP IX
(Cont'd)

ATTACHMENT 2
(Cont'd)

D. ACTION PLAN DETAILS (Cont'd)

5b. The result of the pipe stress analysis will be used to evaluate the adequacy of the supports, penetrations, and equipment nozzles. Valve accelerations will be compared to their qualified level to assure operability. The new stress results will also be evaluated for consistency with the postulated pipe break locations in the existing design.

The pipe support requalification effort will be performed by experienced pipe support engineers in accordance with project procedures CPPP-6 and CPPP-7. Every ASME large bore and selected small bore support designs will be requalified by SWEC. The requalification will be performed by either producing a complete new calculation or using the verified existing project calculations as the basis, supplemented by additional calculations for new loads and items which may not have been fully covered in the existing calculation.

The approach to be used for selection and requalification of small bore piping and supports will be developed and documented in Project procedure CPPP-15 "Small Bore Stress/Support Requalification Procedure".

E. CLOSURE

The completed calculations from the SWEC qualification effort will become the permanent qualification documents of record for the plant and will provide assurance of the structural qualification of the above scope in accordance with CPSES licensing commitments and the applicable ASME Codes.

COMANCHE PEAK RESPONSE TEAM

RESULTS REPORT

DSAP IX

TITLE: PIPING AND SUPPORTS DISCIPLINE SPECIFIC ACTION PLAN

REVISION 1

Discipline Coordinator	8/27/87 Date
Review Team Leader	8/27/87 Date
John W. Beck, Chairman CPRT-SRT	9/3/87 Date

COMANCHE PEAK RESPONSE TEAM

DESIGN ADEQUACY PROGRAM

DISCIPLINE SPECIFIC RESULTS REPORT: PIPING AND SUPPORTS

DAP-RR-P-001
Revision 1
August 27, 1987

TENERA, L.P.
1995 University Avenue Berkeley, California 94704 415-845-5200

TABLE OF CONTENTS

SECTION | PAGE

TABLE OF CONTENTS
(Continued)

SECTION PAGE

LIST OF FIGURES AND TABLES

PAGE COUNT SUMMARY

1.0 EXECUTIVE SUMMARY AND CONCLUSIONS

This Results Report summarizes the results of a Third Party review of the adequacy of certain large bore piping and supports at the *Comanche Peak Steam Electric Station* (CPSES) as described in Section 2.0. This review was performed as part of the *Design Adequacy Program* (DAP) under the charter of the *Comanche Peak Response Team* (CPRT) Program Plan *(Reference 7.1)* by a Third Party Organization (TENERA, L.P.) The approach, methodology, and scope developed to accomplish this review are described in *Discipline Specific Action Plan* (DSAP) IX (Appendix C of the CPRT Program Plan) as modified in Appendix A of Reference 7.1.

The purpose of DSAP IX is to determine with reasonable assurance the adequacy of the design of certain piping and piping supports at CPSES. "Adequacy" is defined as conformance to the CPSES *Final Safety Analysis Report* (FSAR) and licensing commitments, including appropriate codes and standards.

The scope of this review, which involves external source concerns, has been categorized into thirty-two "*external source issues*," each of which has been the subject of an engineering evaluation. These issues were identified in publicly available NRC docketed information. The purpose of this report is to summarize the results of these evaluations and to provide conclusions regarding the adequacy of the design aspects reviewed by the Third Party.

The Third Party overview of the *Stone and Webster Engineering Corporation* (SWEC) pipe stress reanalysis and pipe support requalification program has been completed. This effort involved evaluation of SWEC's methodologies that address resolution of the concerns related to the thirty-two external source issues. This scope involved large bore pipe stress reanalysis and large bore pipe support requalification, including the basis for the methods discussed in the procedures to be used in these activities. Other activities, including the review of technical procedures for reanalysis and requalification of small bore piping and supports and the overview of the implementation of procedures for both types of piping including verification of design input, such as construction/as-built verification, will be addressed as part of the TU Electric Quality Assurance Technical Audit Program (See Reference 7.2).

This report summarizes the results and presents the conclusions from this Third Party review.

The activities addressed in this report are as follows:

- Issue Review (DSAP IX, Section 4.2.1.1)
- Commitment Verification (DSAP IX, Section 4.2.1.2)
- Large bore piping reanalysis and support requalification procedures review (DSAP IX, Section 4.2.1.3)

Briefly stated, the review identified external source issues, established applicable criteria based on the CPSES FSAR and licensing commitments, reviewed SWEC's procedures against those criteria, and evaluated the resolution methodologies for the issues. The resolution methodologies were presented in SWEC's *Generic Issues Report* (GIR) *(Reference 7.3)* and incorporated into SWEC's procedures. Considerations regarding root causes and generic implications and the programmatic aspects of the external source issues will be addressed as part of the TU Electric programs for processing and evaluation of nonconformance and discrepancy reports (See Reference 7.2).

As required in DSAP IX, the Third Party identified external source issues by conducting a document review. The Third Party review of over 40,000 pages of documents resulted in the issuance of approximately 800 piping-related *Discrepancy/Issue Resolution Reports* (DIRs) which documented concerns raised by external sources. These DIRs were consolidated into *External Source Issue Summaries* (ESISs, which are also referred to as "issues"), to facilitate efficient resolution of the concerns. These DIRs and ESISs were forwarded to SWEC and form the basis for the scope of this report.

SWEC procedures were reviewed for compliance with applicable CPSES FSAR and licensing criteria. Licensing commitments applicable to CPSES were used to establish a listing of criteria which were then used to check SWEC procedures. The procedures were determined to be in compliance either with the existing criteria or criteria changes that were accepted by the NRC for submittal as FSAR amendments. (see NRC letter to TUGCO dated November 4, 1986, *Reference 7.4*).

As documented in the GIR and its procedures, SWEC addressed each of the thirty-two issues using one or more of the following options:

- Elimination of selected designs
- Use of analysis and design practices that are typical of industry practice
- Development of new methods specifically applicable to the concerns raised
- Use of more advanced analysis techniques or testing to confirm the adequacy of analysis and design methods
- Use of SWEC Corporate Quality Assurance Program
- Implementation of project specific procedures for control of all phases of design and design interfaces

For each of the thirty-two issues, the resolution methodology has been reviewed by the Third Party and found to be responsive to the concern and in compliance with applicable FSAR and licensing criteria. The Third Party has concluded that the overall objectives of the review have been met, and considers all piping-related external source issues applicable to the large bore piping scope to be closed with respect to the methodology being applied to the requalification effort assuming the NRC approves the FSAR amendments.

The Third Party has concluded that SWEC's large bore pipe stress reanalysis and pipe support requalification program is comprehensive and capable, if properly implemented, of resolving known issues. Proper implementation will ensure that the CPSES large bore piping and supports will meet the FSAR and licensing commitments.

2.0 SCOPE

This report addresses three areas of review identified in DSAP IX as follows:

- **Issues** - The Third Party identified, reviewed, and tracked external source identified issues which were raised regarding pipe analysis and pipe support design. This effort also included consideration of TRT Issue V.c (*Reference 7.5*) which addresses design considerations for piping between seismic Category I and non-seismic Category I buildings. The criteria and methodology used by the Project (SWEC) for analysis of these systems were reviewed by the Third Party. This review provides reasonable assurance that the external source issues have been identified and that criteria and methodology used by the Project address all identified issues.
- **Commitment Verification** - The Third Party verified that commitments which establish piping and support-related design criteria and standards are adequately addressed in procedures and other Project documents. The commitment sources included the FSAR, design specifications, and the ASME Codes of Record for piping *(Reference 7.6)* and for piping supports (*Reference 7.7)*. For each criterion source and standard identified, the appropriate criteria and commitments were summarized. These criteria were used in the development of checklists for the review of specific program areas. This review ensures that Project procedures are consistent with applicable criteria and commitments.

  Where criteria changes have been submitted by the project to resolve differences between the approved FSAR and Project procedures (documented on C-DIRs) closure is based on the assumption that the NRC will approve the amendments.
- **Procedure Review** - The Third Party reviewed procedures (including appropriate SWEC Project Management memoranda) developed by the Project (SWEC) for the performance of the SWEC scope involving large bore piping analysis and support design to verify, by evaluation of the supporting analyses, that they are adequate to achieve their intended purpose. This review verifies that the project procedures resolve the external source issues.

The focus of these review efforts is to ensure that the SWEC procedures adequately address:

- compliance with Project licensing commitments, codes, and standards,
- resolution of externally identified issues, and
- ability to accommodate and resolve additional issues as needed.

The portions of the SWEC scope involving piping reanalysis and pipe support requalification addressed in this report are:

- all piping and pipe supports within ASME III Code Classes 2 and 3 large bore (larger than 2 inch pipe size) stress problem boundaries (including ASME Code Classes 2 and 3 small bore and Class 5 piping and supports within these boundaries), and
- all pipe supports within ASME III Code Class 1 stress problem boundaries (including all ASME III Code Classes 1, 2, and 3 and Class 5 supports within these boundaries). (See Reference 7.1).

SWEC analytical methods are governed by procedure CPPP-7 *(Reference 7.8)* which applies to both Unit 1 and Unit 2. Procedure CPPP-6 *(Reference 7.9)* is largely administrative and is applicable to Unit 1. CPPP-9 *(Reference 7.10)* is the corresponding Unit 2 procedure. The Third

Party reviews of both CPPP-6 and CPPP-9 determined that the differences in these procedures reflect differences in the stage of completion between the two units and provide equivalent adequacy of analytical methods. The results expressed in this report are applicable to both units because the procedural differences do not have a significant effect on the adequacy of the methods. Where it has been necessary to review implementation activities as part of this review, the Third Party generally examined Unit 1 results because Unit 1 implementation was at a further stage of completion. Unit 1 and 2 implementation is based on the same methodology.

Where the scope of the review covered by this report required an interface with another DAP discipline, that interface was established as discussed in Section 3.2.3 under the appropriate issue.

This report does not address the following DSAP IX reviews:

- Review of technical procedures for small bore piping and supports
- Overview of the implementation of procedures
- Overview of Project verification/reconciliation of as-built information.

The status of these areas of DSAP IX reviews will be addressed in separate reports to be transmitted to TU Electric for further consideration under their Quality Assurance Technical Audit Program.

3.0 EXTERNAL SOURCE ISSUES

3.1 Review Methodology

All external source issues identified as being related to the piping and supports discipline are addressed in this report. DSAP IX addresses both the identification of these issues and the program for resolving them. The conduct of the Third Party review was controlled in accordance with Third Party procedures and Discipline Instructions, written in accordance with *Design Adequacy Procedure 10* (DAP-10) (*Reference 7.11*).

The diagram in FIGURE 3.1-1 depicts the relationship among review activities leading to the conclusions documented in this report. There were two independent, parallel paths that led to the evaluation of the SWEC methodology. One path focused on the information directly related to the external concerns. The other path focused on the criteria to which the CPSES is committed. The process incorporated consideration of the external source issue DIRs and the licensing commitments to verify that the methodology used will produce an acceptable resolution of the external source issues. All issue resolutions were reviewed and the results documented in Engineering Evaluations which are the basis for the conclusions presented in this report.

A discussion of each of the thirty-two issues is provided in Section 3.2.3. The remainder of this section describes the Third Party approach to identification of external source issues, criteria and commitment compliance review of SWEC procedures, and evaluation of SWEC resolution methodology.

3.1.1 Identification of External Source Issues

External source issues were identified and documented in accordance with DAP-2 (*Reference 7.12*). The process required the following three steps:

1) identification of external source documents,

2) source document review and preparation of issue records/DIRs, and

3) consolidation of individual issues into issue summaries.

The identification of source documents focused on documents judged to include summaries of relevant issues, particularly information either presented to the *Atomic Safety and Licensing Board* (ASLB) or originated by the Board. ASLB hearing transcripts were used as a basic source of information. In addition to the ASLB hearing transcripts, pertinent filings with the board by the NRC staff, *Texas Utilities Electric Company* (TU Electric) (previously Texas Utilities Generating Company or TUGCO), *Citizens Association for Sound Energy* (CASE), and Cygna Energy Services were included and, as appropriate, the *Safety Evaluation Report* (SER) and supplements thereto (SSERs). The documents also encompassed transcripts of meetings between any of the above-mentioned parties, and between those parties and the Third Party, that addressed piping or support issues. Cygna reports and letters addressing these issues were also included. The listing of all source documents used by the Third Party for external issue identification is provided as Attachment A.

Each source document was reviewed in accordance with DAP-2. The result is a record of external issues discussed in the source documents. Issues are documented on Issue Records to capture a minimum of one citation of each distinct issue.

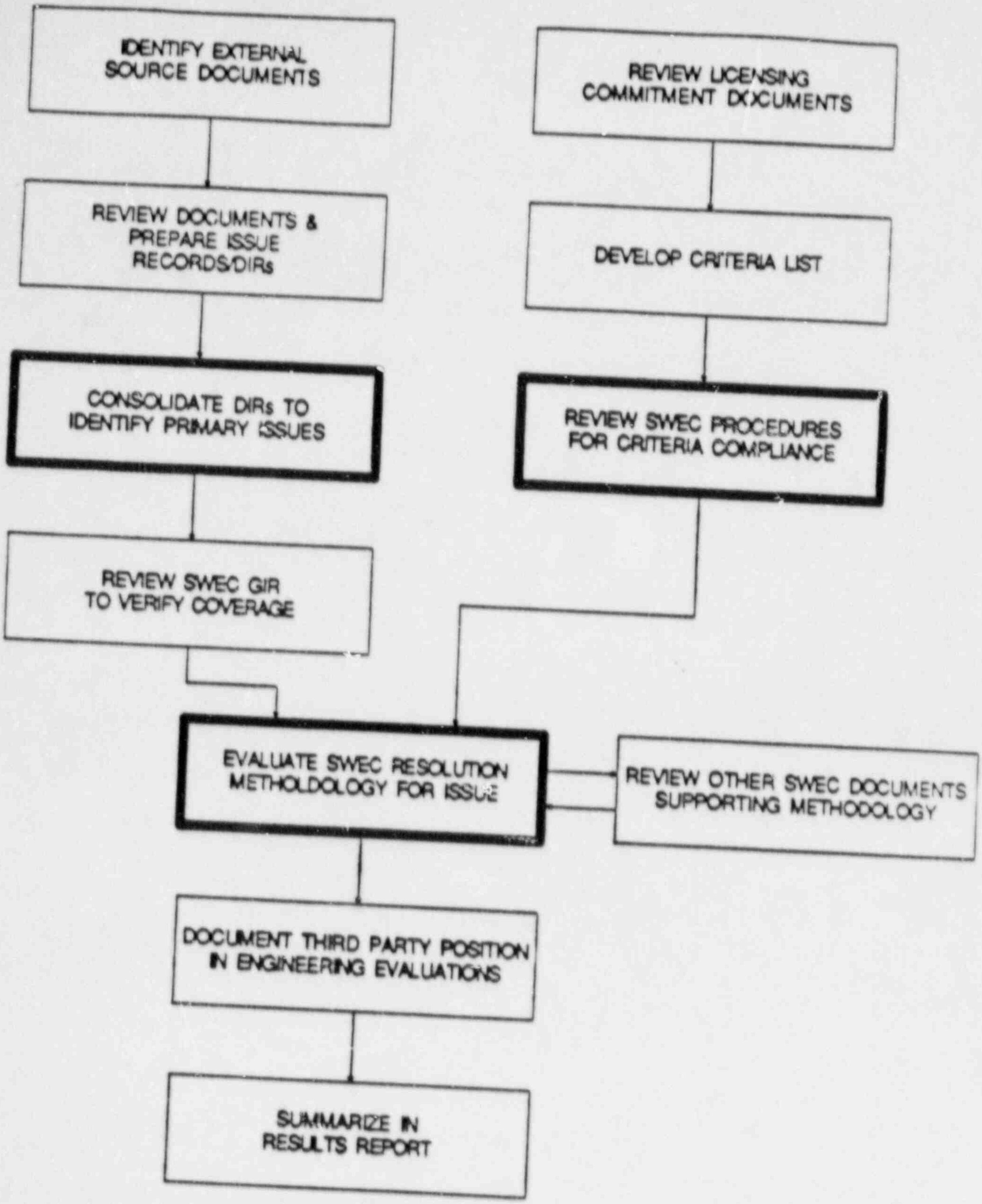


FIGURE 3.1-1

EXTERNAL SOURCE ISSUE
LOGIC DIAGRAM

For every Issue Record, a DIR was issued to assist the Third Party in tracking closure of the issue. The document title and specific page(s) on which the issue is discussed are recorded on each DIR. The reviewer was not permitted to exclude any issue based on an assessment of validity or consideration by the source that the issue was closed.

The public records used as source documents contain considerable discussion of all of the piping and support issues. In most cases, external issues are discussed in many documents, resulting in repetitive documentation of the same issue in more than one DIR. To comprehend the full extent and to support effective resolution of each issue, it was necessary to consolidate information relating to a given issue. The aim of this consolidation was to ensure that key aspects of the issue identified in the various DIRs were included within the definition of the issue. The consolidated issues are defined in thirty-two ESISs. The issue descriptions in each ESIS were developed by technical assessment of the key aspects discussed in the source documents. The DIRs serve as references to the external source documents pertaining to the issue. Lists of the pertinent DIRs are provided in each ESIS, and a primary DIR is used for each issue to track the resolution. Because TU Electric elected to proceed directly to corrective actions for the external source issues in piping and supports, the Primary DIRs are categorized as "unclassified trends" as described in Appendix E of the Program Plan.

3.1.2 Criteria and Commitment Compliance Review of SWEC Procedures

The second review activity conducted by the Third Party to evaluate the adequacy of the requalification program was to identify the criteria and commitments which the SWEC procedures must address. The criteria and commitments used for the overview of piping reanalysis and support and pipe requalification were taken from the FSAR (*Reference 7.29*); applicable Regulatory Guides; industry standards; the ASME Code; and design specifications. These documents were used by the Third Party to develop the Design Criteria List, DAP-CR-P-001 (*Reference 7.13*) in which applicable requirements are consolidated in accordance with DAP-1.

The criteria were then evaluated collectively. Design Criteria Review Checklist DAP-CLA-P-001 was used to review the criteria for completeness, accuracy, and consistency,

The acceptance criteria identified in the Design Criteria List were further tailored to each review by development of Design Review Evaluation Checklists. Applicable criteria were broadened into checklist attributes, as appropriate, by stating the specific requirements of the code, standard, or regulatory guide. This approach permitted a detailed, documented assessment of the review items.

Application of a Design Review Evaluation Checklist to specific design procedures involved assessment of compliance of the document with the checklist attributes. For each attribute, the reviewer determined if the procedure was in compliance with design commitments. If compliance was satisfactory, the reviewer indicated "SAT." If the procedure was not in compliance, or was indeterminate, the disposition was "UNSAT." Each UNSAT determination was followed by issuance of a Discrepancy/Issue Resolution (DIR) Report which documented the finding for future evaluation. An attribute which was not applicable to the specific document or design was marked "N/A." If an attribute was outside the defined scope of review documented on a particular checklist, it was marked "N/C" (Not Checked) since it was not evaluated.

The final status of the Design Review Evaluation Checklist will be delineated and forwarded to the TU Electric QA Technical Audit Program.

SWEC has issued two procedures that define input and methods, and technical process for Unit 1, including information interfaces, for the reanalysis and requalification effort:

1) **CPPP-6**: Pipe Stress/Support Requalification Procedure — Unit 1 (*Reference 7.9*)
2) **CPPP-7**: Design Criteria for Pipe Stress and Pipe Supports (*Reference 7.8*)

CPPP-7 procedure applies to both units and serves to define the technical methodology which includes the approaches used to resolve the external source issues. Additionally, SWEC has issued CPPP-9 which applies to Unit 2 and corresponds to CPPP-6.

The procedures were reviewed using a set of checklists. The checklist, DAP-CLC-P-002, was used to document the review for Revision 2 of CPPP-6 and CPPP-7. Some aspects of the methodology were not included within Revision 2 and were either so indicated within the procedures or documented in a series of project memoranda. A list of project memoranda reviewed as part of CPPP-7 is included as Attachment C of this report. Comments were issued with the checklist and DIRs were used to track open items. Differences between revisions reviewed and later revisions will be addressed as part of the TU Electric Quality Assurance Technical Audit Program (See Reference 7.2).

3.1.3 Evaluation of Resolution Methodology

The third review activity conducted by the Third Party was to evaluate the SWEC resolution methodology. This evaluation incorporated the results of the Third Party review of SWEC procedures that were described in the preceding section. Assessments by the Third Party of the SWEC approach to each of the external source issues are provided in a series of engineering evaluations.

The SWEC *Generic Issues Report* (GIR) outlined the approach to resolving external source issues. This report and the procedures that implement the approach are the major sources of information used by the Third Party to evaluate the resolution methodology. The Third Party evaluation required additional information concerning CPPP-7 which involved review of the SWEC documents supporting the methodology (primarily generic analyses/calculations). These generic analyses/calculations were reviewed to facilitate selective numerical checks of tabulated values and checks of the mathematical development of equations specified in CPPP-7, because the procedure does not include this level of detail. The calculations also provided justification for certain assumptions on which specific methods were based. The approach used for these justifications was also reviewed.

Using the issues as defined in the ESISs, acceptance criteria for resolution were developed. Documentation of those criteria and the evaluation of SWEC's methodology against them are provided in a separate engineering evaluation for each issue. This report summarizes the results of those evaluations.

3.2 Results

3.2.1 External Source Issue Identification

As discussed in Section 3.1.1, repeated references to a common set of issues were found within the documents reviewed. The references were documented by the Third Party in approximately 800 Issue Records that have corresponding DIRs that are used to track each issue to closure. TABLE 3.2-1 lists the consolidated issues, the primary DIRs used to track them, and the

TABLE 3.2-1

ISSUE DOCUMENTATION

ISSUE TITLE	ENG. EVAL.	ESIS	PRIMARY DIR
Richmond Inserts	DAP-E-P-001	ESIS-P-001	E-1234
Local Stresses	DAP-E-P-002	ESIS-P-002	E-1235
Large Framed Wall-to-Wall and Floor-to-Ceiling Supports	DAP-E-P-003	ESIS-P-003	E-1236
Support System Stability	DAP-E-P-004	ESIS-P-004	E-1237
Generic Stiffness	DAP-E-P-005	ESIS-P-005	E-1238
U-Bolts Acting as Two-Way Restraints	DAP-E-P-006	ESIS-P-006	E-1239
Friction Forces	DAP-E-P-007	ESIS-P-007	E-1240
AWS vs. ASME	DAP-E-P-008	ESIS-P-008	E-1241
A500, Grade B Tube Steel	DAP-E-P-009	ESIS-P-009	E-1242
Section Properties	DAP-E-P-010	ESIS-P-010	E-1243
U-Bolt Cinching	DAP-E-P-011	ESIS-P-011	E-1244
Axial/Rotational Restraints	DAP-E-P-012	ESIS-P-012	E-1245
Gaps	DAP-E-P-013	ESIS-P-013	E-1246
Seismic Design Load Specification	DAP-E-P-014	ESIS-P-014	E-1247
Support Mass Effects on Piping Analysis	DAP-E-P-015	ESIS-P-015	E-1248
Mass Point Spacing	DAP-E-P-017	ESIS-P-017	E-1249
High Frequency Mass Participation	DAP-E-P-018	ESIS-P-018	E-1250
Fluid Transients	DAP-E-P-019	ESIS-P-019	E-1251
Self-Weight Excitation	DAP-E-P-020	ESIS-P-020	E-1252
Local Stress in Pipe Support Members	DAP-E-P-021	ESIS-P-021	E-1253
Safety Factors	DAP-E-P-022	ESIS-P-022	E-1254
SA-36 and SA-307 Steel	DAP-E-P-023	ESIS-P-023	E-1255
Valve and Flange Qualification and Valve Modeling	DAP-E-P-025	ESIS-P-025	E-1256
Piping Model	DAP-E-P-026	ESIS-P-026	E-1257
Welding	DAP-E-P-027	ESIS-P-027	E-1258
Anchor Bolts	DAP-E-P-028	ESIS-P-028	E-1259
Strut Angularity	DAP-E-P-029	ESIS-P-029	E-1260
Structural Modeling for Frame Analysis	DAP-E-P-031	ESIS-P-031	E-1263
Computer Program Verification and Use	DAP-E-P-032	ESIS-P-032	E-1264
Hydrotest	DAP-E-P-034	ESIS-P-034	E-1266
Seismic/Non-Seismic Interface	DAP-E-P-038	ESIS-P-038	E-1275
Programmatic Aspects and QA	DAP-E-P-016	ESIS-P-016	E-1276

associated ESISs. Each ESIS lists the individual DIRs used to track the closure of the concerns identified. DIRs for Issue Records that were not included within one of the summaries are addressed in Section 3.2.3.33. These DIRs generally covered less complex questions. These DIRs were addressed using the DIR form for documentation in accordance with Third Party procedures.

In the opinion of the Third Party, there is sufficient information in the public record (documents listed in Attachment A) for each concern, to enable the Third Party to define and focus each issue. The list of documents reviewed is extensive and the level of repetition high, providing a high degree of assurance that all concerns are addressed.

The external source issues can be classified into the following four groups of concerns:

1) concerns that well-defined and explicit working level requirements were not correctly implemented,
2) concerns that a technically specific FSAR commitment, industry code or standard, or regulatory position was not implemented in design methods,
3) concerns that the use of standard design and analysis practices were not changed as necessary when applied to atypical designs, and
4) concerns that specific aspects of methodology, although in compliance with industry codes, standards, or standard practice, failed to satisfy the requirements imposed by Appendix A of 10CFR50.

3.2.2 SWEC Compliance with CPSES Criteria

The collective evaluation of the Design Criteria List concluded that it represents a complete, consistent, and adequate set of criteria.

SWEC procedures CPPP-6 and CPPP-7 were reviewed, and comments provided to SWEC. For every item in the procedures that was determined to be a discrepancy when compared with the checklist attribute, a DIR was written. These DIRs are C-type DIRs, which are used to document technical resolution and to track the closure of open items. Each DIR issued against SWEC procedures provides both a description of the question posed by the third party and the technical resolution. The DIRs have all been closed by the Third Party through either technical resolution or transfer to the TU Electric Quality Assurance Technical Audit Program (*Reference 7.2*). DIRs which were closed based on proposed FSAR amendments assume acceptance of the changes by the NRC. Unresolved DIRs will be delineated in the final Third Party surveillance audit report. Additionally, CPPP-9 was compared to CPPP-6 to determine if there were significant differences. The conclusion was that no differences existed that affected the adequacy of SWEC compliance with CPSES criteria.

Based on the above reviews, the conclusion was reached that the SWEC procedures comply with that set of criteria.

3.2.3 External Source Issue Resolution

Evaluations of the resolution methodologies have been completed for the thirty-two external source issues. Each of the thirty-two issues is described in an individual subsection below along with discussions of resolution methodology and the Third Party evaluation and conclusions.

3.2.3.1 Richmond Inserts

ISSUE DESCRIPTION

The use of Richmond Inserts in structural tube connections (see FIGURE 3.2-1) has raised concerns generally relating to design allowables, methods used to compute bolt loads in tube connections, and frame modeling and analysis of the insert/tube connection. A more detailed discussion of this issue can be found in Engineering Evaluation DAP-E-P-001. Specific concerns within these areas are the following:

- **Factor of Safety** - The design allowables for tension and shear were determined based on Richmond Screw Company test data from tests using 3000 psi concrete and a safety factor of 2.0. The Richmond Screw Company recommends a safety factor of 3.0 for their products. A second, related concern is adequacy, without confirmatory testing, of the interaction equation for combined tension and shear, which was taken from the *Prestressed Concrete Institute* (PCI) Handbook.
- **Concrete Strength** - The concern is that the Richmond Inserts have been installed in concrete weaker than the 4000 psi design strength used for design.
- **Shear Stress Allowables for 1-1/2" Richmond Inserts** - Shear allowables for 1-1/2" Richmond inserts have been extrapolated from test data for 1" and 1-1/4" inserts and may not be conservative.
- **Computation of Bolt and Insert Loads** - Richmond Insert/tube steel connections were analyzed using a simplified method which does not account for bolt angularity or bolt bending due to shear in the tubing, and may not accurately predict the prying tension in the insert and the tube.
- **Frame Modelling of Tube-to-Insert Connections** - Inconsistencies in modeling tube-to-insert connections (such as the selection of pinned versus fixed joints) may result in inaccurate calculation of support stiffness and tube/frame stresses. These inconsistencies may also result in unconservative calculations of loads on bolts and inserts.
- **Testing of Richmond Inserts** - TUGCO performed tests on Richmond Inserts to determine the load-carrying capacity of the insert and to examine the behavior of connection for combined loading. Questions were raised by external sources regarding: (a) the representativeness of the tests to actual plant conditions, and (b) the interpretation of the test results.
- **TUGCO Finite Element Study** - Verification of the screening method used to justify the simplified method for design of Richmond Inserts was based on improperly interpreted results of finite element analyses.
- **Local Stress at Bolt Holes in Tubing** - The local stress at bolt holes in structural tubing was not evaluated. Such stress could cause punching-type failure in the tubing.
- **Fatigue** - Fatigue caused by cyclic loading of the connection was not considered in the design.
- **Improper Use of Richmond Allowables** - Threaded rods/bolts at Richmond Inserts occasionally were unconservatively evaluated because the tension and shear allowables for the insert were used.

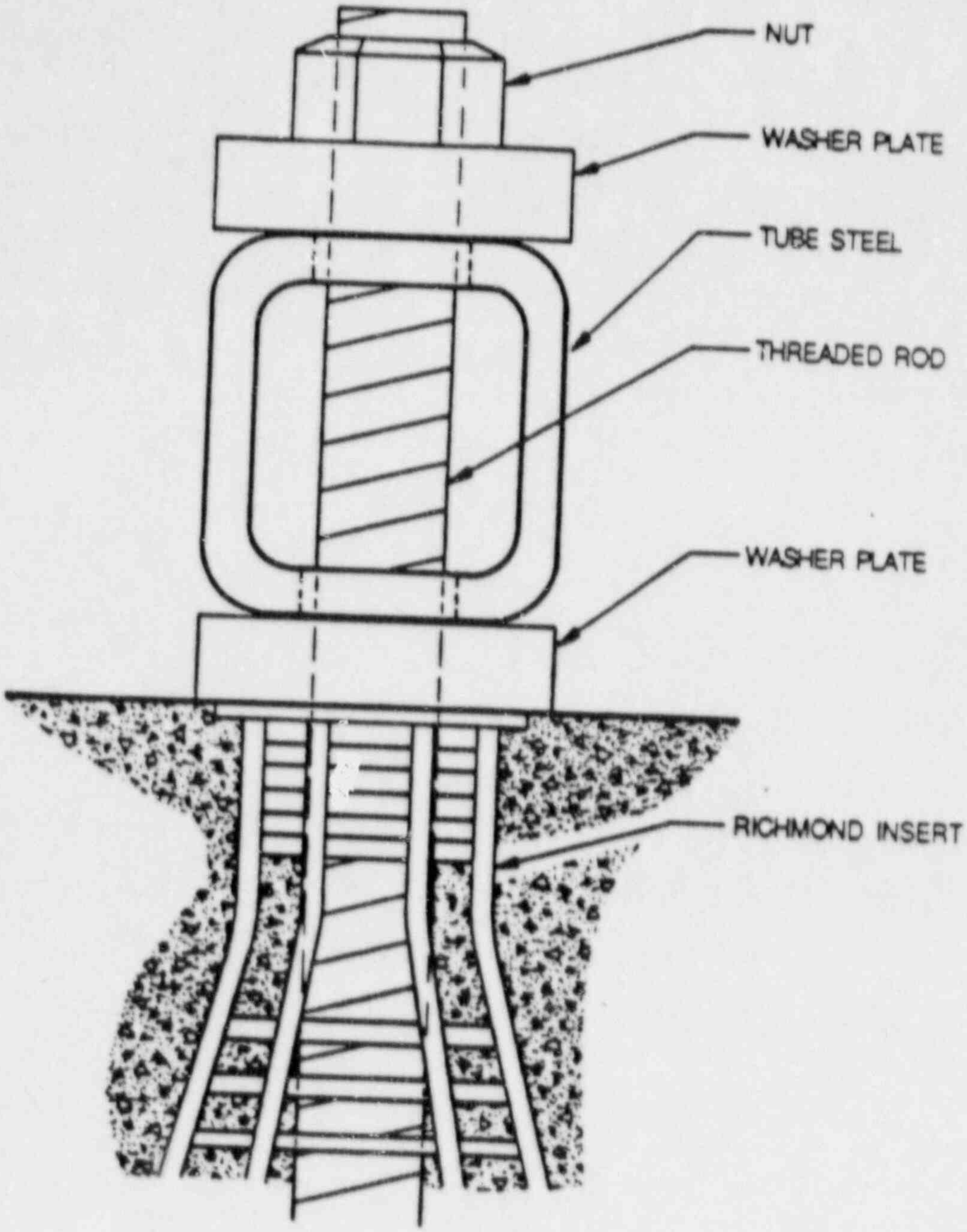


FIGURE 3.2-1

TYPICAL RICHMOND INSERT/
TUBE STEEL CONNECTION

- **Spacing at Richmond Inserts** - Lack of TUGCO structural attachment interface program could result in failure to consider spacing effects of nearby anchors/sleeves in the structural evaluation of inserts.
- **Shear Distribution at Richmond Inserts** - The threaded rod and hole fit-up tolerances could cause unequal sharing of shear loading from tubing which is anchored by two or more Richmond Inserts.
- **LOCA Thermal Expansion of Tube Steel** - Under LOCA conditions, thermal expansion of long tubing anchored by two or more Richmond Inserts could produce unacceptably high loads and large deformations in the insert/rod connection.

SWEC RESOLUTION METHODOLOGY

The methods used by SWEC to resolve or address the concerns identified above are as follows:

- **Factor of Safety** - SWEC has adopted a safety factor of 3 for Richmond Inserts under normal, upset, and emergency loading conditions, as recommended by The Richmond Screw Company, but SWEC used a safety factor of 2 for faulted condition loading. The allowables are based on averaging TUGCO insert capacity test failure loads. Additionally, specific requirements have been imposed for concrete strength, anchorage spacing, and concrete edge distance.

  For combined tension and shear, SWEC has adopted the *Prestressed Concrete Institute* (PCI) Handbook interaction equation which is used to evaluate all loading conditions.
- **Concrete Strength** - SWEC methods assume a concrete strength of 4000 psi.
- **Shear Stress Allowables for 1-1/2" Richmond Inserts** - TUGCO performed additional tests to establish allowables for all sizes of Richmond Inserts. Shear allowables for all Richmond Inserts are based on the average test failure loads presented in the TUGCO test reports.
- **Computation of Bolt and Insert Loads** - The SWEC approach for computation of bolt and insert loads depends on certain modeling requirements for structural analysis; a non-linear interaction equation to evaluate the adequacy of the rod in the insert for combined bending, tension, and shear; and a force-couple transformation of bolt bending moment to compute insert tension.
- **Frame Modeling of Tube-to-Insert Connections** - The SWEC approach for evaluating tube-to-insert connections establishes specific modeling requirements at specific structural interfaces, including: tube steel and rod at the insert, the rod end attaching to the insert, rod end attaching to the tube steel, and rod and tube steel.
- **Testing of Richmond Inserts** - The SWEC approach uses the load capacity insert test results of two TUGCO test reports. For Richmond Inserts, these test results are used to establish the design allowables for plant service conditions, to validate the interaction equation for combined shear and tension, to establish the design stiffness for insert connections, and to establish the design limits used to evaluate the effects of LOCA thermal expansion. The TUGCO tests used previously to examine the behavior of the connection are not used.
- **TUGCO Finite Element Study** - The SWEC approach to insert connection qualification does not rely on the previously performed TUGCO finite element study.

- **Local Stress at Bolt Holes in Tubing** - SWEC procedures provide a methodology and implementing tables for evaluating the local load capacity at bolt holes in structural tube steel. This methodology limits the local stress in the bolt hole vicinity.
- **Fatigue** - SWEC does not consider fatigue to be a relevant factor in these connections, and therefore does not include it in the design.
- **Improper Use of Richmond Allowables** - The SWEC methodology requires that the threaded rod and insert be evaluated separately, using specified allowables and interaction equations.
- **Shear Distribution at Richmond Inserts** - SWEC procedures assume equal distribution of shear loads resulting from rod and hole fit-up tolerances, where tubing is anchored by two or more Richmond Inserts. However, during final reconciliation, these designs will be reviewed by SWEC to verify that unequal shear load sharing assumption is adequate.
- **LOCA Thermal Expansion of Tube Steel** - SWEC procedures provide methods for evaluating the effects of LOCA thermal expansion of tubing on Richmond Insert connections. The method is based on RLCA Report RLCA/P142/01-86/009 *(Reference 7.18)* which uses shear test results in combination with an elastic analysis of failure to estimate deformations. By applying a safety factor of 2 to these deformations, design limits on insert/rod deformations are established for LOCA thermal expansion and system mechanical loads.
- **Spacing at Richmond Inserts** - SWEC Corrective Action Program (SWEC-CAP) is responsible for collecting all structural attachment load information and performing final evaluation for all pipe support structural attachments, including Richmond Inserts.

THIRD PARTY EVALUATION

The following paragraphs describe the Third Party evaluations of the SWEC methods for the identified concerns:

- **Factor of Safety** - The safety factor of 3 for normal, upset, and emergency loading conditions complies with the recommendation of the Richmond Screw Company. The safety factor of 2 for faulted conditions is based on *American Concrete Institute* (ACI) Standard 349-85 (*Reference 7.15*) using the results of tests performed by TUGCO. ACI 349-85 provides an industry experience/consensus basis for design of nuclear safety related concrete structures. TUGCO does not have a licensing commitment to comply with this standard for this application; however, this is an acceptable standard for establishing adequate margin. The TUGCO test data indicates that the scatter in the test failure loads is quite small, particularly when compared to data for other types of concrete anchorages, indicating that the reliability of Richmond Inserts is much greater than that of expansion bolts. A lower safety factor is acceptable, based on the test data and ACI 349-85.

  Use of the interaction equation for combined tension and shear is supported by PCI Technical Report, "Connections for Precast Concrete Building", which states that an interaction equation (identical to that used by SWEC) represents a lower bound curve on insert test results. The statement is not limited to prestressed concrete. The application of this equation was evaluated and determined by the Third Party to be acceptable for the Richmond Inserts without reliance on confirmatory tests.

- **Concrete Strength** - Plant concrete strength was addressed in *Issue Specific Action Plan* (ISAP) II.b Results Report, titled Concrete Compressive Strength, (*Reference 7.16*) of the CPRT program. This report concluded that reasonable assurance exists that the minimum required design strength of 4000 psi was met.
- **Shear Stress Allowables for 1-1/2" Richmond Inserts** - The SWEC allowables are based on average results obtained from TUGCO tests performed specifically for 1-1/2" Richmond Inserts. The test results are adjusted in accordance with ACI 349-85. The safety factors discussed above are maintained. This is an acceptable basis to account for variations in shear stress allowables.
- **Computation of Bolt and Insert Loads** - The SWEC methodology for computation of bolt and insert loads provides a conservative evaluation of the rod and insert, which adequately considers bolt angularity, bolt bending due to shear in the tubing, and prying action in the insert and the tube. The SWEC structural modeling procedure results in a set of rod loads that yields conservative rod interaction values when compared to results of detailed finite element studies performed by RLCA. The SWEC procedure for transforming rod loads into insert loads results in conservative insert interaction values (using the PCI interaction equation) when compared to the detailed RLCA studies. The rod interaction equation and allowables for SA-36 and A-193 Grade B7 materials, along with the additional check for direct stress in A-193 material, provide a code acceptable evaluation of the threaded rod in tension, shear, and bending.
- **Frame Modeling of Tube-to-Insert Connections** - The influence of structural modeling on Richmond Insert qualification is discussed above. The influence on support stiffness and member stresses is covered in Section 3.2.3.28, where it is concluded that the modeling is adequate and in compliance with ASME Section III, Paragraph XVII - 2420. Briefly stated, the classical approach to modeling a connection based on an assumption of either a pinned or fixed connection is replaced with a more detailed model.
- **Testing of Richmond Inserts** - The representativeness of test to in-plant conditions is being evaluated under DSAP VIII in Third Party *Issue Resolution Report* (IRR) DAP-E-C/S-515. (*Reference 7.17*)

  The concern regarding interpretation of TUGCO test results is acceptably resolved because: a) the SWEC procedure for evaluating the tube steel to Richmond Insert connection relies upon the RLCA analysis previously discussed, not on the TUGCO connection tests previously used to justify the TUGCO methods, b) the SWEC procedure appropriately adjusts insert capacities to account for the difference between plant concrete design strength and the concrete strength for the insert capacity tests, and c) industry codes and standards (e.g. ACI 349) permit the averaging of test failure results to establish the design strength of inserts.
- **Finite Element Study** - Because the SWEC approach does not use the simplified screening method and does not rely on the previously performed analysis, this concern is irrelevant to the current technical resolution.
- **Local Stress at Bolt Holes in Tubing** - Richmond Insert/tube steel connections utilize large rectangular 1-inch thick washer plates which distribute the stress at the bolt hole. Under the maximum allowable tension loads which can develop at 1-inch and 1-1/2 inch connections for the sizes of tube steel used, the simplified SWEC local load capacity methodology provides an adequate means for evaluating local effects at the loaded connection hole. The model on which the SWEC methodology is based employs a

simplifying construct to calculate the stresses in the bolt hole region. To verify the adequacy of this analysis, additional analyses were performed by the Third Party using an alternate methodology. These separate analyses confirmed the acceptability of the SWEC methodology.

- **Fatigue** - Since specific loads identified in the SWEC procedures are dynamic, a separate SWEC evaluation was performed to consider high cycle fatigue as required by ASME Section III. This evaluation confirmed that the lower threshold limit of 20,000 cycles, established in subsection NF, below which fatigue is not a concern, will not be reached.
- **Spacing at Richmond Inserts** - The SWEC approach provides a centralized comprehensive program for evaluating Richmond Inserts, considering effects of all nearby anchorages/sleeves.
- **Improper Use of Richmond Allowables** - The SWEC procedures ensure that Richmond Insert connections will be properly evaluated.
- **Shear Distribution at Richmond Inserts/Tube Steel Connections** - The SWEC procedures provide specific written criteria for the evaluation of Richmond Inserts used in conjunction with tube steel. The Third Party considers these methods adequate for evaluating shear distribution.
- **LOCA Thermal Expansion of Tube Steel** - The SWEC procedure for evaluating LOCA thermal expansion of Richmond Insert connected tube steel is based on the results of a detailed analysis, RLCA/P142/01-86/009 *(Reference 7.18)*, performed by RLCA. To verify the adequacy of this analysis, additional analyses were performed by the Third Party using an alternate methodology. These separate analyses confirmed the acceptability of the SWEC methodology.

CONCLUSION

SWEC methodology adequately addresses the concerns identified in this issue. This issue is closed.

3.2.3.2 Local Pipe Stresses

ISSUE DESCRIPTION

A concern was raised that local pipe stresses at welded attachments, such as lugs and trunnions, were not being evaluated for comparison to piping stress limits. Although the Code of Record *(Reference 7.6)* does not contain specific requirements for the analysis of attachments, it is standard practice to calculate stresses in the pipe that result from support loads on the attachments. Analysis of reinforcing pads and dimensional limitations on analytical methods are two concerns that are related to evaluation of local pipe stresses.

There are some frame supports at CPSES with zero radial clearance. Normally, box frames are designed with a gap to allow for pipe radial thermal growth. A concern was raised that the differential radial growth between the pipe and the support could result in unacceptably high stresses in the pipe and the support. For Class 2/3 piping, radial thermal expansion effects are not normally considered and the Code does not specify criteria for this type of loading. Similar concerns were raised about cinched U-bolts and anchors. In these cases, the effect can be classified as a circumferential line load. Another concern was raised regarding the consequences of longitudinal line loads on piping. At a frame support, the pipe rests with line contact on a cross-member. Local stresses are induced in the pipe as a result of a support load at this line contact. The local pipe stress issue is evaluated in Engineering Evaluation DAP-E-P-002 which contains a detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

SWEC is evaluating local pipe stresses at welded attachments. Procedures were developed for common lugs and trunnions, including reinforcement pads. Local stresses are added to the piping stresses for comparison to Code allowables. *Welding Research Council Bulletin (Reference 7.19)* (WRC) 107 methodology is followed for some of the configurations. Certain attachment dimensions are not within the WRC 107 recommended limits. SWEC has completed special studies which justify the use of procedures in these cases where the designs incorporate dimensions outside the WRC recommended limits and for unique designs such as plate anchors.

Design changes have eliminated zero gap frames and cinched U-bolts, thus allowing for radial thermal expansion. Radial thermal expansion local stresses are being evaluated for U-bolts (uncinched--cinched U-bolts have been deleted), stiff pipe clamps, and opposing trunnions. In addition, SWEC has developed procedures to investigate radial thermal expansion stresses at anchors.

Procedures were also defined for evaluating local pipe stresses at circumferential and longitudinal line loads at supports.

THIRD PARTY EVALUATION

SWEC has issued procedures for evaluating local pipe stresses at welded attachments and at supports with circumferential or longitudinal line loads. The computed stress values that are compared to Code allowables are determined by addition of local stresses to pipe stresses. This is consistent with Code Cases N-318-2 and N-329 which represent established methodology. Code Cases N-318-2 and N-329 use allowables from a later Code which are higher than the Code of Record. These higher allowables are also used for circumferential and longitudinal line load evaluations. These higher allowables are considered acceptable by the Third Party for application to local stresses in the cases analyzed by SWEC.

SWEC has detailed (finite element) analyses to justify the procedures and range of applicability for certain parameters, and to qualify unique designs (trunnions with gussets, anchors, attachments on fittings, etc). Such finite element analyses are an acceptable means for addressing the issue. A sample of thirteen finite element analyses has been reviewed. Eight of these are generic calculations which justify procedures which including attachments on fittings, expanded beta limits, expanded Pitrife limits, non-integral pads, opposing trunnions, bearing pads, clamp anchor local stress, and a finite element model sensitivity study. Five of the calculations reviewed are qualifications of specific support attachment designs.

As a result of the finite element analysis studies, several procedures for local stress evaluation have been changed. Pipe local stresses caused by radial thermal expansion are being evaluated for support designs where they could be significant. The stresses are being added to piping stresses for comparison to Code allowables--this is a conservative approach for Class 2/3 piping.

CONCLUSIONS

SWEC's approach (calculating local stresses and adding local stresses to the pipe stresses for comparison to piping allowables) adequately addresses the concerns. This issue is closed.

3.2.3.3 Large Frame Wall-To-Wall And Floor-To-Ceiling Supports

ISSUE DESCRIPTION

This issue is evaluated in Engineering Evaluation DAP-E-P-003 which provides a detailed discussion of the issue. In summary, the concern is that in the design evaluation of large frame wall-to-wall and floor-to-ceiling supports the following considerations for frame or anchor bolts were not explicitly included:

- frame thermal expansion due to LOCA and containment ambient conditions,
- relative differential displacements between the frame and the building attachment points for seismic building movements and time-dependent displacement effects, e.g., concrete creep, and
- cumulative effects resulting from thermal expansion, seismic, and time-dependent relative movements.

SWEC RESOLUTION METHODOLOGY

SWEC addresses the issue through analysis or support modifications as follows:

- With the exception of service water tunnel supports, large frame wall-to-wall or floor-to-ceiling supports are modified to include slip joints to accommodate differential displacements and thermal expansion.
- Service water tunnel supports extending from wall-to-wall or floor-to-ceiling are qualified for loading combinations that include frame thermal expansion, relative differential building displacements due to seismic movement, long term concrete creep, and live loads. Effects are evaluated cumulatively.
- Corner supports other than those attached to secondary walls are qualified using piping loads only. Relative building displacements have been demonstrated to be insignificant by SWEC. For supports spanning between building primary and secondary walls, project procedure CPPP-35 (*Reference 7.25*) has been issued to address such designs.

THIRD PARTY EVALUATION

The approach adopted by SWEC addresses issue resolution by three methods. The modification of all large frame supports (except those in the service water tunnel) to include slip joints eliminates the concern of differential displacements for these supports. The combination of loads used to evaluate large frame wall-to-wall and floor-to-ceiling supports in the service water tunnel addresses the issue and the requirements of subsection NF-3231.1(a) of the ASME Code (*Reference 7.7*) and the intent of Regulatory Guide 1.124, Position 5.

CONCLUSIONS

The SWEC approach adequately addresses this issue for wall-to-wall and floor-to-ceiling supports either by physical modification or by design qualification. SWEC method to address corner supports for significant OBE building displacements spanning primary and secondary walls as defined in CPPP-35 is adequate to close this issue.

3.2.3.4 Support System Stability

ISSUE DESCRIPTION

Certain pipe supports were identified which appeared to be capable of large displacements. A possible result of such displacements is a loss of intended function, that is, the support might not restrain the pipe as modeled in the piping analysis. Such supports are considered unstable. The supports in question have been grouped, for convenience, into the following categories:

- Box frames connected to struts or snubbers
- U-bolts connected to a single strut or snubber
- Trapeze supports
- Column/strut assemblies
- Trunnion/strut assemblies

For each of these categories, a displacement mechanism can be postulated that leads to a failure to carry the intended load. The technical issue is whether one can analytically demonstrate that the postulated mechanisms do not occur under the set of loading conditions imposed for the qualification of piping. FIGURE 3.2-2 depicts a postulated displacement wherein a box frame moves along the axis of a pipe. A support which may undergo such displacement is considered unstable because it may not perform as required or as modeled in the analysis.

The stability issue is evaluated in Engineering Evaluation DAP-E-P-004 which provides a more detailed discussion of the issue. A related issue is U-bolt cinching, which is evaluated in Engineering Evaluation DAP-E-P-011.

SWEC RESOLUTION METHODOLOGY

SWEC addressed support system stability with the following solutions:

- delete the potentially unstable supports from the analysis and physically remove them from the piping system,
- redesign these supports, using a rigid configuration or standard hardware (e.g. pipe clamps),
- modify trapeze designs to eliminate potential for large displacements, and
- develop analytical methods to confirm stability.

SWEC established a procedure for evaluating support function and stability which includes the specific types of design that were previously questioned and extends the evaluation to other designs. Both support designers and piping analysts participate in these evaluations. The evaluation is performed for all piping analyses. This evaluation is intended to provide assurance that variations of the questionable configurations are also considered.

THIRD PARTY EVALUATION

The approach adopted by SWEC addresses the concern specifically for the types of supports that were previously challenged, and also for every piping analysis, by performing evaluations for stability. The implementation of this process is a significant factor in the determination by the Third Party that the stability issue is comprehensively addressed. The SWEC solutions for

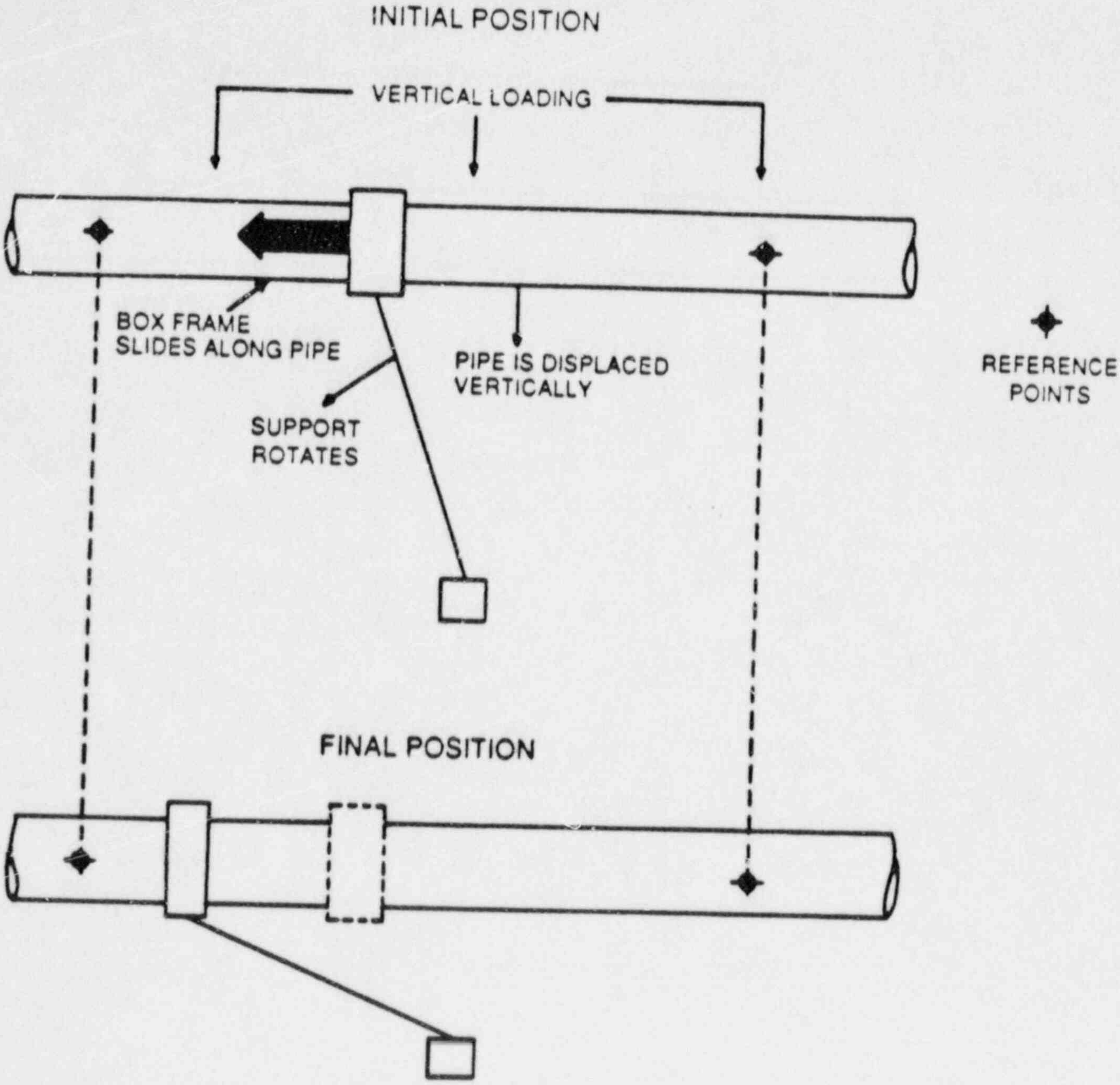


FIGURE 3.2-2

SUPPORT STABILITY

specific support designs provide the basis for determining the adequacy of the approach. SWEC has placed the major emphasis on support removal or redesign. Implementation of the SWEC approach has resulted in elimination of two of the five categories of unstable design. The support categories were treated in the following ways:

- **Box frames** - Box frames connected to struts or snubbers were eliminated.
- **U-bolts** - U-bolts connected to a single strut or snubber were eliminated.
- **Trapeze supports** -Trapeze supports were not entirely eliminated. The alternative preferred by SWEC was to remove the support, or redesign to eliminate the trapeze, but this was not mandatory. The cinched U-bolt, however, was in all cases eliminated. Three types of trapeze modification were permitted. The displacement mechanisms for these designs have been examined, and the designs have been determined to be stable.
- **Column/strut assemblies** - Analytical confirmation of stability was employed only for column/strut assemblies, where classical buckling analysis techniques could be used to establish a criterion for adequacy. This criterion was confirmed by independent analysis in Third Party calculation DAP-C-P-002.
- **Trunnion/strut assemblies** - The only potentially unstable support category not specifically addressed by SWEC under the issue of support stability is the trunnion/strut assembly. SWEC procedures, however, require a SWEC review of all supports, and SWEC has adequately defined the general requirement for achieving stability. A Third Party review of the specific configuration questioned by CASE indicated that the specific concern was addressed by SWEC as part of their modeling procedures for supports and by the methods used for local stress evaluation of trunnions.

CONCLUSION

SWEC has established an approach addressing stability of support design that is acceptable to the Third Party. The stability issue is closed.

3.2.3.5 Generic Stiffness

ISSUE DESCRIPTION

Generic stiffness values were used to represent the pipe supports in the pipe stress analysis for Class 2 and 3 systems. During the original support qualification, a 1/16" deflection criterion was imposed as a check to ensure that the stiffness was representative of the generic value used. A support stiffness criterion was not established. External sources determined that for specific lightly loaded supports, the calculated stiffness was orders of magnitude lower than the generic values. Since the response of the piping/support system is influenced by the stiffness of the supports, the results of the pipe stress analysis may not be valid if generic values are used.

Additional concerns were raised regarding the method used to calculate deflections or support stiffness values. It was contended that the calculation should include the associated flexibilities of all support components, i.e. U-bolts, base plates, and the potential effects of oversized bolt holes.

Specific questions resulting from the generic stiffness issue are as follows:

- Is the piping response accurately predicted if generic stiffness values are used?

- Is the stiffness used in the piping analysis verified as being representative of the actual stiffness of the installed support?
- Does the calculation of the support stiffness account for the flexibility effects of all support components?

This issue is evaluated in Engineering Evaluation DAP-E-P-005 which provides a more detailed description of the issue.

SWEC RESOLUTION METHODOLOGY

SWEC addressed the piping response aspect of the generic stiffness issue in SWEC report "Generic Pipe Support Stiffness Values for Piping Analysis." This report documents the SWEC determination of generic stiffness values to be used in the piping analysis and the minimum stiffness values below which calculated stiffnesses are used. The report concluded that for stiffnesses exceeding the minimum values, use of generic stiffnesses instead of calculated values will not result in significant variations in qualification parameters.

SWEC addressed the support validation issue by implementing the following sequence of steps during the pipe/support system qualification process:

1) Generic stiffness values were established based on support type (e.g., rigid support, anchor, snubber, etc.). The generic values were derived from a sample survey of installed supports and are representative of the majority of sample supports considered.
2) Minimum stiffness values were also established for each generic value defined. These minimum values were determined to define a stiffness range below each generic value that would produce comparable pipe stress results.
3) Prior to performing the piping analysis, each support stiffness was calculated based on as-built drawings and screened against the minimum values. If the calculated value was above the minimum value, generic stiffness values were used in the piping analysis; if the calculated value was below the minimum value, calculated stiffnesses were used. An exception is made regarding supports that are to be modified or replaced. For these supports, the generic value is assumed, with "confirmation required." Confirmation required supports are to be designed to meet or exceed the minimum stiffness values defined by Tables 3-10-8-1 through 3-10-8-3 of CPPP-7. Additionally, specific criteria were defined so that the analytical value would be used when certain local conditions existed (i.e., supports which restrain large masses or large axial runs) that may alter the generic values.

SWEC concluded that using the generic stiffness value produces no significant variation in pipe results. The stiffness values used in the analysis are verified on this basis.

Additional SWEC confirmation of the generic stiffness method was provided in GENX-117, a comparative analysis study of five piping problems selected by the Third Party. A comparison of results was made between analyses using the generic stiffness and the analyses using "actual" (calculated) stiffnesses for all supports. (*Reference 7.20*). The problems were selected from completed production analyses having higher than average numbers of supports where generic values were used. The problems were not considered worst case but were considered representative.

SWEC addressed the issue of including the local flexibilities of support components in the stiffness calculation by the procedures defined in CPPP-7.

Class 2 and 3 pipe support stiffness was evaluated by methods prescribed in Attachment 4-18 of CPPP-7. These methods include engineering judgment (inspection or comparison to similar designs with known stiffnesses), simple hand calculation, and detailed analysis. Attachment 4-18 also defines methods used to determine the stiffness of "special support types."

In addition to the guidance given in Attachment 4-18, the following additional guidance is provided for specific details elsewhere in CPPP-7:

- Attachment 4-4: Anchor stiffness values for Drilled-in Expansion-type Concrete Anchors.
- Attachment 4-5: Stiffness values for a single tube with insert connections along one line as the only means of structural attachment.
- Attachment 4-8: Allowable stiffness ratios between support structures (for dual snubber/strut supports using riser clamps).
- Attachment 4-12: U-bolt Stiffness, Trapeze Crosspiece stiffness, clamping stiffness of U-bolt and crosspiece.
- Attachment 4-15: Stiffnesses of trunnion type anchors.

The procedures for calculating support stiffness do not explicitly address oversized bolt holes. See Section 3.2.3.26 for a discussion of bolt hole clearances.

THIRD PARTY EVALUATION

The Third Party evaluation of the SWEC generic stiffness approach centered on the evaluation of the two sources of SWEC documentation; the SWEC report "Generic Pipe Support Stiffness Values for Piping Analysis" and the SWEC calculation GENX-117 summarizing the sample verification results of the five problem comparison analyses.

This approach, developed by SWEC, as well as those used throughout the nuclear industry have as their objective to provide a methodology to ensure that the stiffness values used in analysis are representative of the actual structures used in the plant. It is not industry practice to use actual calculated stiffness for all supports and all analyses but rather to use generic values which provide acceptable results.

Industry approaches generally involve establishing minimum stiffness (or sets of minimum stiffness values) prior to the design of the supports. Usually a deflection criterion or frequency criterion is also used. In this case, however, it is different in that these minimum values were not established prior to design and installation. The effect of this is that the supports tend to be more flexible than if a minimum stiffness or frequency criterion had been used. The object of SWEC's methodology is to use generic values where appropriate and to use actual values for the softer supports. This objective is considered by the Third Party to be reasonable and practical.

Based on the number and degree of piping analysis parameters and the factors which influence the piping system qualification, the basis for acceptance of the generic approach focused on the sample verification effort provided in GENX-117 (*Reference 7.20*). The review of the SWEC report noted the analysis approach used "simplified piping models and fundamental engineering principles." Third Party concerns were raised that the simplified piping models were not representative of actual configurations. The Third Party acceptance of the SWEC approach to generic stiffness was therefore based on evaluation of the sample analysis verification documented in GENX-117.

The results of the comparative analyses of the problems selected by the Third Party were reviewed in detail. The conclusions are discussed below:

- **Pipe Stresses** - The analysis using calculated stiffness indicated increases in stress over those calculated using generic stiffness at certain locations. These increases were generally less than 15%.
- **Support Loads** - Support loads from the analysis using calculated stiffness indicated increases in loads over those calculated using generic stiffness by more than 15% in a significant number of instances.
- **Valve Accelerations** - Valve accelerations from the analysis using calculated stiffness indicated increases in accelerations over those calculated using generic stiffness significantly more than 15%.

While the differences in the two analytical results were in some instances greater than 15%, the Third Party agrees with SWEC that in general, with some additional considerations, there are sufficient inherent safety factors associated with standard industry design practices so that variations of this order of magnitude can be neglected. The various parameters investigated in the comparative analysis are discussed below:

- **Piping Analysis** - The Third Party agrees that there is significant conservatism in the simplified SIF approach used in production piping design such that variations of this nature can be neglected recognizing the overall inherent factors of safety.
- **Support Loads** - No documentation has been provided to demonstrate overall conservatism such that the variations in loads can be neglected. SWEC issued a Project Memorandum requiring that during final reconciliation, all highly loaded supports (i.e., those with loads greater than 85% of design capacity) will be reviewed by the Options Review Committee to ensure that the use of the generic stiffness approach on a system basis does not violate the overall factor of safety consideration. The SWEC procedural requirements to review all highly loaded supports are sufficient to ensure that potential variations in support loads will not unacceptably compromise safety margins.
- **Valve Accelerations** - Accurate modeling of supports near large masses is important to ensure accurate calculation of valve accelerations. To ensure adequate representation, SWEC has issued a Project Memorandum to review, during final reconciliation, stiffness representation near valves. In addition, SWEC has provided data which indicate inherent design margins for the acceleration values used as design limits. Based upon this, the Third Party believes that SWEC's position regarding overall design margins is maintained.

Based upon the above discussion, the Third Party considers the reasonableness of the approach to be confirmed.

The detailed guidance for calculation of support stiffness including support component local flexibility was also considered of sufficient accuracy to be consistent with the generic stiffness methodology.

CONCLUSION

The method established by SWEC of accounting for support flexibility in the piping model is considered adequate. The generic stiffness issue is closed.

3.2.3.6 U-Bolts Acting As Two-Way Restraints

ISSUE DESCRIPTION

U-bolts have been used at CPSES to attach piping to rigid support members. In the applications in question, the U-bolts are not cinched. Supports of this type were used when the piping analysis called for restraint in a single translational degree of freedom. Such supports are typically referred to as *one-directional stops*. The intent was that the U-bolt would provide restraint in a direction parallel to the axis of the threaded portion. No restraint was modeled in the lateral direction, and no lateral loads were considered in the design of the support. The concern is that insufficient space exists between the pipe and the U-bolt in the lateral direction to permit the pipe to move thermally and seismically without contacting and loading the support. In effect, it was alleged that the support acted in two directions and should have been modeled and designed accordingly.

This issue is evaluated in Engineering Evaluation DAP-E-P-006 which provides a more detailed description of the issue.

SWEC RESOLUTION METHODOLOGY

Resolution of the issue under the SWEC requalification program consists of:

- replacing all uncinched U-bolts on pipes greater than 6-inch with a support that complies with the analyzed function, and
- modeling all uncinched U-bolt supports on pipes 6-inch and less as two-way restraints in the piping analysis, and qualifying the support for the resulting loads.

THIRD PARTY EVALUATION

U-bolts that continue to be used at CPSES, i.e., 6 inch and smaller, will be modeled and qualified as both axial and lateral restraints. The allowable loads for the U-bolts are based on compliance with ASME Section III, Subsection NF, paragraph NF-3330 (*Reference 7.7*). This is an adequate basis for addressing the concern and qualifying the support in accordance with CPSES licensing commitments.

CONCLUSIONS

SWEC has established an approach to address the issue that is acceptable. The issue is closed.

3.2.3.7 Friction Forces

ISSUE DESCRIPTION

The influence of friction was considered to be inadequately and inconsistently addressed in the support design calculations. For designs produced by certain design organizations, CASE contended that:

- the coefficient of friction was incorrect,

- friction had been neglected for pipe movement less than 1/16" without justification,
- the reduction in friction load based on support stiffness was incorrect, and
- friction should have been included for dynamic load cases but was not.

The friction forces issue is evaluated in Engineering Evaluation DAP-E-P-007 which provides a more detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

SWEC addressed the technical concerns as follows:

- The effect of friction at all sliding surfaces is considered in pipe support design regardless of the size of the pipe displacement.
- A coefficient of friction value of 0.3 is used for all steel to steel friction load assessments.
- The calculated friction force is not reduced based on support stiffness.
- Friction loads are included in all static and/or steady state load cases. Dynamic load conditions are not included in the friction load evaluation.

THIRD PARTY EVALUATION

The SWEC approach to friction forces eliminates the inconsistency concern. It also eliminates the concerns related to pipe movement and support stiffness affecting friction.

The use of a coefficient of friction of 0.3 is consistent with industry practice and is considered to be sufficiently representative of the condition that would exist at a contact point between the pipe and support. The coefficient of friction will vary between a dynamic value for sliding contact, which is significantly less than 0.3, and a static value corresponding to zero movement of the pipe relative to the support. It is not engineering practice to attempt to quantify the time varying friction force or to use upper bound values. The nuclear industry has adopted a practice of using a value of approximately 0.3.

The industry practices for addressing friction loads for dynamic conditions such as seismic response varies to some extent; however, the predominant practice is to neglect friction that might develop due to dynamic conditions. Under vibratory conditions, friction forces are lower than those encountered in simple sliding without vibration. The friction force that would occur would also typically be intermittent, because the surface contact is interrupted. These conditions are not analyzed. Instead an industry practice is to establish a design practice that recognizes that the forces are not likely to be significant in support design. This practice is considered adequate.

CONCLUSION

The SWEC approach to friction forces in support design calculations is acceptable. The friction forces issue is closed.

3.2.3.8 AWS Versus ASME

ISSUE DESCRIPTION

The issue arises from a CASE concern that the *ASME Boiler and Pressure Vessel Code* (ASME Code) does not adequately address aspects of weld design and welding procedures that are essential to ensuring the adequacy of welds. Further 10CFR50 Appendix A, General Design Criteria I, requires the establishment of appropriate standards, and, since the ASME Code is inadequate, *The American Welding Society Structural Welding Code*, AWS D1.1 (AWS Code), should be imposed. There are ten areas where the ASME Code was considered by CASE to be inadequate. These are listed as numbered by CASE (*Reference 7.21*):

1) Pre-heat requirements for welds on plates over 3/4 inch thick
2) Drag angle and work angles (which limit the space allowed for the welder to function)
3) Beta Factor for tube-to-tube welds
4) Multiplication factor and reduction factors for skewed "T" weld joints
5) Limitations on angularity for skewed "T" joints
6) Calculations for punching (actually a reduction factor for the weld) shear on step tube joints
7) Lap joint requirements
8) Design procedure for joint of tube to tube with Beta equal to 1.0
9) Calculation for effective throat of flare bevel welds
10) Limitations on weld sizes relative to plate thicknesses

Additionally, the appropriateness of the CPSES welding procedures for weave welding, downhill welding, preheat requirements, and cap welding were questioned.

The AWS versus ASME issue is evaluated in Engineering Evaluation DAP-E-P-008 which provides a more detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

Items (3), (4), (5), (6), (8), (9), and (10) as listed above, are welding design aspects. Items (4), (5), and (10) are discussed in Section 3.2.3.25 as part of the Skewed "T" Joint Weld issue and the "Undersized Fillet Welds" issue. Items (3), (6), and (8) are discussed in Section 3.2.3.20, as part of the Tube Steel and Wide Flange Web Stresses at Connections issue. The remaining areas of the AWS versus ASME (areas 1, 2, 7, and 9) are discussed further in this section.

THIRD PARTY EVALUATION

Of the ten numbered items discussed in this section, three relate to welding procedures, i.e. items (1), (2), and (7). Weave welding, downhill welding, preheat requirements, and cap welding are also related to welding procedures. The principal issue, as stated by the NRC staff and accepted by the ASLB, was "whether welding procedures qualified by test in accordance with the ASME Code are adequate in light of AWS requirements for prequalified welds". Using the NRC staff comparison of ASME and AWS and their review of TUGCO welding procedures, the ASLB was able to reach a conclusion. On June 29, 1984, ASLB ruled that, "Applicant's compliance with ASME Code has been adequate to assure the safety of its welding procedures with respect to welding parameters in this issue." The Third Party evaluation of the welding procedures portion of this issue is based on that decision.

NRC staff examination of this subject, and in particular the ASLB decision, leads to the conclusion that a Third Party review of TUGCO procedures is not required. Additionally, there is nothing to indicate that the weld procedure concerns would impact SWEC design practices.

Item number (9) was a design issue closed by the ASLB on December 28, 1983, and is therefore a closed issue. An aspect related to this issue is weld design associated with structural tube outside corner radius. This is discussed in Section 3.2.3.10, Section Properties.

CONCLUSION

There is no need to evaluate the adequacy of TUGCO welding procedures, because the NRC staff and ASLB have concluded they are acceptable with respect to this issue. The design related aspects are addressed in Sections 3.2.3.20 and 3.2.3.25. This issue is closed.

3.2.3.9 A500 Grade B Tube Steel

ISSUE DESCRIPTION

Pipe supports at CPSES, using A-500 Grade B tube steel, were designed based on 42 ksi yield stress. This was in accordance with ASME Supplement 9 of Code Case N71. Supplement 10 lowered the design yield stress to 36 ksi. It was contended that these supports should be redesigned using the allowable based on the lower yield stress in Supplement 10. There was also a concern that the ductility of A-500 Grade B steel was too low.

This issue is evaluated under Engineering DAP-E-P-009 which provides a detailed description of the issue.

SWEC RESOLUTION METHODOLOGY

The methodology used in requalification of pipe supports is as follows:

- Supports designed using A-500, Grade B tube steel will be qualified using an allowable yield stress of 36 ksi.
- Those supports not qualifying with a 36 ksi yield stress will be qualified using an allowable yield stress of 42 ksi and marked "Confirmation Required". The "Confirmation Required" will be removed upon issuance of a later supplement to Code Case N71, which is expected to return the allowable yield stress to 42 ksi.

THIRD PARTY EVALUATION

ASME considers A-500 Grade B tube steel to be an acceptable material for use in support design by virtue of its inclusion in Code Case N71. Since use of the material complies with the Code and the NRC has accepted this code case in Regulatory Guide 1.85, its use is in compliance with TUGCO licensing commitments and is therefore acceptable.

Regarding the concern over an acceptable yield stress for A500 Grade B tube steel, Supplements 9 and 10 of Code Case N71 have been adopted by the NRC under Regulatory Guide 1.85, Revisions 18 and 20, respectively. A response from the ASME regarding this issue confirmed that (1) the yield stress for A-500 Grade B tube steel was reduced to 36 ksi in Code Case N71-10 to address the slight reduction in yield strength which occurs in the heat affected zone of weldments, and (2) 36 ksi was a conservative lower bound value.

The initial SWEC approach, using a design allowable based on 36 ksi yield stress is consistent with the more conservative position taken by the ASME and is acceptable on that basis. The acceptance of 42 ksi by the ASME would be an acceptable basis for allowing the increase in yield stress. The ASME has full knowledge of the issue and their decision constitutes a reasoned industry consensus. If the ASME revises the yield stress to 42 ksi there will be a sufficient basis for removing the "Confirmation Required" status of the supports.

CONCLUSION

The SWEC approach of identifying and tracking those supports that were qualified using the higher allowable yield stress permitted by Code Case N71-9 ensures that appropriate values will be used in the final designs. This issue is closed.

3.2.3.10 Section Properties

ISSUE DESCRIPTION

Section properties of structural tubing are properties entirely dependent upon the geometric configuration and dimensions of the tubing cross section. An example is moment of inertia. Such properties are used in structural calculations of member stresses and stiffness. The values for commercially available structural tubing are tabulated in the *American Institute of Steel Construction* (AISC) Manual of Steel Construction and in various other industry publications; however, the properties differ from publication to publication. The differences can be shown to depend primarily on the corner radius used to calculate the values. Four concerns developed regarding this corner radius:

- CASE contended that steel milled prior to 1980 had a different corner radius than that milled after 1980, the date corresponding to the issuance of the 8th Edition of the AISC Manual.
- CASE contended that the AISC manual was the appropriate source for section properties, but that both the 7th and 8th Editions had to be used, depending on the date that the steel was fabricated.
- There was a concern that flare bevel welds for tube-to-tube connections could be adversely affected by the dimensional fit-up at the corner.
- There was also a concern that the effect of bolt holes on section properties had not been considered.

The section properties issue is evaluated in Engineering Evaluation DAP-E-P-010 which provides a more detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

The technical concerns relating to section properties are addressed as follows:

- SWEC performed an industry survey and determined that standard milling tolerances did not change during the CPSES procurement of structural tubing and the properties assumed are consistent with the 8th Edition of the manual. For the requalification of pipe supports, the section properties of structural tubing are taken from the 8th Edition of the AISC Manual.

- To address the concern related to flare bevel welds, SWEC performed tests to establish a basis for the effective weld throat calculation. A sample of installed supports was measured to determine corner radius. This was compared to the assumed AWS D1.1 configuration, i.e., a corner radius of twice the tube steel thickness. See FIGURE 3.2-3 for samples with the AWS configuration which would provide weld penetration. SWEC uses a throat equal to t minus 1/16 inch where t is the tube steel thickness in inches. For configurations that were more limiting with respect to weld penetration, specimens were welded and the effective throat measured. This resulted in a SWEC requirement to design welds on 2 x 2 x 1/4 and 2 x 2 x 3/16 inch tube steel using an effective throat equal to t minus 1/8 inch. These were the only tube steel sizes requiring a reduction of the effective throat, i.e., less than t minus 1/16 inch.
- SWEC addresses the effect of bolt holes on section properties in accordance with ASME Section III, Appendix XVII, which allows the designer to neglect the effect of a hole, provided the reduction in cross sectional area does not exceed 15 percent of the cross sectional area.

THIRD PARTY EVALUATION

The Third Party evaluation results are summarized as follows:

- The AISC Manual is an acceptable source for section properties. It is a recognized industry standard and is commonly used throughout the nuclear industry for this purpose. The 7th and 8th Editions have slightly different values for section properties. The 8th Edition states that the properties are exact or slightly conservative, and there is no evidence that standard milling practice changed in 1980, or at any other time during CPSES procurement. The AISC Manual chapter titled "Standard Mill Practice" did not change for structural tubing between the 7th and 8th edition, indicating that no milling practice change was noted by the AISC. The SWEC survey also supports this point.
- The 8th Edition properties are based on an assumed outside corner radius equal to twice the tube steel wall thickness. Based on the dimensions taken in the SWEC sample, that assumed radius is a reasonable basis for determining section properties. It had been contended by CASE that a radius of three times the tube steel wall thickness might be more appropriate. This contention was not substantiated by the physical measurements. The AISC Manual, the SWEC survey of milling practice, and the physical measurements taken for a sample of tube steel all support the conclusion that the 8th Edition is an adequate source of section properties for tube steel. In the absence of any data that supports a contrary position, the use of the 8th Edition is evaluated to be acceptable.
- The SWEC procedure generally applied for calculating weld throat, i.e., t minus 1/16 inch, is conservative with respect to the weld throat permitted by AWS D1.1, provided the AWS assumed geometry or a geometry allowing greater weld penetration is achieved. SWEC's method is conservative in such cases, because the throat is reduced 1/16 below the AWS value.
- In the process of sampling tube steel dimensions, a geometric configuration was identified by SWEC that has an effect on the capacity of a flare bevel weld for a matched tube steel connection. FIGURE 3.2-3 depicts the difference between the configuration typically assumed and the actual configuration. As a result of the difference, the opportunity to achieve weld penetration is lessened, which has an adverse effect on weld throat. For such cases the tests performed by SWEC to arrive at a calculation method, i.e., t - 1/8 inch, are an acceptable means for qualifying the welds.

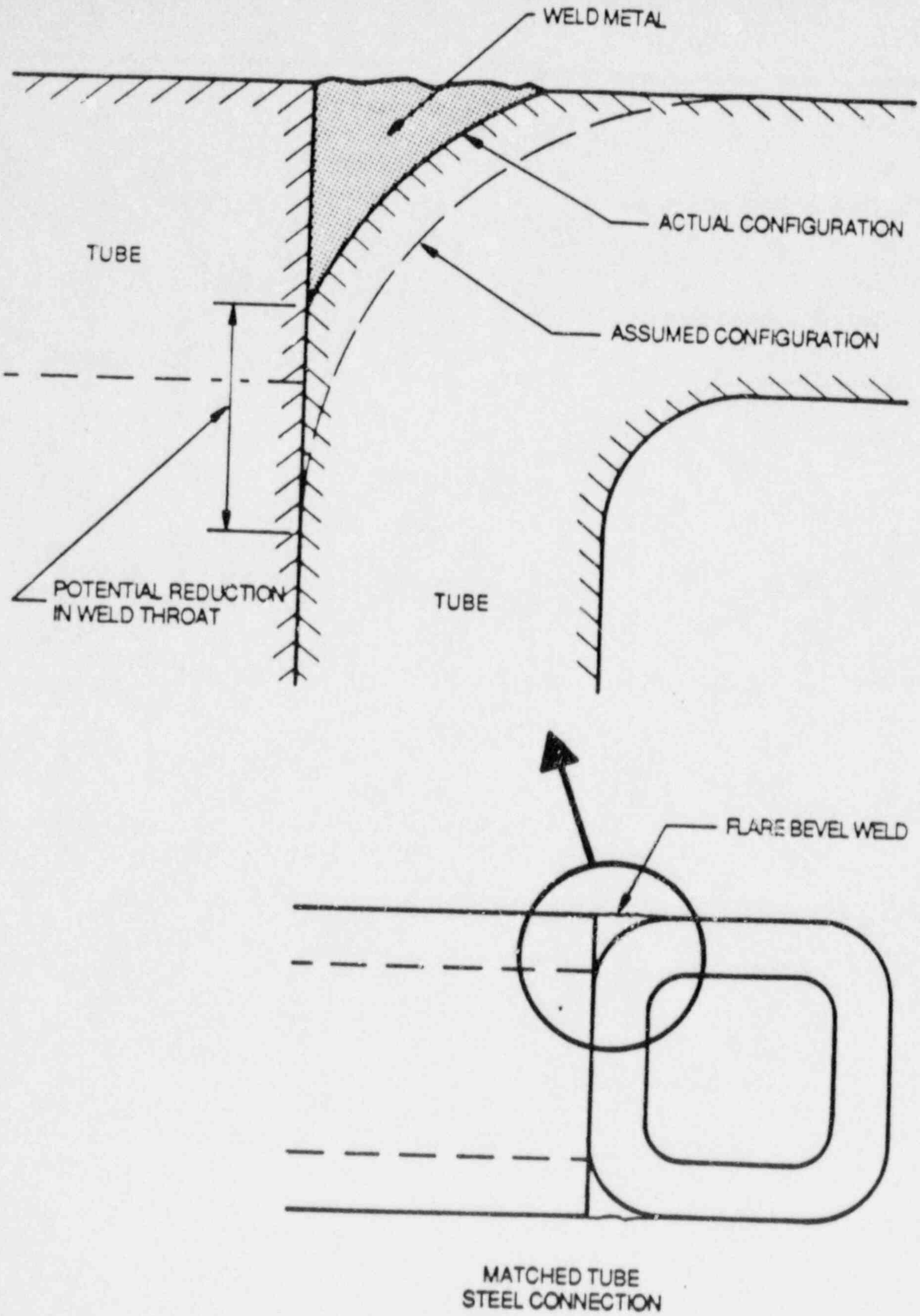


FIGURE 3.2-3

FLARE BEVEL WELD

- Compliance with ASME Section III, Appendix XVII as a means of considering the effect of bolt holes on section properties, is an acceptable basis for addressing the concern. For critical bending sections, the section properties are reduced if the area of the side of the member is reduced by 15%. This is an appropriately conservative interpretation of the ASME rule.

CONCLUSION

The approaches for addressing the three aspects of the section property issue are acceptable. The issue is closed.

3.2.3.11 Cinched U-Bolts

ISSUE DESCRIPTION

U-bolts were used instead of pipe clamps on some single strut or snubber pipe supports in the original design. Stability of these supports was questioned because of the possibility of the U-bolts rotating about the axis of the run pipe. As a response to the stability issue, cinching of the U-bolts (installation to a specific torque) was proposed as a design fix. However, the cinching of U-bolts resulted in additional technical concerns. These included:

- assurance of adequate preload through plant life,
- preload-torque relationship,
- adequacy of SA-36 material for the preload application,
- U-bolt stresses including effects of preload
- radial thermal expansion effects, and
- localized pipe stresses at stiff pipe clamps are also a concern, based on concerns similar to those raised for cinched bolts.

The cinched U-bolt issue is evaluated in Engineering Evaluation DAP-E-P-011 which contains a detailed discussion of the issue. The local pipe stress aspects are evaluated in Engineering Evaluation DAP-E-P-002.

SWEC RESOLUTION METHODOLOGY

SWEC is eliminating all cinched U-bolts at pipe supports.

THIRD PARTY EVALUATION

Eliminating cinched U-bolts eliminates the concerns. The function of the stiff clamp has been reviewed with respect to all concerns raised for cinched U-bolts, and it has been determined that the concerns are not valid based on the SWEC qualification procedures employed for stiff pipe clamps. Local stresses for stiff clamps are discussed in Section 3.2.3.2 and that aspect of stiff clamps is adequately addressed by SWEC.

CONCLUSIONS

SWEC has elected to eliminate the concerns regarding cinched U-bolts by eliminating them. Stiff pipe clamps are adequately addressed for local pipe stress. The issue is closed.

3.2.3.12 Axial/Rotational Restraints

ISSUE DESCRIPTION

Certain axial and/or trapeze type supports at CPSES use welded lug or trunnion attachments to transfer loads to frames or component hardware. The concerns regarding these specific types of supports are summarized as follows:

- Eccentric loading, which can result from effects such as differential snubber lock-up and support steel stiffness variations, must be considered in the design process.
- Snubber end clearance effects may cause significant increase in loads, or invalidate linear analysis results.
- Multiple lug configurations must consider a conservative loading distribution for lug and frame design.
- Insufficient clearances or eccentricities may exert rotational restraint on the pipe.
- Rotational restraint effect must be treated as a primary stress for the support design.

The axial/rotational restraint issue is evaluated in Engineering Evaluation DAP-E-P-012 which contains a detailed discussion of the issue. Related issues are discussed in the following Engineering Evaluations:

- Local Stress (Pipe) - DAP-E-P-002
- Generic Stiffness - DAP-E-P-005
- Gaps - DAP-E-P-013

SWEC RESOLUTION METHODOLOGY

SWEC addressed the above concerns by separately considering integral dual component support, non-integral dual component supports, and lug/frame.

Integrally attached supports (including those which are welded to pads which are welded to the pipe) were addressed by integrating the geometry of the trunnions into the piping model. Additionally the design loads, obtained directly from the analysis, were increased by 20% to account for differential snubber lock-up.

Non-integral dual strut/snubber axial supports (including frame/lug type) are modeled as single translational supports and each component is designed for 75% of the total load from the stress analysis. Four lugs are typically used for non-integral axial clamp supports. Each lug is qualified to 50% of the total load for dual component supports modeled as a single component.

Where significant variations in stiffness exist in the two sides of the support, the support component on the softer side will be physically removed and the eccentricity modeled into the piping analysis. For such eccentrically modeled supports, the load for each lug is based on statics with the assumption that all of the moment is reacted at the lugs, i.e., the clamp to pipe connection does not resist the moment.

Cinched U-Bolt trapeze supports are being eliminated.

Lugs for rigid frame type axial restraints are each qualified for the total load if only two lugs are used, or 50% of the total load if four lugs are present. The total load will be distributed to half the lugs which will produce the most critical stress in the frame.

Analysis of load distribution at lug/frame interfaces will be based on an assumption that will maximize critical stress in the frame.

Support stresses resulting from rotational restraints effects will be treated as primary stress for both integral and non-integral supports.

THIRD PARTY EVALUATION

The use of a 20% increase in load to account for differential snubber lockup on integrally attached supports is appropriate for matched snubbers.

SWEC is reviewing the vendor data to ensure that paired snubbers are matched. Where necessary, modifications will be made to achieve this. SWEC calculations to support the load distribution for dual strut/snubbers modeled as single axial restraint were reviewed, and it is concluded that the 75% load, which assumes an increase of 50% of the load for each half of the dual support, is adequately conservative.

For non-integral dual strut/snubber supports that are modified by removal of one snubber/strut, support eccentricities and configurations are modeled into the piping analysis, thereby adequately addressing the rotational restraint. Load distributions are sufficiently accurate and adequate.

Supports modeled as single/axial (e.g., frame/lug type and clamps with dual snubbers/struts) do not consider rotational restraint of the piping. SWEC has issued a procedure which evaluates pipe/support conditions during final reconciliation to determine if there are conditions which will produce unusually large pipe rotations. Evaluations of supports will be conducted if required to include the effects of pipe rotations.

The SWEC method for determining load distribution on multiple lugs is considered both reasonable and conservative based on the close lug/frame gap tolerances.

The SWEC approach to evaluating support/frame stresses based on a selected, critically applied load distribution is reasonable and acceptable based on simple statics.

The approach to evaluating constraint of free end displacement is consistent with the ASME Code.

End clearance effects are evaluated in the Engineering Evaluation of the Gaps issue (DAP-E-P-013).

CONCLUSION

The SWEC approach to resolving this issue is considered adequate based on the guidance provided in the SWEC procedures. The axial/rotational restraint issue is closed.

3.2.3.13 Gaps

ISSUE DESCRIPTION

The concern was raised that the piping analysis does not adequately account for the effect of gaps in the piping/support system. The specific gaps of concern are:

- excessive clearance between pipe and supports in the loaded directions,
- inadequate lateral clearance for U-bolts,
- excessive clearance between Hilti expansion anchors and the bolt holes in the base plate, and
- excessive clearance between Richmond Insert threaded rods and the tube steel bolt holes.

The first of these is discussed in this section based on Engineering Evaluation DAP-E-P-013. The general concern was the applicability of a linear elastic analysis to predict the piping system response given that the actual system contains gaps.

The adequacy of U-bolt lateral clearance is discussed in Section 3.2.3.6 based on Engineering Evaluation DAP-E-P-006. Bolt hole clearance for Hiltis is discussed in Section 3.2.3.26 based on Engineering Evaluation DAP-E-P-028. Richmond Insert bolt hole clearances are discussed in 3.2.3.1 based on Engineering Evaluation DAP-E-P-001.

SWEC RESOLUTION METHODOLOGY

The pipe/support gap clearances to be used by SWEC in designs are listed in Table 1A, Attachment 4-11 of CPPP-7.

THIRD PARTY EVALUATION

Table 1A, Attachment 4 of CPPP-7, Rev. 2, specifies clearances that allow a maximum 1/8 inch gap. This is consistent with standard industry practice. It is accepted throughout the industry that linear analysis, which does not model gaps, is an appropriate means of analyzing piping and this applies to piping systems that have 1/8 inch gaps. This is predicated on the assumption that the linear analysis is a sufficiently accurate means for calculating the response of piping and loads on supports. On the basis that SWEC is applying accepted industry practices, the practice is considered acceptable.

CONCLUSIONS

The SWEC approach to pipe/support clearances is acceptable. This issue is closed.

3.2.3.14 Seismic Design Load Specification

ISSUE DESCRIPTION

The seismic design load specification issue is comprised of several miscellaneous concerns regarding the adequate specification of conservative design criteria. The external source concerns are summarized as follows:

- Analysis procedures allowed a dynamic amplification factor of 1.0 for equivalent static analysis. No justification was provided, but justification is required by the CPSES FSAR.

- NRC Regulatory Guide 1.61 is not conservative.
- NRC Regulatory Guide 1.61 requires the use of the lower OBE dampening values for the SSE spectra for design of active components, e.g. active valves. External Sources interpret this to apply to analysis of piping systems, which are passive, if an active valve is part of the system.
- Analyses of stress problems with both large and small bore piping incorrectly employed the less conservative, higher dampened spectra for large bore piping.
- Spectra used did not envelope all the applicable spectra.
- Observation that emergency design loads sometimes exceed faulted loads led to a presumption that errors in the determination of the loads may have been made.

The seismic design load specification issue was evaluated in Engineering Evaluation DAP-E-P-014 which provides a detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

SWEC procedures require a dynamic amplification factor of 1.5 for equivalent static analysis, unless otherwise justified.

SWEC's approach to resolving damping concerns is to apply industry accepted standards which specify damping values for qualification of piping systems. This includes NRC Regulatory Guide 1.61 and the NRC-approved (*Reference 7.22*) usage of the more recent ASME Code Case N-411, which recognizes the variable damping relative to systems frequency. The concern regarding reduced damping for active components is not considered to be applicable to piping analysis. Such reductions are not consistent with industry practice for piping. SWEC procedures require that piping systems containing mixed pipe sizes above and below 12 inch nominal be evaluated with the lower damping values.

SWEC envelopes spectra or uses multiple response spectra input. The latter option is not used with N-411 spectra.

Implementation of SWEC corporate quality assurance procedures is intended to resolve concerns regarding random errors.

THIRD PARTY EVALUATION

The concerns raised are of three types:

1) equivalent static analysis criteria,
2) damping criteria, and
3) implementation of various criteria.

The use of a 1.5 factor for equivalent static analysis is the approach accepted by the NRC and used throughout the industry as a conservative calculation. It is an acceptable practice.

The SWEC approach to addressing the spectra damping is considered acceptable. NRC Regulatory Guide 1.61 has long been the industry accepted basis for licensing of nuclear power plants. The results of more recent industry studies are reflected in Code Case N-411 which has been approved for use by the NRC on other nuclear plants and specifically for CPSES *(Reference 7.22).*

Certain requirements were established as NRC conditions for the use of N-411 at CPSES. These were primarily documentation requirements. For example, all pipe stress packages that use Code Case N-411 are to be identified in the FSAR. Compliance with such requirements does not directly relate to the assessment of technical methodology. Other requirements were associated with walkdown programs that follow the completion of analysis. It has been determined that the requirements can be satisfied by SWEC walkdown programs and the stability evaluations included in CPPP-6 and CPPP-9; however, the adequacy of the technical approach to damping is not dependent on completion of such programs. Therefore, the walkdown procedure has not been evaluated as part of this issue. One requirement is that N-411 damping is not to be used for time history analysis. SWEC complies with this.

SWEC's position regarding reduced damping for active components is acceptable and consistent with industry practice.

The other resolutions addressing random errors of incorrectly damped spectra selection and the specific procedure errors are considered to be adequately addressed by SWEC corporate and/or project procedures.

CONCLUSION

SWEC has provided an acceptable approach to address seismic design load specification consistent with that utilized by the industry. The seismic design load specification issue is closed.

3.2.3.15 Support Mass Effects On Piping

ISSUE DESCRIPTION

It was alleged that Gibbs and Hill procedures did not specify how or when support mass should have been included in the CPSES piping analysis. The result was inconsistent and potentially inadequate accounting of support mass effects in the prediction of piping dynamic response and stress. Specific concerns were the related effects of eccentric support mass on piping response for evaluating dynamic loads, including fluid transient induced loads. The support mass issue is evaluated in Engineering Evaluation DAP-E-P-015 which provides a more detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

SWEC will consider support mass in the analysis of all CPSES piping systems. Project procedures have been issued which address common support configurations for standard component type supports, detailing the component mass or portions of mass which are to be modeled concentrically or eccentrically in the piping model. In addition to the guidelines for modeling support mass effects in the piping model, methods for evaluating changes in support mass effect on piping response, due to design or installation deviations, have been described.

THIRD PARTY EVALUATION

The methods described in the SWEC procedures address the majority of support hardware in sufficient detail. Other component support hardware can be addressed by extrapolating from the data in the procedures.. The SWEC procedures do not address certain other types of supports, e.g., structural frames or cantilever supports. The significance of the effect of the mass of these types of supports is dependent on both the mass and stiffness of the support. This aspect has been assessed by reviewing a selection of specific designs and it was determined that the practice of modeling stiffness and evaluating self weight excitation provide an adequate means of considering the mass effect for the type of designs encountered.

As part of the assessment of this issue a review was conducted of an aspect of support mass modeling which extended beyond the level of detail provided in procedures. For certain trapeze design modifications in limited use, it is possible for the support mass to act only in two of the three directions. The NUPIPE-SW Program has the capability to model directional mass. The caution provided by SWEC procedures are adequate for evaluating "special situations." The Third Party considers these adequate for closure of this issue.

CONCLUSION

SWEC has provided guidelines for considering support mass, including eccentric support mass effects, in the piping model which are adequate. The issue of support mass effects on piping analysis is closed.

3.2.3.16 Mass Point Spacing

ISSUE DESCRIPTION

Gibbs & Hill procedures for CPSES established requirements for minimum spacing of mass points in the piping model, to predict an accurate response to dynamic loadings. The piping analysis reviewed by Cygna did not comply with the established requirements. In addition, the computer program used (ADLPIPE Version C) improperly lumped concentrated masses. The primary issue is adherence to established requirements for mass point spacing. The mass point spacing issue was evaluated in Engineering Evaluation DAP-E-P-017 which contains a detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

SWEC modeling guidelines specify where lumped mass points are to be located in the piping analysis. To assure adherence to these requirements, SWEC has included mass point spacing as a review item in the analysis checklists.

THIRD PARTY EVALUATION

The review of the SWEC requirements indicates that the lumped mass points will be sufficiently accurate to capture dynamic characteristics. The evaluation of SWEC formulations is contained in DAP calculation number DAP-C-P-003. The inclusion of mass point spacing as a specific checklist item provides adequate assurance that the established guidelines are verified both for manually derived and automatically generated mass point spacing.

CONCLUSIONS

The SWEC procedures provide adequate guidelines for locating lumped mass points in a piping model. The mass point spacing issue is closed.

3.2.3.17 High Frequency Mass Participation

ISSUE DESCRIPTION

The pipe stress analyses conducted by Gibbs & Hill did not comply with CPSES FSAR requirements in that there was no assurance provided that the potential inclusion of higher frequency modes in response spectrum analyses would not increase system response by more than 10% of that predicted up to the cutoff frequency. This high frequency mass participation issue was evaluated in Engineering Evaluation DAP-E-P-018 which provides a detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

SWEC has addressed this issue by requiring one of the following:

- Perform amplified response spectrum (ARS) modal analysis up to a 50 Hz cutoff frequency using NUPIPE-SW V04/L02 with the high frequency missing mass correction option chosen.
- Perform a NUPIPE ARS analysis with a 50 Hz cutoff frequency without the missing mass correction option chosen. Combine these results with the results from an equivalent static analysis for the zero period acceleration (ZPA). The combination is by SRSS in each of three orthogonal directions.

The above criteria are specified in the current project procedures. In addition, high frequency mass correction is specifically included in SWEC's pipe stress analysis checklist as a review item.

THIRD PARTY EVALUATION

The two methods permitted in SWEC procedures addressing the concern for response of higher frequency modes were reviewed. The NUPIPE missing mass correction is an approach based on technical methods described in published papers that have been subjected to peer review. The methods are in common use and have achieved acceptance by both the NRC and the industry. This is the basis for accepting this method for CPSES.

The second method was in common use prior to the availability of missing mass correction methods. It is a conservative means of bounding the response.

CONCLUSION

SWEC has established an approach to resolution of the high frequency mass participation issue that is acceptable. The high frequency mass participation issue is closed.

3.2.3.18 Fluid Transients

ISSUE DESCRIPTION

Several indirectly related concerns were raised relative to design of piping systems for fluid transients.

Two of the concerns are related to assumptions regarding Main Steam *Safety/Relief Valve* (S/RV) discharge loads. These are:

- flow distribution in Crosby dual-port S/RVs for the purpose of developing moment loads and stresses on the Main Steam line, and
- conservatism of assumptions regarding multiple S/RV actuation sequence used to evaluate the maximum instantaneous stress in the Main Steam piping system.

The remaining concerns are related to analysis/design requirements and acceptance criteria specifically addressing the unique characteristics of fluid transient loads. These are:

- rigid frame gaps in unrestrained directions for fluid transients,
- criteria or requirements to validate time step selection for time history analysis, and
- consideration of steady state versus dynamic fluid transient loads in piping systems supported by snubbers.

The fluid transients issue was evaluated in Engineering Evaluation DAP-E-P-019 which provides a detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

SWEC's approach to addressing the fluid transient issue is to develop conservative design inputs and loading criteria.

Concerns regarding Main Steam S/RV loading have been verified with the vendor, and work is underway to develop conservative piping response to single and multiple S/RV actuation.

The specific concerns regarding analysis/ design requirements and acceptance criteria are addressed in project procedures as follows:

- Clearance requirements are addressed by requiring the transmittal of piping displacements for all pipe loadings, combined in accordance with the loading combinations, to the pipe support design group for acceptance.
- Guidelines are provided for determining time steps and cutoff frequencies in a time history analysis and reviewing results for reasonableness.
- General guidelines are provided for consideration of the type of loading (static or dynamic) for modeling snubbers in the piping analysis.

THIRD PARTY EVALUATION

The SWEC approach to resolving the concerns is sufficiently detailed to provide assurance that specific concerns will be adequately addressed. The more general concern, regarding the adequacy of overall design criteria and procedures to address the consideration of fluid transients, is partially addressed by the procedures. Review of the issues and SWEC procedures indicates that the attention to fluid transient related design requirements is adequately consistent with general practice. However, because it is not general practice to proceduralize most aspects of fluid transients design and analysis activities, implementation review was required to confirm the adequate consideration of all related design criteria.

The Third Party's review of fluid transients implementation was conducted through two tasks which paralleled the SWEC activities: first, the identification of significant events, and; second, the quantification of fluid transient loads from these events. The Chemical and Volume Control System (CVCS) and the Main Steam System were selected as subjects for this review.

Task 1: The first task was a review of the identification of (screening for) significant fluid transient events. The System Information Documents, the supporting calculations and assumptions, and the implementing (fluid transient) analyses were reviewed against a data base of CPRT systems, alignments, and events, independently prepared expressly for the Third Party review. Bases used for the determination of significance as well as system and scope boundaries were also specifically reviewed.

The review indicated an adequate implementation of the SWEC procedures and commitments consistent with industry practice. The SWEC screening process appropriately resulted in the specific design attention to more events than originally addressed. The review also indicated adequate attention to the major aspects of plant design and operations which can result in fluid transients and knowledge of general nuclear plant experience with transients.

Adequacy of the SWEC screening process is dependent on verifying that bounding fluid transient loads are properly evaluated to determine significance on piping and support code compliance. SWEC has issued a calculation and an implementation procedure for evaluating pipe stress. The procedure additionally requires supports to be evaluated in all cases to assure that fluid transient loads, which are screened out based on pipe stress, can be accommodated.

Assurance is also dependent upon verification that some additional events consistent with the FSAR design basis have been reviewed for significance. Specific concerns raised by the Third Party are being addressed by SWEC procedures. The procedures require the following:

- The non-safety piping and supports for the Main Steam line from the moment restraint to the turbine and condenser are to be reviewed to determine if the new turbine trip loads calculated by SWEC are within ANSI B31.1 allowables.
- Recent modifications performed on the Feedwater and Auxiliary Feedwater systems and the effects of these revisions on the piping and supports are to be reviewed for design adequacy.
- The Safety Injection system will be reviewed for potential two phase water hammer loads due to valve leakage. System operating procedure or design analysis remedies will be implemented if necessary. Other Class 2/3 systems will also be reviewed for potential valve leakage fluid transients.
- The piping integrity will be reviewed for the isolation of pipe rupture events occurring in Main Steam and CVCS piping adjacent to SWEC piping scope. The licensing base for CPSES will be reviewed to determine if these events need to be addressed in piping and support design.

The Third Party concludes that these procedures provide sufficient assurance that the fluid transients events identification process is adequate.

Task 2: The second task of the Third Party review of fluid transients implementation verified the adequacy of the development of loadings to be used in pipe stress analysis. Review of the CVCS system analyses, MS turbine trip analysis, and FW break isolation analysis verified a generally adequate and conservative approach to the estimation of fluid transient loadings.

The review verified that the various methods used by SWEC, including computer analyses with Method of Characteristics programs (WATHAM and STEHAM), RELAP, and hand calculations, were suitably selected and applied for the specific events being analyzed. The results for these analyses were verified in magnitude as well as transient behavior to be reasonable by independent calculations. Inputs for the analyses, including equipment data, were verified as to source, consistency, and reasonableness of values. Modeling decisions, including time steps, nodalization, equipment modeling, and duration of analysis were verified as reasonable and generally conservative through a detailed review of implementing calculations.

Modeling assumptions, including the selection of boundary conditions and initial conditions were verified as consistent with system operation by independent review and comparison with system descriptions, range of operating modes, and equipment alignments. During the review it was verified that essential equipment and alignments which dominate the validity of the analytical results were adequately considered.

The analytical models were also reviewed to assure the insensitivity to nodalization and other governing parameters. Sensitivity analyses were specifically done for the FW break isolation analysis model as appropriate for the RELAP program used in that analysis. Sensitivity analyses performed on the Main Steam turbine trip analysis model were also reviewed although turbine trip results are not unduly sensitive. Time steps were verified to be selected small enough so that results are adequate for the the majority of the transients analyzed. Also, a sensitivity analysis representative of SWEC analyses was performed and verified the reasonable insensitivity of the remaining analyses.

Assurance as to the adequacy of the SWEC fluid transients analyses is dependant upon verification that flashing during the majority of depressurization transients analyzed does not increase the calculated loads or impair valve performance. Specific verification that the potential for vapor pocket collapse overpressures and loads are not significant or are bounded by existing load cases will be provided by the implementation of specific project procedures issued to address this concern. SWEC will calculate loads for relevant systems and events (using a method that explicitly addresses vapor pocket formation and collapse) and will include these loads in piping analysis.

Additionally, specific substantiation that the RV's can pass two phase flow (caused by depressurization) and maintain their certified flow consistent with ASME overpressurization requirements will be provided by a review of these valves and systems as guided by SWEC procedures.

Related discussions are contained in the following Engineering Evaluations:

- Mass Point Spacing DAP-E-P-017
- Support Mass Effects on Piping Analysis DAP-E-P-015
- High Frequency Mass Participation DAP-E-P-018
- Valve and Flange Qualification DAP-E-P-025
- Generic Stiffness DAP-E-P-005

CONCLUSION

SWEC's attention to requirements specifically related to fluid transients and the additional review as discussed above are sufficient to provide assurance that all related design/analysis considerations will be addressed. The fluid transients issue is closed.

3.2.3.19 Self-Weight Excitation

ISSUE DESCRIPTION

The qualification of large bore pipe supports did not generally include the pipe support dead weight or loads due to self-weight seismic excitation in the support calculations. Also, adequate justification was not provided for neglecting these loads.

Support self-weight excitation was evaluated in Engineering Evaluation DAP-E-P-019 which contains a more detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

SWEC addressed this issue by the following methodology:

- **Dead Weight Loads** - SWEC has committed to evaluate all large bore pipe supports for dead weight loads. Under this approach, the component dead weight is considered in either the structural (support) analysis or the piping stress analysis.
- **Self-Weight Excitation Loads** - SWEC procedures require that all self-weight excitation loads be included in the support evaluation for all frame supports. The procedures do not require a calculation of these loads for elements of supports attached directly to the building structure, i.e., supports without structural frames. These loads are considered to be insignificant.

THIRD PARTY EVALUATION

The Third Party evaluation is summarized as follows:

- **Dead Weight Loads** - The dead weight load of any component support hardware is included in the piping analysis model or directly in the support design calculations. The dead weight load is not double counted. This adequately addresses this aspect of this issue.
- **Self-Weight Excitation Loads** - The SWEC procedures provide four methods for analyzing supports for seismic loads. Support mass that is not modeled with the piping is modeled with the support. Three of the methods statically analyze the supports using acceleration values derived by SWEC from the CPSES response spectra. A separate Third Party evaluation performed to review this derivation determined that the method and acceleration values are acceptable. The fourth method is a dynamic analysis which normally would not be necessary to calculate self-weight excitation loads because the simpler and more conservative static analysis typically produces loads which are conservative. Dynamic analysis would be used to reduce the loads if necessary. Such dynamic analysis is an appropriate analytical tool; however, it has not been used to date.

The SWEC approach of not requiring a calculation of seismic self-weight excitation for component support hardware attached directly to the building structure is acceptable, because the component part (e.g., snubber rear bracket) which is attached is so rigid that it follows the building motion without amplification and does not produce significant additional load to the support itself. This is considered a valid approach and one which is typical of industry practice.

CONCLUSION

The SWEC procedures establish an acceptable methodology for addressing support dead weight loads and loads due to the self-weight excitation of the support. This issue is closed.

3.2.3.20 Local Stresses In Pipe Support Members

ISSUE DESCRIPTION

Certain types of pipe supports or details of pipe supports have been identified where local stresses may be the limiting design factor, but they were not evaluated during the design process. These include:

- local stresses in cinched U-bolts,
- local stresses in piping anchors,
- local stresses in zero gap box frames,
- tube steel and wide flange web stresses at connections, and
- short beam stresses.

Local stress in pipe support members was evaluated in Engineering Evaluation DAP-E-P-021 which provides a more detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

Local stresses in piping anchors are discussed in Section 3.2.3.2. The resolution methodology for the remaining concerns is as follows:

- **Local Stresses in Cinched U-bolts** - TUGCO has eliminated the use of cinched U-bolts.
- **Local Stresses in Zero Gap Box Frames** - SWEC has committed to eliminate all zero gap box frames.
- **Tube Steel and Wide Flange Stresses at Connections** - SWEC procedures specify that local stresses in tube steel connections and welded bracket connections be designed in accordance with the requirements of AWS D1.1, U-bolt nuts bearing on tube steel walls are qualified through a separate SWEC analysis and attachments to open shapes (e.g., wide flanges) are designed using AISC Specification guidelines.
- **Short Beam Stresses** - Local stresses in short members are evaluated using a qualitative approach which depends on an engineer to correctly judge load transfer behavior of the beam.

THIRD PARTY EVALUATION

The Third Party evaluation is summarized as follows:

- **Local Stresses in Cinched U-bolts** - Elimination of all cinched U-bolts resolves the concern.
- **Local Stresses in Zero Gap Box Frames** - Elimination of all zero gap box frames from the CPSES designs resolves this concern.
- **Tube Steel and Wide Flange Stresses at Connections** - Review of the design procedures, and calculations used in the engineering development of the procedures,

verify that SWEC methodology for the design of tubular connections, including consideration of beta factors and punching shear, and for the design of welded attachments to tube steel is consistent with the requirements of AWS D1.1.

The SWEC analysis performed to develop the methodology for qualification of nuts bearing on tube steel walls was reviewed and determined to be acceptable when appropriate washer plates are used between the nut and the tube steel.

The SWEC procedures provide adequate directions for evaluating the local stresses in open shapes due to welded attachments. The procedures are in accordance with the guidelines presented in the AISC specification.

- **Short Beam Stresses** - The SWEC procedures provide an acceptable qualitative approach to evaluating the local stresses in short beams.

CONCLUSION

The approach used by SWEC for the evaluation of local stresses in pipe supports is acceptable. This issue is closed.

3.2.3.21 Safety Factors

ISSUE DESCRIPTION

The concern relates to possible reduction of built-in safety factors resulting from failure to comply with various applicable regulatory, licensing and code requirements. This diminution results from improper compliance or lack of compliance with various design criteria requirements and practices. The safety factor issue is a concern for failure generally to comply with the requirements, not to any specific, individual issue compliance.

Safety factors are evaluated under Engineering Evaluation DAP-E-P-022 which provides a more detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

The resolution methodology implemented by SWEC is that all generic issues must be resolved before CPSES can invoke the inherent design margins (safety factors) accumulated from the built-in conservatisms in codes, input, and regulatory positions that typically provide sufficient margin so that minor variations or small loads that might potentially occur during normal operation can be neglected. All generic issues have been evaluated and included into CPPP-7 design criteria. With all generic issues appropriately addressed, there is sufficient margin to allow for small potential loads that occur during normal operation.

THIRD PARTY EVALUATION

The safety factor adequacy of codes and regulatory positions per se is not at issue, and in fact is not specified within such documents. Generally, such positions reflect consensus acceptance by a group of experts in the field. Compliance with applicable FSAR, AISC Manual, ASME Code, and Regulatory Guides and Bulletins requirements is sufficient to demonstrate existence of appropriate safety margins. Only in cases where deviation from such requirements occur, or where such requirements fail to provide adequate guidance, should questions regarding safety be a concern. The SWEC CPSES piping and pipe support requalification effort, as defined in CPPP-6 and CPPP-7, is consistent with standard design methods for nuclear generating facilities. These methods include compliance with applicable codes, standards, and regulatory requirements and are supplemented, where necessary, by good engineering practices. SWEC identified the technical issues involved, established the method of resolution, and implemented the resolution by way of CPPP-7 design procedures.

The general safety factor concern is resolved by satisfactory resolution of all individual issues.

CONCLUSION

Based on the fact that individual issues have been satisfactorily resolved, the general issue of safety factors is also resolved. The issue is closed.

3.2.3.22 SA-36 And SA-307 Steels

ISSUE DESCRIPTION

Specific aspects of this issue relating to the use of SA-36 and SA-307 steels in the design of supports are as follows:

- **SA-36 Steel Used In Dynamic Applications** - The use of SA-307 bolting material is not recommended, by code, for use in dynamic applications. CASE contended that since SA-36 material is similar to SA-307, the same cautionary consideration should apply.
- **SA-307 Material Used In Dynamically-Loaded Friction Connections** - SA-307 material has been used in dynamically-loaded friction connections. This is prohibited by the code.
- **Regulatory Guide 1.124 Limitations** - Bolting material has been designed using allowable stresses which exceed the material yield strength under Level D Service Limits. This does not meet the requirements of NRC Regulatory Guide 1.124, which limits load increases to 1.5 times Level A Service limits because of the potential for non-ductile behavior.
- **Use of Low Strength Nuts with High Strength Bolting** - Low strength nuts, A-563 Grade A (companion nuts to SA-307 bolting) were used with high strength (A-193 Grade B7) bolting.

A detailed discussion of this issue is provided in Engineering Evaluation DAP-E-P-023.

SWEC RESOLUTION METHODOLOGY

The SWEC approach to resolve each of the concerns identified above is as follows:

- **SA-36 Used In Dynamic Applications** - SWEC procedures permit the use of SA-36 material in bolted type connections subject to dynamic loads.
- **SA-307 Material Used In Dynamically-Loaded Friction Connections** - SWEC procedures preclude the use of SA-307 material for U-bolt and rod type applications type connections subject to dynamic loading.
- **Regulatory Guide 1.124 Limitations** - SWEC procedures make no direct reference to the Regulatory Guide 1.124 requirement that allowables be limited to 1.5 times Service Level A limits. SWEC has adopted ASME Code paragraph NF-3225.2, Winter 1982 addenda which limits the stresses to yield.

- **Use of Low Strength Nuts With High Strength Bolting** - SWEC procedures require that, for high strength bolting connections using low strength nuts, the tensile allowables of the connection be reduced by 40 percent.

THIRD PARTY EVALUATION

The Third Party evaluation results are summarized as follows:

- **SA-36 Used In Dynamic Applications** - Although SA-36 and SA-307 material are similar, it must be recognized that neither the ASME nor the AISC codes specifically prohibit the use of SA-36 material under dynamic loading. However, since specific loads identified in the SWEC procedures are dynamic, a separate Third Party evaluation was performed to consider high cycle fatigue as required by ASME Section III. This evaluation confirmed that the lower threshold limit of 20,000 cycles, below which fatigue is not a concern, will not be reached.
- **SA-307 Material Used In Dynamically-Loaded Friction Connections** - To implement the resolution, SWEC has undertaken a program to review all applicable Certified Materials Test Reports, Load Capacity Data Sheets, and Certified Design Reports to ensure that SA-307 material is not used. The procedures also require that any SA-307 threaded rod identified on the pipe support drawing be replaced.
- **Regulatory Guide 1.124 Limitations** - The requirements of Regulatory Guide 1.124 apply specifically to ASME Class 1 bolting. However, the intent of the Regulatory Guide has been met through the adoption of a later code paragraph which limits bolt stresses to the material yield strength at temperature under all service loads.
- **Use of Low Strength Nuts With High Strength Bolting** - A separate Third Party evaluation was performed verifying that the reduced allowables for connections using low strength nuts with high strength bolts is acceptable.

CONCLUSION

The approach adopted by SWEC adequately addresses the issues. The issue is closed.

3.2.3.23 Valve And Flange Qualifications And Valve Modeling

ISSUE DESCRIPTION

The issue of qualification of valves and flanges and the correct modeling of valves in the piping analysis raised three areas of concern:

1) The main steam relief valve operator supports (snubbers) are not qualified for as-built loads, and the adequacy of the valve has not been demonstrated for as-built loads through the operator supports.
2) Valves with fundamental frequencies less than 33 Hz which have operator seismic restraints should have accurate modeling of the yoke stiffness to ensure that the valve response is correctly predicted.
3) The validity of a sampling process to assure the acceptability of valve accelerations and flange loads has not been demonstrated.

The valve and flange qualifications and valve modeling issue is evaluated in Engineering Evaluation DAP-E-P-025 which provides a more detailed discussion of the issue. A related issue is the damping used for seismic analysis of piping systems containing active valves. This issue is discussed in Engineering Evaluation DAP-E-P-014, Seismic Design Load.

SWEC RESOLUTION METHODOLOGY

SWEC procedures require as-built data (e.g., support locations) to be incorporated into requalification analysis. All valves are checked by SWEC against acceleration limits as provided by TUGCO. Then all valve accelerations, valve end loads, and valve operator support requirements are transmitted to TUGCO for ultimate acceptance and confirmation.

Valves with fundamental frequencies less than 33 Hz are modeled using a cantilever-based equation to determine an equivalent moment of inertia based on the valve's fundamental frequency. Valve operator supports are treated the same as any pipe support using methods that include support directions, function, stiffness, and mass.

The SWEC procedures require all valves be qualified for applicable acceleration and end load limits. All bolted flange joints are required to be qualified for moment loadings, which includes ASME qualification of the bolts.

THIRD PARTY EVALUATION

The SWEC procedures provide methods and requirements for modeling and qualification of valves, flanges, and associated supports. No specific reference is made to valves with supported motor operators; however, this case is addressed by the general criteria in the procedures. Because SWEC's scope of review requires qualification of all valves and flanges, the issue of use of a sampling process is no longer a concern.

CONCLUSIONS

The SWEC approach to the qualification of valves and flanges is acceptable. Procedural valve and support modeling techniques provide adequate methods of addressing the issue. Therefore, this issue is closed.

3.2.3.24 Piping Model

ISSUE DESCRIPTION

This issue comprises several concerns relating to the accuracy and input of piping analysis models. These concerns are:

- support location tolerances,
- correct identification and input of *Stress Intensification Factors* (SIFs),
- inclusion of valve and flange insulation/fluid mass, and
- location of snubbers adjacent to rigid attachment points.

The piping model issue was evaluated in Engineering Evaluation DAP-E-P-026 which contains a detailed discussion of this issue.

SWEC RESOLUTION METHODOLOGY

SWEC addressed each of these concerns in the project procedures:

- As-built information is to be the basis for all CPSES piping analysis, with differences to be reconciled within the calculations.
- Piping SIFs for the most common components and transitions are specifically identified in the project procedures. The specification of SIFs is noted to be of special concern and is included as an analysis checklist item.
- Procedures contain a general requirement to include mass effects of piping contents and insulation in the analysis model.
- Procedures recommend removal of snubbers near equipment connections. Also included are requirements to evaluate snubber activation for those in close proximity to anchors and equipment connections.

THIRD PARTY EVALUATION

SWEC's method for identifying and documenting reconciliation of deviations in support locations is acceptable and verifiable.

Identification of concern regarding SIFs in general, inclusion of SIFs as an analysis checklist item and specific identification of SIFs for the more common piping components are sufficient to address this concern.

SWEC's general requirement to include mass of contents and insulation is sufficient to address this concern.

SWEC procedures adequately address the concern regarding snubber activation near rigid pipe connections.

CONCLUSION

SWEC procedures are sufficiently detailed to ensure that these piping design/inputs will be evaluated. The piping model issue is closed.

3.2.3.25 Welding

ISSUE DESCRIPTION

Concerns have been raised regarding the adequacy of a) engineering methods which were used for sizing of welds and/or checking of weld stresses, b) violation of applicable code requirements, and c) fabrication practices. Specific aspects of these concerns are as follows:

- **Unsymmetrical Welds** - For three-sided welds, the eccentricity between the center of gravity of the member and the weld was not considered in the weld design, although it could increase weld stresses with a consequent effect on the weld size.
- **Cover Plate Welds** - The weld design methods were inadequate for evaluating shear stresses of welds attaching cover plates to primary members to form composite sections. A related concern involves the failure to consider local loading effects of component rear bracket attachments.
- **Undersized Fillet Welds** - Some welds did not meet the minimum size requirements specified in the Code of Record.

- **Combination Bolted and Welded Connections** - Connections which combine structural bolting and welds did not meet the Code criteria requiring welds to be designed to carry the entire shear force.
- **Skewed "T" Joint Welds** - The design of skewed "T" joints in accordance with the ASME Code did not adequately consider reduction factors for determining the effective throat and angularity limits as prescribed by *American Welding Society* (AWS) Code D1.1.
- **Fabrication Practices** - Concerns were raised relating to inadequate welding practices, including weave welding, downhill welding, preheat requirements, lap joint requirements, cap welding, and weld cracking.

This issue is discussed in detail in Engineering Evaluation DAP-E-P-027.

SWEC RESOLUTION METHODOLOGY

The SWEC resolution methodology for each of the design issues is as follows:

- **Unsymmetrical Welds** - SWEC procedures require that any eccentricity between the center of gravity of a member and the associated weld be evaluated when determining the total weld loading. Alternatively, for symmetric weld patterns with different weld sizes, eccentricity need not be considered if the weld evaluation uses the smallest effective throat.
- **Cover Plate Welds** - SWEC procedures require that cover plate welds be qualified for shear flow.
- **Undersized Fillet Welds** - SWEC has adopted ASME code Case N-413 which excludes the minimum fillet or partial penetration weld size requirements.
- **Combination Bolt and Weld Connections** - SWEC procedures require that, on base plates using bolt and weld combinations, the weld be designed to carry the entire shear load on the face of the plate.
- **Skewed "T" Joint Welds** - SWEC procedures identify specific requirements for the design of skewed "T" joints.
- **Fabrication Practices** - Concerns regarding the fabrication practices have not been addressed by SWEC in design procedures. These concerns are discussed under the "AWS vs. ASME Issue Summary."

THIRD PARTY EVALUATION

The Third Party evaluation results are summarized as follows:

- **Unsymmetrical Welds** - SWEC procedures for evaluating unsymmetrical welds are acceptable because proper weld stresses will be calculated when the eccentricity is considered, and conservative results will be obtained when using the smallest effective weld throat for patterns made up of different weld sizes.
- **Cover Plate Welds** - SWEC procedures identify specific instructions for calculating maximum weld stress. Although the procedures require that cover plate attachment welds be qualified for shear flow, no specific guidelines or instructions are provided for performing this evaluation. Normally, pipe support design practices do not involve the

use of composite members; therefore, the absence of specific guidelines is not considered significant.

- **Undersized Fillet Welds** - Code Case N-413 (which has been incorporated into later Code revisions) recognizes the differences in ASME and AISC weld joint qualification. The ASME requirement to qualify all construction joints obviates the need for specifying minimum weld sizes in the Code. This Code Case has been endorsed by the NRC in Regulatory Guide 1.84, Revision 24. (Reference 7.28).
- **Combination Bolt and Weld Connections** - The SWEC requirements for evaluating combination bolted and welded connections are consistent with ASME Section III, Appendix XVII, Paragraph XVII-2442 (*Reference 7.7*) and are acceptable.
- **Skewed "T" Joint Welds** - SWEC procedures adequately address the design of skewed "T" joints, including specific requirements for determining effective throats of welds and applying reduction factors to welds based on the angularity between members. These requirements are consistent with AWS D1.1.

CONCLUSION

Where necessary SWEC has established specific requirements which adequately address the welding design issues. This issue is closed.

3.2.3.26 Anchor Bolts

ISSUE DESCRIPTION

Concerns identified regarding the design of anchor bolts at CPSES are the following:

- **Friction vs. Bearing Connections** - Whether base plates fastened with Hilti expansion anchors should be designed as friction or bearing connections. If the connections are bearing connections, there is a question regarding unequal shear load distribution on the anchors and the effect on support stiffness caused by oversized bolt holes (See FIGURE 3.2-4).
- **Anchor Bolt Location Tolerances** - Construction tolerances for anchor bolts or attachment steel installation were not considered in the original design. Neglecting these tolerances may result in unconservatively predicted stresses.
- **Anchorage Embedment** - The embedment lengths on some support sketches do not match those used in the respective calculations.

This issue is discussed in detail in Engineering Evaluation DAP-E-P-028.

SWEC RESOLUTION METHODOLOGY

The SWEC methodology for addressing the items above is as follows:

- **Friction vs. Bearing Connections** - SWEC procedures require that only bearing connections be used in pipe support design. SWEC has adopted Subsection NF-4721, Summer 1985 addenda (*Reference 7.23*) which defines the allowable bolt hole sizes for such bearing connections.
- **Anchor Bolt Location Tolerances** - In addition to specifying minimum edge distances for holes in base plates, SWEC provides a procedure for verifying the acceptance of as-

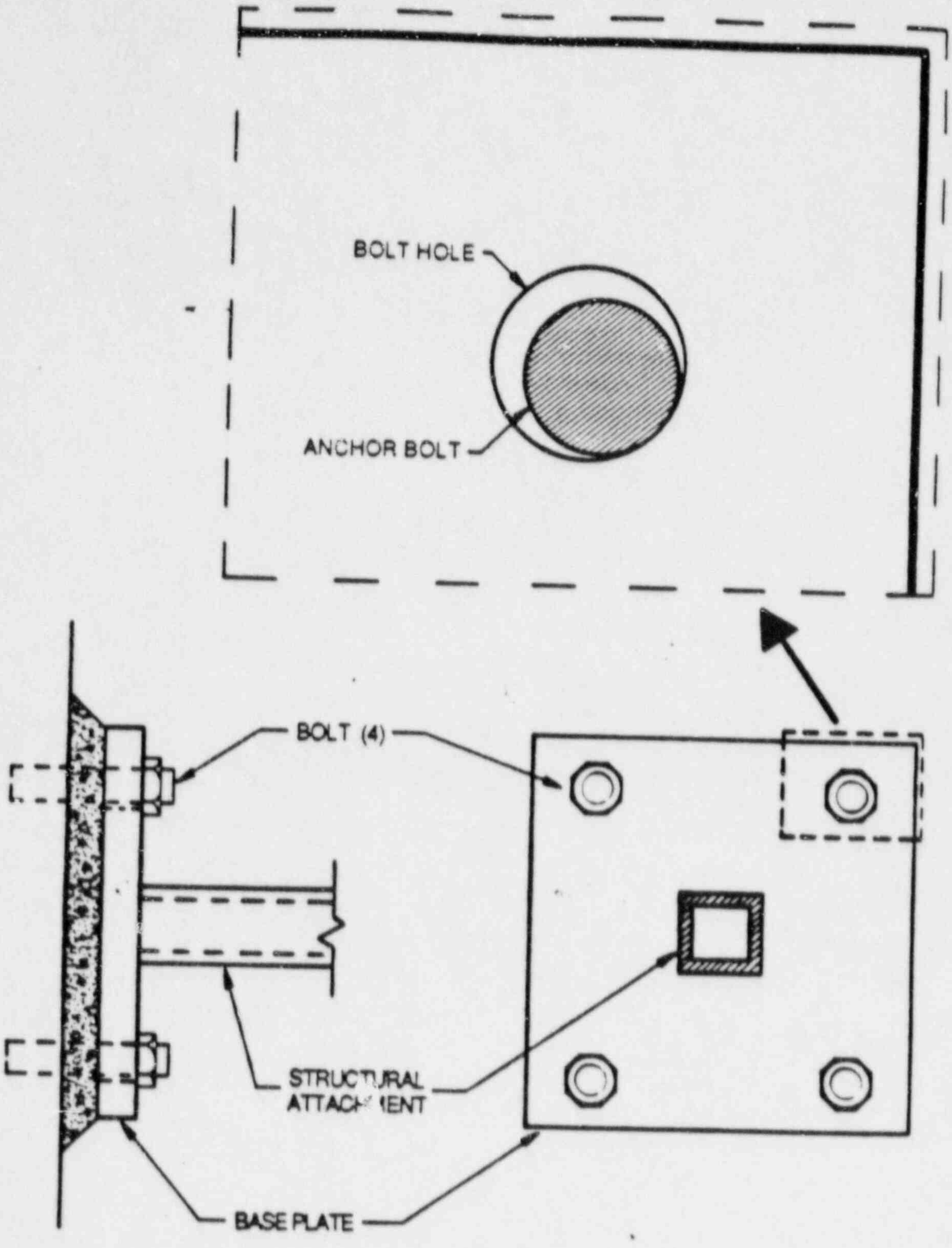


FIGURE 3.2-4

ANCHOR BOLT GAPS

built plates that were designed without consideration of possible bolt and attachment location tolerances.

- **Anchorage Embedment** - SWEC procedures provide specific requirements for the design of anchor bolts including establishing minimum embedments.

THIRD PARTY EVALUATION

The Third Party evaluation results are summarized as follows:

- **Friction vs. Bearing Connections** - The concern related to the connection of base plates to the concrete surface has been evaluated using the requirements of subsection NF of the ASME Code based on NRC staff acceptance of the adoption of subsection NF-4721, Summer 1985 addenda. SWEC procedures and design requirements comply with subsection NF, and are therefore acceptable. Such connections are used without exception in all commercial nuclear facilities in the United States.

  The CPSES Hilti installation procedure requires preloads which correspond to a level which was shown by test to have no effect on local-displacement behavior and thus no effect on anchor stiffness.

- **Anchor Bolt Location Tolerances** - SWEC procedures define specific calculation requirements which conservatively consider all possible design combinations of attachment and bolt location changes. The design combinations provide for converting the specific member shape into an equivalent square member.

- **Anchorage Embedment** - SWEC procedures provide adequate requirements for determining the embedment depths on anchors. These requirements include reductions in embedment length for concrete topping, as well as specific methods for calculating embedments when the depth is not indicated on the drawing. In such cases the specified bolt length is used as input to the calculation which will then conservatively determine minimum embedment.

CONCLUSION

The SWEC methodology is consistent with ASME and AISC Codes and provides adequate consideration of the issue. This issue is closed with respect to external source concerns.

Anchor bolts are also the subject of the self-initiated review documented in DAP-E-C/S-514 (*Reference 7.24*) and 515 (*Reference 7.17*).

3.2.3.27 Strut Angularity

ISSUE DESCRIPTION

Standard component supports, such as snubbers and struts, may transmit an additional ("kick") load component resulting from relative pipe displacement(s). A "kick" load occurs whenever the component orientation is other than normal (at 90° to) or parallel with the pipe axis. Angular swing results from relative pipe movements (caused by thermal, seismic and/or fluid transients) or relocation permitted by installation tolerances.

The issue is whether or not the "kick" load component associated with the angular swing tolerance must be considered in the support design. The strut angularity issue is evaluated in Engineering Evaluation DAP-E-P-029 which provides a detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

SWEC addressed this issue by establishing the following requirements:

- Struts and snubbers installed with swing angle exceeding ± 2° tolerance will be documented in the as-built program.
- Angular swing of struts and snubbers from relative movements caused by thermal, seismic, and/or fluid transients combined with the as-built installation angle will be assessed.
- The load component associated with swing angle will be considered for all support designs.
- Angular swings exceeding ± 5° will be additionally evaluated to ensure proper function and load rating of support components.
- Support Design Checklists include an evaluation for the swing angle effects of load components.

THIRD PARTY EVALUATION

The approach taken by SWEC addresses both the concern regarding consideration of load component associated with angular swing and the concern that the support component's function and load rating is evaluated. The approach is therefore acceptable.

CONCLUSION

SWEC has established acceptable guidelines to address the design consideration associated with strut and snubber angularity variations. This issue is closed.

3.2.3.28 Structural Modeling For Frame Analysis

ISSUE DESCRIPTION

The computer modeling of pipe support frames by TUGCO engineers and engineering contractors at CPSES did not reflect actual conditions under the following circumstances:

- **Torsion Evaluation** - To evaluate the wide flange member torsional stresses conservatively, a procedure was implemented which overpredicted the torsional loads by using an extremely high value for the torsional resistance. This method, when used with actual member torsional properties, resulted in conservative estimates of flange torsional stresses and unconservative estimates of deflections. Further, evaluations of local effects in the wide flange members at locations of torsional loading were not done.
- **Member End Restraints/Boundary Condition Modeling for Richmond Inserts** - Three different approaches were used to model member end restraints at Richmond Inserts connections.

  1) Release all rotational degrees of freedom (DOF) at member end.
  2) Release rotational DOF along axis of member and along axis of the Richmond Insert, and restrain rotational DOF normal to the member and the Richmond Insert.
  3) Restrain all rotational DOF at member end.

- **Pipe Support Boundary Conditions** - CASE identified several supports that had been evaluated assuming questionable boundary conditions. Analyses used engineering experience/practice in defining support boundary conditions.

This issue is evaluated in Engineering Evaluation DAP-E-P-031 which provides a detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

SWEC addressed this issue with the following methodology:

- **Torsion Evaluation** - The SWEC approach to modeling and evaluating structural members in pipe supports is based on using values for torsional resistance determined from dimensions provided in the AISC Manual of Steel Construction. Equations are provided in the design procedure for evaluating wide flange members and local effects due to torsional loading. A stiffness criterion is used in lieu of deflections; therefore, actual torsional resistance values are required to be used in the support stiffness determination.
- **Member End Restraints/Boundary Condition Modeling for Richmond Inserts** - SWEC procedures identify specific modeling requirements for Richmond Insert-Tube steel connections. These requirements are discussed in Section 3.2.3.1 where it is concluded that the SWEC approach is adequate.
- **Pipe Support Boundary Conditions** - SWEC requires the individual support designers to establish the boundary conditions appropriate for the model used.

THIRD PARTY EVALUATION

The Third Party evaluation results are summarized as follows:

- **Torsion Evaluation** - The SWEC procedure provides a conservative approach to evaluating member stresses induced by torsion. Torsional shear, warping shear, and warping normal stresses are all conservatively evaluated by assuming each stress is produced by the full torsional moment. These stresses are also conservatively combined with other stresses by assuming that all maximums occur at the same point in the wide flange cross section. By using AISC torsional resistance values for wide flange members in structural models, pipe support stiffnesses will be calculated appropriately.
- **Member End Restraints/Boundary Condition Modeling** - The SWEC approach to modeling the Richmond Insert/Tube steel connection includes the threaded rod in the structural model and uses realistic section properties for the rod. Any offset between the centerlines of the rod and tube steel is modeled as a fictitious member. This modeling approach acceptably addresses the flexibility of connections to unmodeled structures in accordance with the requirements of ASME Section III, Paragraph XVII-2420, "Connection Design".
- **Support Boundary Conditions** - Modeling assumptions for boundary conditions at connections of structural elements in a support are typically made by the support designer. It is not appropriate to attempt to describe typical boundary conditions for the multitude of conditions encountered. The adequacy of the modeling is dependent upon the use of sufficiently experienced designers and checkers. This is common practice for such design efforts and SWEC's dependence on their designers' judgments is an acceptable practice.

CONCLUSION

SWEC has established an adequate approach to structural modeling through:

- use of representative section properties of wide flanges for structural analysis of pipe supports,
- conservative calculation of member torsional stress and conservative combination of them in evaluating member stresses in accordance with code requirements, and
- accurate specification of boundary conditions for modeling of Richmond Insert/tube steel connections.

The issue is closed.

3.2.3.29 Computer Program Verification And Use

ISSUE DESCRIPTION

Concerns were raised regarding the existence of adequate program verification (quality assurance) and use of the appropriate program versions for the following computer programs:

- ADLPIPE Version 2c (Date: 4/77) (a piping analysis program)
- FUB-II (an ITT-Grinnell base plate qualification program)
- Corner and Lada Base Plate Qualification Program

The computer program verification and use issue was evaluated in Engineering Evaluation DAP-E-P-032 which provides a more detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

SWEC addressed the computer program verification issue in the following ways:

- All computer program verification is documented for the identified programs and the verification documentation addresses all project applications. Also, these programs are qualified for the purpose for which they are to be used.
- All computer programs and applicable program versions used for Piping/Support analysis are appropriately identified in the project procedures and/or the FSAR.

THIRD PARTY EVALUATION

The computer programs about which specific concerns were raised are not being utilized in the SWEC requalification effort. However, the original acceptance criteria still apply to the SWEC programs. SWEC's use of computer programs is verified in accordance with SWEC standard QA program requirements with regard to verification, technical adequacy, and use of appropriate version. The methods used to control computer program use are acceptable.

CONCLUSION

SWEC's approach to addressing the issues related to computer program verification and use is acceptable. This issue is closed.

3.2.3.30 Hydrotest

ISSUE DESCRIPTION

Concerns were raised that hydrostatic test loading conditions for specific piping and support designs were not adequately considered. Specifically, the following concerns were raised:

- Damage observed during or subsequent to a hydrotest of the component cooling system was attributed to hydrotesting.
- The Cygna review indicated a lack of consideration for hydrotest conditions in piping analysis and support design calculations.

The hydrotest issue was evaluated in Engineering Evaluation DAP-E-P-034 which provides a more detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

Procedurally, SWEC addressed the hydrotest issue by evaluation of piping and supports for hydrotest conditions in accordance with the Code of Record (*Reference 7.6)*, except for the Classes 2 and 3 hydrostatic test pressure, which was taken as 1.25 times the design pressures instead of 1.5.

THIRD PARTY EVALUATION

SWEC's method of evaluating Classes 2 and 3 piping systems for hydrostatic test conditions is in accordance with the ASME Code. ASME Classes 2 and 3 piping were tested and analyzed at 1.25 times the system design pressure. Classes 5 and 6 piping are tested and analyzed using a Classes 2 and 3 hydrostatic test pressure of 1.5 times the design pressure. All hydrostatic testing is in accordance with a later Code version, which is less stringent than the Code of Record. This code update is acceptable based on the Project meeting requirements of ASME Code NA-1140. This criterion was confirmed by the Third Party in the Engineering Evaluation DAP-E-P-034.

CONCLUSION

SWEC has adequately established and defined requirements for inclusion of hydrotest loading conditions for piping and support evaluations. The hydrotest issue is closed.

3.2.3.31 Seismic/Non-Seismic Interface

ISSUE DESCRIPTION

This issue, identified by the NRC and addressed in the CPRT ISAP V.c, (*Reference 7.5*) involves the adequacy and implementation of seismic/non-seismic piping interface design criteria. The issue was transferred to DSAP IX. Specific concerns were the following:

- Safety related piping is routed between seismic Category I buildings and non-seismic Category I buildings without seismic isolation.
- Postulated Turbine Building failure, due to an earthquake, was not addressed for safety related piping routed between seismic Category I buildings and the Turbine Building, which is a non-seismic Category I building.

- The seismic effects of non-safety related piping attached to safety related piping may not have been adequately considered in the associated piping and anchor support design.

The seismic/non-seismic interface issue was evaluated in Engineering Evaluation DAP-E-P-038 which contains a detailed discussion of the issue.

SWEC RESOLUTION METHODOLOGY

SWEC procedures address ASME piping as described in Section 2.0 of this report. The criteria and methods for assuring seismic isolation and designing against postulated Turbine Building failure as well as the interface between seismic and non-seismic piping are also addressed. There are three basic methods described for the design of seismic piping at non-seismic interfaces. Two methods assume a collapse of this non-seismic pipe: one method assumes a collapse adjacent to the seismic interface anchor whereas the other assumes a collapse at a point separated from the seismic interface anchor by seismically designed non-seismic Category I piping and supports. The third method requires that all attached non-seismic Category I piping be seismically analyzed and supported to the next anchor.

THIRD PARTY EVALUATION

The three methods described by SWEC provide a reasonable basis for design of seismic/non-seismic interfaces where interface anchors are present. The first two methods can be used to address Turbine Building failure. Although SWEC procedures do not specifically address seismic/non-seismic interfaces without anchors, the procedures do contain overlapping methods for seismic piping interfaces. This method is acceptable if applied to seismic/non-seismic interfaces where non-seismic piping is seismically analyzed.

CONCLUSION

The methods defined by SWEC are an adequate way to address the seismic/non-seismic interface. The seismic/non-seismic interface issue is closed.

3.2.3.32 Programmatic Aspects And QA

ISSUE DESCRIPTION

The programmatic aspects and QA issue comprises various concerns identified in public documents. The external source programmatic concerns are summarized as follows:

- **Interfaces** - A significant number of the technical concerns that were raised at CPSES result from inadequate interface control between the numerous organizational interfaces.
- **Iterative Design** - Identification and correction of design errors should not be put off until the end of the iterative design process.
- **Quality Assurance** - Calculations did not follow industry or project guidelines for Quality Assurance.
- **Timeliness** - Generic concerns which affect numerous designs were not evaluated in a timely manner, leading to widespread design deficiencies of similar types.
- **Field Changes** - Field changes were made without obtaining proper approvals, leading to unconventional designs being evaluated for adequacy "after the fact."

- **Personnel** - Qualifications of personnel approving design/modifications were inadequate due to insufficient procedures defining qualifications required to perform at various levels of responsibility.
- **Procedures** - Procedures and instructions at CPSES were changed frequently, inadequately controlled and often not in place resulting in a chaotic situation in which procedures were often violated, relying on the final review to identify design criteria changes.
- **Construction** - Procedures and documents controlling installation/construction were inadequate and/or not kept up-to-date.
- **Calculation Errors** - Numerous random calculation errors were identified which may imply programmatic deficiencies.
- **Miscellaneous** - Various other concerns were raised regarding the updating of criteria and the adequacy of various practices used in design/qualification activities.

SWEC RESOLUTION METHODOLOGY

SWEC's approach to resolving the various programmatic issues is through procedures which document responsibilities, interface control requirements and quality assurance programs. The plan is outlined in project procedure CPPP-1, the Management Plan for Project Quality (*Reference 7.26*), which addresses each of the eighteen criteria of 10CFR50, Appendix B. The plan is implemented through issuance of Project Procedures, Engineering Assurance Procedures and Quality Standards.

THIRD PARTY EVALUATION

The Third Party evaluation is summarized as follows:

- **Interfaces** - The Project Procedures controlling interfaces and defining responsibilities provide detailed descriptions of responsibilities and specific definition of interface information to be transmitted between various design organizations within the CPSES project. The controls delineated in SWEC procedures are acceptable since they provide requirements at all applicable interfaces. The significant reduction of the number of external interfaces also enhances the implementation of these procedures.
- **Iterative Design** - The SWEC Procedure Controls provide an acceptable basis for the iterative design process since all stages from design to as-built are tracked to identify design deficiencies and open items. This will assure that design changes and errors are closed, and that any preliminary information that was used is confirmed.
- **Quality Assurance** - The SWEC Management Plan for Project Quality establishes a program to assure project quality consistent with industry guidelines. Implementation of the plan is an acceptable basis for closure of this issue.
- **Timeliness** - SWEC procedure CPPP-13 (*Reference 7.27*) provides adequate assurance that changes due to design iterations or disposition of non-conformances will be addressed and/or incorporated within a reasonable time frame by providing a tracking mechanism on forms used to document such changes. Implementation of the Management Plan for Project Quality will assure that concerns regarding trending and generic implications are appropriately addressed.

- **Field Changes** - Requirements contained in SWEC Project Procedures are adequate to ensure that new designs, modifications, or reconciliations with as-built conditions are documented and approved by a qualified responsible engineer/designer.
- **Personnel** - SWEC procedures for project personnel training and indoctrination provide the means to ensure that the design is performed to acceptable standards by qualified people.
- **Procedures** - SWEC has published guidelines for issue and control of procedures. Strict adherence to these guidelines will ensure that proper procedures are in place for the design of safety related items.
- **Construction** - Initial walkdowns performed to Project Procedures to verify the accuracy of analysis input data to identify additional technical issues combined with a final reconciliation walkdown/analysis review will ensure that the as-built condition of piping and supports is properly evaluated.
- **Calculation Errors** - The detailed Project Procedures for documentation, review, and control of calculations provide a means to identify random types of errors. The review of the implementation of these procedures during the TU Electric QA Technical Audits will provide additional assurance that random errors will be minimized.
- **Miscellaneous** - Standard SWEC procedures are adequate to ensure that criteria and design practices used for qualification of CPSES piping and supports address these miscellaneous concerns.

CONCLUSION

The SWEC procedures establish adequate methods and controls to eliminate the reoccurrance of programmatic concerns raised over the initial design effort. A review of the implementation of these procedures by the TU Electric Quality Assurance Technical Audit Program and the SWEC Engineering Functional Evaluation will provide added assurance that similar concerns do not reoccur. This issue is closed.

3.2.3.33 Other DIRs

In addition to the DIRs addressed by the thirty-two Primary Issue evaluations, fifty-one DIRs unrelated to the Primary issues were reviewed. A list of these DIRs and a description of the resolutions are included as Attachment B of this Report. Detailed resolutions are documented on each respective DIR. Each of the fifty-one DIRs is resolved and closed.

4.0 SELF-INITIATED REVIEW

All of the Third Party review activities required by DSAP IX are external source issue reviews or corrective action overviews. There are no self-initiated reviews.

5.0 CORRECTIVE ACTION

The SWEC resolution methodology and Third Party evaluation for external source issues are discussed in Section 3.0 of this report. The implementation of that methodology for the scope of work defined in Attachment 2 of DSAP IX is the corrective action for the piping and supports discipline. The Third Party evaluated this methodology in conjunction with the resolution of the External Source Issues and determined that the methodology resolves external source issues and meets applicable criteria and commitments. Among the purposes of the corrective action overview described in Appendix H of the CPRT Program Plan was the evaluation of the implementation of procedures. In accordance with direction from the Senior Review Team, Third Party activities under Appendix H have been modified (*Reference* 7.1). Documentation of the completed Third Party Corrective Action overview is being transmitted to Texas Utilities Quality Assurance, including recommendations for further consideration under their Technical Audit Program.

6.0 CONCLUSIONS

This report presents the results of a Third Party review of the adequacy of certain large bore piping and pipe supports as related to issues raised in external source documents. The Third Party categorized these issues into thirty-two issue categories which formed the basis for the scope of the review. Resolution methodology for all these issues is provided in the SWEC Generic Issue Report and the SWEC procedures. The evaluation of adequacy comprised an evaluation based on the CPSES FSAR and licensing commitments of the SWEC resolution methodology. The Third Party has concluded that the SWEC large bore pipe stress reanalysis and pipe support requalification program is comprehensive and capable of resolving known technical issues. Proper implementation will ensure that the CPSES large bore piping and supports will meet the FSAR and licensing commitments. Where criteria changes are proposed by the Project final verification of compliance is subject to review of NRC approved amendments. The overview of the implementation of the program by the TU Electric QA Technical Audit Program provides assurance that the technical issues will be resolved.

7.0 REFERENCES

7.1 Comanche Peak Response Team Program Plan, Rev. 4, June 18, 1987.

7.2 Memorandum from John W. Beck (Chairman, SRT) to Howard A. Levin, DAP-RTL re: DAP Piping and Piping Supports Results Report, August 12, 1987.

7.3 Report on SWEC's Evaluation and Resolution of Generic Issues, Rev. 1, April 6, 1987.

7.4 Letter from Vincent Noonan (NRC) to William Counsil (TUGCO) re: Proposed FSAR Change - Piping/Pipe Supports, November 4, 1986.

7.5 ISAP V.c, "Design Consideration for Piping Systems Between Seismic Category I and Non-Seismic Category I Buildings," Rev. 2, January 24, 1986.

7.6 ASME Boiler and Pressure Vessel Code, Section III, Division 1, 1974 Edition including Summer 1974 Addenda, Subsection NC and ND (as documented in Section 2.0 of Reference 7.8).

7.7 ASME Boiler and Pressure Vessel Code, Section III, Division I, 1974 Edition including Winter 1974 Addenda, Subsection NF.

7.8 CPPP-7, "Design Criteria for Pipe Stress and Pipe Supports," Rev. 2, April 25, 1986.

7.9 CPPP-6, "Pipe Stress/Support Requalification Procedure - Unit No. 1," Rev. 3, November 28, 1986.

7.10 CPPP-9, "Pipe Stress/Support As-Built Procedure - Unit No. 2," Rev. 3, November 28, 1986.

7.11 DAP-10, "Development and Use of DAP Procedures and Discipline Instructions," Rev. 4, March 31, 1987.

7.12 DAP-2, "Documentation and Tracking of Issues and Discrepancies," Rev. 6, May 19, 1987.

7.13 Design Criteria List DAP-CR-P-001, Rev. 2, May 8, 1987.

7.14 R.L. Cloud and Associates Report RLCA/P142/01-86/008, "Richmond Insert/Structural Tube Steel Connection Design Interaction Equation for Bolt/Threaded Rods," Rev. 0, September 10, 1986, including Errata dated September 11, 1986 (1 page).

7.15 American Concrete Institute (ACI) Standard 349-85.

7.16 ISAP II.b Results Report "Concrete Compressive Strength," Rev. 1, February 28, 1986.

7.17 Third Party Issue Resolution Report (IRR) DAP-E-C/S-515, Rev. 0, October 2, 1986.

7.18 R.L. Cloud and Associates Report RCLA/P142/01-86/009, "Richmond Insert/Structural Tube Steel Connection, Effect of Thermal Expansion of Tube Steel on Richmond Inserts and Bolts," Rev. 0, April 6, 1987.

7.19 K.R. Wichman et al. "Local Stresses in Spherical and Cylindrical Shells due to External Loadings." Welding Research Council Bulletin 107, August 1965.

7.20 SWEC Calculation 15454-NP(C) - GENX-117, "Verification of Generic Stiffness Criteria in the Analysis of Piping System," Rev. 1, May 26, 1987.

7.21 CASE's Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations) before the ASLB dated August 22, 1983.

7.22 Letter from Vincent Noonan (NRC) to W.G. Council (TUGCO), March 13, 1986.

7.23 ASME Boiler and Pressure Vessel Code, Section III, Division I, 1983 Edition including Summer 1985 Addenda, Subsection NF, Paragraph 4721.

7.24 Third Party Issue Resolution Report (IRR) DAP-E-C/S-514, Rev. 1, March 20, 1987.

7.25 CPPP-35, "Piping and Pipe Support Qualification Procedure for Secondary Wall Displacement," Rev. 0, June 8, 1987.

7.26 CPPP-1, "Management Plan for Project Quality," Rev. 7, March 25, 1987.

7.27 CPPP-13, "Site Construction Support Activities Procedures," Rev. 1, December 6, 1986.

7.28 USNRC Regulatory Guide 1.84, "Design and Fabrication Code Case Acceptability ASME Section III Division 1" Revision 24, June 1986.

7.29 Comanche Peak Steam Electric Station, Final Safety Analysis Report with amendments through 55.

ATTACHMENT A
EXTERNAL SOURCE DOCUMENTS

ATTACHMENT A
EXTERNAL SOURCE DOCUMENTS

Source Document	Date	Document Title
ASLB-1	09/01/83	BOARD MEMORANDUM AND ORDER - MOTION TO REOPEN THE RECORD AND TO STRIKE
ASLB-2	12/28/83	BOARD ORDER AND MEMORANDUM LBP-83-81: (QUALITY ASSURANCE FOR DESIGN)
ASLB-3	02/08/84	MEMORANDUM AND BOARD ORDER LBP-84-10: (RECONSIDERATION CONCERNING QUALITY ASSURANCE FOR DESIGN)
ASLB-4	06/29/84	ASLB MEMORANDUM AND ORDER LBP-84-25 (WRITTEN-FILING DECISIONS, #1: SOME AWS/ASME ISSUES)
ASLB-5	12/18/84	BOARD MEMORANDUM CONCERNING WELDING ISSUES
ASLB-6	12/18/84	BOARD MEMORANDUM - REOPENING DISCOVERY: MISLEADING STATEMENT
ASLB-7	07/29/82	ASLB PROCEEDINGS TRANSCRIPT
ASLB-8	07/30/82	ASLB PROCEEDINGS TRANSCRIPT
ASLB-9	09/13/82	ASLB PROCEEDINGS TRANSCRIPT
ASLB-10	09/13/82	ASLB PROCEEDINGS TRANSCRIPT
ASLB-11	09/14/82	ASLB PROCEEDINGS TRANSCRIPT
ASLB-12	09/15/82	ASLB PROCEEDINGS TRANSCRIPT
ASLB-13	09/16/82	ASLB PROCEEDINGS TRANSCRIPT
ASLB-14	04/23/83	ASLB PROCEEDINGS TRANSCRIPT
ASLB-15	05/16/83	ASLB PROCEEDINGS TRANSCRIPT
ASLB-16	05/17/83	ASLB PROCEEDINGS TRANSCRIPT
ASLB-17	05/17/83	ASLB PROCEEDINGS TRANSCRIPT
ASLB-18	05/18/83	ASLB PROCEEDINGS TRANSCRIPT
ASLB-19	05/19/83	ASLB PROCEEDINGS TRANSCRIPT
ASLB-20	05/20/83	ASLB PROCEEDINGS TRANSCRIPT
ASLB-21	06/13/83	ASLB PROCEEDINGS TRANSCRIPT
ASLB-22	06/14/83	ASLB PROCEEDINGS TRANSCRIPT
ASLB-23	06/15/83	ASLB PROCEEDINGS TRANSCRIPT
ASLB-24	06/16/83	ASLB PROCEEDINGS TRANSCRIPT
ASLB-25	10/17/83	ASLB PROCEEDINGS TRANSCRIPT
ASLB-26	10/18/83	ASLB PROCEEDINGS TRANSCRIPT

Source Document	Date	Document Title
ASLB-27	02/20/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-28	02/21/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-29	02/23/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-30	03/19/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-31	03/20/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-32	03/21/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-33	03/22/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-34	03/23/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-35	03/30/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-36	04/18/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-37	04/24/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-38	04/25/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-39	04/26/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-40	04/27/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-41	05/01/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-42	05/02/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-43	05/03/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-44	02/22/84	ASLB PROCEEDINGS TRANSCRIPT
ASLB-45 *	10/31/85	ASLB MEMORANDUM AND ORDER LBP-85-14 (PROCEDURAL RULING BOARD CONCERN ABOUT QA FOR DESIGN).
ASLB-46	02/28/84	TELEPHONE CONFERENCE - TO DISCUSS SCHEDULING MATTERS RELATED TO MARCH 12 THROUGH MARCH 16 HEARINGS
CASE-1	07/29/82	CASE EXHIBIT 659 - WALSH TESTIMONY (EXH 659A-H)
CASE-2	08/19/82	CASE EXHIBIT 669 - DOYLE ORAL DEPOSITION (VOLUME I), EXHIBIT 669A - (VOLUME II), AND EXHIBIT 669B - (DEPOSITION EXHIBITS)
CASE-3	09/13/82	CASE EXHIBIT 683 - DOYLE SUPPLEMENTAL TESTIMONY
CASE-4	07/28/83	OBJECTION TO BOARD'S FINDINGS AND CASE'S ANSWER TO APPLICANTS' 07/15/83 SUMMARY OF THE RECORD REGARDING WEAVE AND DOWNHILL WELDING
CASE-5	08/22/83	CASE PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW

Source Document	Date	Document Title
CASE-6	09/03/83	CASE'S MOTION REGARDING 09/07/83 CONFERENCE CALL
CASE-7	11/10/83	CASE'S RESPONSE TO (1) APPLICANTS' BRIEF REGARDING BOARD INQUIRY INTO APPLICABILITY OF AWS AND CODES TO WELDING ON PIPE SUPPORTS AT CPSES: (2) NRC RESPONSE TO BOARD QUESTION ON CPSES WELDING CODE
CASE-8	11/23/83	CASE'S MOTION FOR RECONSIDERATION (AFFIDAVITS ON OPEN ITEMS RELATING TO WALSH/DOYLE ALLEGATIONS)
CASE-9	08/06/84	CASE'S ANSWER TO APPLICANTS MOTION FOR SUMMARY DISPOSITION REGARDING CONSIDERATION OF FRICTION FORCES IN THE DESIGN OF PIPE SUPPORTS WITH SMALL THERMAL MOVEMENTS
CASE-10	08/06/84	CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION OF CERTAIN CASE ALLEGATIONS REGARDING AWS AND ASME CODE PROVISIONS RELATED TO DESIGN ISSUES
CASE-11	08/06/84	CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING ALLEGED ERRORS MADE IN DETERMINING DAMPING FACTORS FOR OBE AND SSE LOADING CONDITIONS
CASE-12	08/13/84	CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING CASE ALLEGATIONS REGARDING SECTION PROPERTY VALUES
CASE-13	08/20/84	CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION OF CASE'S ALLEGATIONS REGARDING U-BOLTS ACTING AS TWO-WAY RESTRAINTS
CASE-14	08/27/84	CASE'S PARTIAL ANSWER TO APPLICANTS' STATEMENT OF MATERIAL FACTS AS TO WHICH THERE IS NO GENUINE ISSUE REGARDING THE UPPER LATERAL RESTRAINT BEAM
CASE-15	08/27/84	CASE'S PARTIAL ANSWER TO APPLICANTS' STATEMENT OF MATERIAL FACTS AS TO WHICH THERE IS NO GENUINE ISSUE REGARDING ALLEGATIONS CONCERNING CONSIDERATION OF FORCE DISTRIBUTION IN AXIAL RESTRAINTS

Source Document	Date	Document Title
CASE-16	08/27/84	CASE'S PARTIAL ANSWER TO APPLICANTS' STATEMENT OF MATERIAL FACT AS TO WHICH THERE IS NO GENUINE ISSUE REGARDING APPLICANTS' USE OF GENERIC STIFFNESSES INSTEAD OF ACTUAL IN PIPING ANALYSIS
CASE-17	08/27/84	CASE'S PARTIAL ANSWER TO APPLICANTS' STATEMENT OF MATERIAL FACTS AS TO WHICH THERE IS NO GENUINE ISSUE REGARDING DIFFERENTIAL DISPLACEMENT OF LARGE-FRAMED, WALL-TO-WALL AND FLOOR-TO-CEILING SUPPORTS
CASE-18	08/27/84	CASE'S PARTIAL ANSWER TO APPLICANTS' STATEMENT OF MATERIAL FACTS AS TO WHICH THERE IS NO GENUINE ISSUE REGARDING SAFETY FACTORS
CASE-19	08/29/84	CASE'S ANSWER TO APPLICANTS' STATEMENT OF MATERIAL FACTS AS TO WHICH THERE IS NO GENUINE ISSUE REGARDING CONSIDERATION OF LOCAL DISPLACEMENTS AND STRESSES
CASE-20	09/10/84	CASE'S ANSWER TO APPLICANTS' STATEMENT OF MATERIAL FACTS RELATING TO RICHMOND INSERTS AS TO WHICH THERE ARE NO MATERIAL ISSUES
CASE-21	10/01/84	CASE'S ANSWER TO APPLICANTS' REPLY TO CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING CONSIDERATION OF FRICTION FORCES
CASE-22	10/08/84	CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING CONSIDERATION OF CINCHING DOWN OF U-BOLTS
CASE-23	10/09/84	CASE'S ANSWER TO APPLICANTS' REPLY TO CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING LOCAL DISPLACEMENTS AND STRESSES
CASE-24	10/13/84	ATTACHMENTS TO CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING CONSIDERATION OF CINCHING DOWN OF U-BOLTS

Source Document	Date	Document Title
CASE-25	10/15/84	DOCUMENTS AND INFORMATION REQUESTED BY CASE REGARDING APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING STABILITY OF PIPE SUPPORTS
CASE-26	10/18/84	CASE'S PARTIAL ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING APPLICANTS' QUALITY ASSURANCE PROGRAM FOR DESIGN OF PIPING AND PIPE SUPPORTS FOR CPSES
CASE-27	10/18/84	CASE'S DISCOVERY REQUESTS TO APPLICANTS REGARDING CROSS-OVER LEG RESTRAINTS
CASE-28	10/30/84	CASE'S 2ND PARTIAL ANSWER TO APPLICANTS' STATEMENT OF MATERIAL FACTS AS TO WHICH THERE IS NO GENUINE ISSUE REGARDING APPLICANTS' QUALITY ASSURANCE PROGRAM FOR DESIGN OF PIPING AND PIPE SUPPORTS
CASE-29	11/20/84	CASE'S ANSWER TO APPLICANTS' REPLY TO CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING THE UPPER LATERAL RESTRAINT BEAM
CASE-30	12/19/84	CASE'S 4TH ROUND ANSWER TO APPLICANTS' REPLY TO CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING THE EFFECTS OF GAPS
CASE-31	01/17/85	CASE'S FIRST SET OF INTERROGATORIES TO APPLICANTS AND REQUESTS TO PRODUCE
CASE-32	02/04/85	CASE'S SECOND SET OF INTERROGATORIES TO APPLICANTS AND REQUESTS TO PRODUCE RE: CREDIBILITY
CASE-33	02/25/85	CASE'S FOURTH SET OF INTERROGATORIES TO APPLICANTS AND REQUESTS TO PRODUCE
CASE-34	02/25/85	CASE'S THIRD SET OF INTERROGATORIES TO APPLICANTS AND REQUESTS TO PRODUCE
CASE-35	03/04/85	CASE'S FIFTH SET OF INTERROGATORIES TO APPLICANTS AND REQUESTS TO PRODUCE
CASE-36	04/26/83	SURREBUTTAL TESTIMONY OF JACK DOYLE (CASE EXHIBIT 761 AND ATTACHMENTS)
CASE-37	04/28/83	SUPPLEMENTARY SURREBUTTAL TESTIMONY OF JACK DOYLE (CASE EXHIBIT 762)

ATTACHMENT A — *Continued*

Source Document	Date	Document Title
CASE-38	05/04/83	SUPPLEMENTARY SURREBUTTAL TESTIMONY OF JACK DOYLE (CASE EXHIBIT 763 AND ATTACHMENTS)
CASE-39	11/04/83	CASE RESPONSE TO NRC AFFIDAVITS ON OPEN ITEMS RELATING TO WALSH/DOYLE ALLEGATIONS
CASE-40	11/28/83	CASE'S ANSWER TO BOARD's 10/25/83 MEMORANDUM (PROCEDURE CONCERNING QUALITY ASSURANCE)
CASE-41	02/01/84	CASE'S ANSWER TO MOTIONS FOR RECONSIDERATION OF BOARD'S MEMORANDUM AND ORDER (QUALITY ASSURANCE FOR DESIGN) BY APPLICANTS AND NRC STAFF
CASE-42	08/13/84	CASE'S ANSWER TO APPLICANTS' STATEMENT OF MATERIAL FACTS AS TO WHICH THERE IS NO GENUINE ISSUE REGARDING THE EFFECTS OF GAPS ON STRUCTURAL BEHAVIOR UNDER SEISMIC LOADING CONDITIONS
CASE-43	05/04/83	SURREBUTTAL TESTIMONY OF MARK ANTHONY WALSH
CASE-44	10/02/84	CASE'S ANSWER TO APPLICANTS' REPLY TO CASES'S ANSWER TO APPLICANTS' MOTION REGARDING ALLEGED ERRORS MADE IN DETERMINING DAMPING FACTORS FOR OBE AND SSE LOADING CONDITIONS.
CASE-45	12/19/85	CASE'S RESPONSE TO APPLICANTS' 11/12/85 CHANGES TO AFFIDAVITS IN SUPPORT OF APPLICANTS' MOTIONS FOR SUMMARY DISPOSITION.
IAP-1	10/12/84	COMANCHE PEAK INDEPENDENT ASSESSMENT PROGRAM FINAL REPORT TR-83090-01, REV. 0
IAP-2	11/20/84	COMANCHE PEAK INDEPENDENT ASSESSMENT PROGRAM FINAL REPORT (PHASE 3) TR-84042-01
IAP-3	03/14/85	TUGCO/CPRT MEETING TO DISCUSS FINDINGS FROM INDEPENDENT ASSESSMENT PROGRAM
IAP-4	04/04/85	REVIEW ISSUES LIST TRANSMITTAL - PIPE STRESS & PIPE SUPPORTS
IAP-5	04/04/85	REVIEW ISSUES LIST TRANSMITTAL - CABLE TRAY SUPPORTS & CONDUIT SUPPORTS
IAP-6	04/04/85	REVIEW ISSUES LIST TRANSMITTAL - ELECTRICAL/I&C

Source Document	Date	Document Title
IAP-7	04/04/85	REVIEW ISSUES LIST TRANSMITTAL - MECHANICAL SYSTEMS
IAP-8	04/04/85	REVIEW ISSUES LIST TRANSMITTAL - DESIGN CONTROL
IAP-9	04/23/85	REVIEW ISSUES LIST TRANSMITTAL - PIPE STRESS (REV. 1) & PIPE SUPPORTS (REV. 1)
IAP-10	04/23/85	REVIEW ISSUES LIST TRANSMITTAL - CABLE TRAY SUPPORTS (REV. 9) & CONDUIT SUPPORTS (REV. 1)
IAP-11	04/23/85	REVIEW ISSUES LIST TRANSMITTAL - ELECTRICAL/I&C, REVISION 1
IAP-12	04/23/85	REVIEW ISSUES LIST TRANSMITTAL - MECHANICAL SYSTEMS, REVISION 1
IAP-13	04/23/85	REVIEW ISSUES LIST TRANSMITTAL - DESIGN CONTROL, REVISION 0
IAP-14	06/21/85	REVIEW ISSUES LIST TRANSMITTAL - CABLE TRAY SUPPORTS, REVISION 10
IAP-15	06/21/85	REVIEW ISSUES LIST TRANSMITTAL - DESIGN CONTROL, REVISION 1
IAP-16	08/13/85	REVIEW ISSUES LIST TRANSMITTAL - CABLE TRAY SUPPORTS (REV. 11) & CONDUIT SUPPORTS (REV. 2)
IAP-17	08/13/85	REVIEW ISSUES LIST TRANSMITTAL - MECHANICAL SYSTEMS, REVISION 2
IAP-18	08/13/85	REVIEW ISSUES LIST TRANSMITTAL - ELECTRICAL/I&C, REVISION 2
IAP-19	05/15/84	IAP PHASE 4 - SUPPLEMENT TO APPLICANTS' PLAN TO RESPOND TO MEMORANDUM AND ORDER (QUALITY ASSURANCE FOR DESIGN), MARCH 13, 1984
IAP-20	10/09/84	CYGNA LTR. 84056.032 - REACTOR COOLANT THERMAL BARRIER RUPTURE
IAP-21	10/22/84	CYGNA LTR. 84056.035 - REACTOR COOLANT PUMP THERMAL BARRIER RUPTURE - CLARIFICATION
IAP-22	01/18/85	CYGNA LTR. 84042.022 - OPEN ITEMS ASSOCIATED WITH WALSH/DOYLE ALLEGATIONS
IAP-23	01/25/85	CYGNA LTR. 84056.050 - STATUS OF IAP CONCLUSIONS, ALL PHASES

ATTACHMENT A — *Continued*

Source Document	Date	Document Title
IAP-24	01/31/85	CYGNA LTR. 84042.025 - PHASE 3 - WALSH/DOYLE ALLEGATIONS (RICHMOND INSERT ALLOWABLES AND BENDING STRESSES)
IAP-25	01/31/85	CYGNA LTR. 84056.053 - PHASE 4 OPEN ITEMS (PUNCHING SHEAR)
IAP-26	02/08/85	CYGNA LTR. 84042.021 - PHASE 3 OPEN ITEMS (MASS PARTICIPATION AND MASS POINT SPACING)
IAP-27	02/12/85	CYGNA LTR. 84056.041 - CABLE TRAY SUPPORT REVIEW QUESTIONS
IAP-28	02/19/85	CYGNA LTR. 84042.035 - STABILITY OF PIPE SUPPORTS
IAP-29	03/08/85	CYGNA LTR. 83090.023 - RESPONSE TO NRC QUESTIONS, IAP PHASES 1 AND 2
IAP-30	03/12/85	CYGNA LTR. 84056.058 - PHASE 4 OPEN ITEMS (PUNCHING SHEAR)
IAP-31	03/25/85	CYGNA LTR. 84042.036 - PHASE 3 OPEN ITEMS (CINCHING OF U-BOLTS)
IAP-32	03/29/85	CYGNA LTR. 84056.060 - GENERIC ISSUES SUMMARY, IAP - ALL PHASES
IAP-33	11/20/85	REVIEW ISSUES LIST TRANSMITTAL - CABLE TRAY SUPPORTS (REV. 12)
IAP-34	11/20/85	REVIEW ISSUES LIST TRANSMITTAL - CONDUIT SUPPORTS (REV. 3)
MAC-1	05/17/78	MANAGEMENT QUALITY ASSURANCE AUDIT
NRC-1	02/15/83	NRC SPECIAL INSPECTION TEAM (SIT) REPORT (50-445/82-26)(50-446/82-14) AS A RESULT OF WALSH/DOYLE CONCERNS
NRC-2	04/11/83	CONSTRUCTION APPRAISAL INSPECTION (CAT) 50-445/83-18, 50-446/83-12
NRC-3	08/29/83	NRC STAFF OBJECTIONS TO PROPOSED INITIAL DECISION
NRC-4	08/30/83	NRC STAFF'S PROPOSED FINDINGS OF FACT IN THE FORM OF A PARTIAL INITIAL DECISION
NRC-5	10/03/83	REGION IV CAT FOLLOW-UP REPORT
NRC-6	10/28/83	NRC STAFF RESPONSE TO BOARD QUESTION REGARDING APPLICABLE WELDING CODES AT CPSES

Source Document	Date	Document Title
NRC-7	07/13/84	COMANCHE PEAK SPECIAL REVIEW TEAM REPORT
NRC-8	11/02/84	NRC STAFF RESPONSE TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION ON AWS AND ASME CODE PROVISIONS ON WELD DESIGN
NRC-9	09/30/85	STAFF EVALUATION OF CPRT PROGRAM PLAN, REVISION 2, DETAILED COMMENTS/CONCERNS
NRC-10	07/01/81	SAFETY EVALUATION REPORT - CPSES UNITS 1 & 2 (NUREG-0797)
NRC-11	10/01/81	SAFETY EVALUATION REPORT - CPSES UNITS 1 & 2 (NUREG-0797) SUPPLEMENT NO. 1
NRC-12	01/01/82	SAFETY EVALUATION REPORT - CPSES UNITS 1 & 2 (NUREG-0797) SUPPLEMENT NO. 2
NRC-13	03/01/83	SAFETY EVALUATION REPORT - CPSES UNITS 1 & 2 (NUREG-0797) SUPPLEMENT NO. 3
NRC-14	11/01/83	SAFETY EVALUATION REPORT - CPSES UNITS 1 & 2 (NUREG-0797) SUPPLEMENT NO. 4
NRC-15	11/01/84	SAFETY EVALUATION REPORT - CPSES UNITS 1 & 2 (NUREG-0797) SUPPLEMENT NO. 6
NRC-16	01/01/85	SAFETY EVALUATION REPORT - CPSES UNITS 1 & 2 (NUREG-0797) SUPPLEMENT NO. 7
NRC-17	02/01/85	SAFETY EVALUATION REPORT - CPSES UNITS 1 & 2 (NUREG-0797) SUPPLEMENT NO. 8
NRC-18	03/01/85	SAFETY EVALUATION REPORT - CPSES UNITS 1 & 2 (NUREG-0797) SUPPLEMENT NO. 9
NRC-19	04/01/85	SAFETY EVALUATION REPORT - CPSES UNITS 1 & 2 (NUREG-0797) SUPPLEMENT NO. 10
NRC-20	05/01/85	SAFETY EVALUATION REPORT - CPSES UNITS 1 & 2 (NUREG-0797) SUPPLEMENT NO. 11
NRC-21	09/02/82	NRC STAFF TESTIMONY OF JOSEPH I. TAPIA AND W. PAUL CHEN IN REBUTTAL TO THE TESTIMONY OF MARK ANTHONY WALSH CONCERNING THE DESIGN OF PIPE SUPPORTS
NRC-22	05/13/83	INSPECTION REPORT 50-445/83-12: 50-446/83-07 – INSPECTION CONDUCTED BY J. I. TAPIA AND W. PAUL CHEN
NRC-23	12/13/83	AFFIDAVITS OF JOSEPH I. TAPIA AND W. PAUL CHEN ON OPEN ITEMS RELATING TO WALSH/DOYLE CONCERNS
NRC-24	/ /	NRC INSPECTION REPORT 82-30

Source Document	Date	Document Title
NRC-25	01/08/85	NRC LETTER TO TUGCO RE: TRT QA/QC FINDINGS (ATTACHED TO NRCT-6).
NRC-26	05/30/85	NRC REGION IV INSPECTION REPORTS 2/17/84 THROUGH 5/30/85.
NRC-27	10/11/84	NRC INSPECTION REPORT (50-445/84-22)(50-446/84-07) - INSPECTIONS CONDUCTED UNDER RESIDENT INSPECTION PROGRAM 05/19/84 THROUGH 07/21/84
NRC-28	02/27/79	SUMMARY OF FEBRUARY 13, 1979 MEETING ON AUXILIARY SYSTEMS BRANCH QUESTIONS
NRC-29	11/17/80	LETTER, R.L. TEDESCO TO R.J. GARY RE: SERVICE INSPECTION OF PRESSURE ISOLATION VALVES
NRC-30	01/14/81	LETTER, R.L. TEDESCO TO R.J. GARY RE: PRESERVICE INSPECTION AND TESTING OF SNUBBERS
NRC-31	10/14/82	TRIP REPORT-AUDIT OF TUSI DOCUMENTATION FOR ENVIRONMENTAL QUALIFICATION OF SAFETY-RELATED EQUIPMENT FOR CPSES 1 AND 2.
NRC-32	10/29/82	SSER INPUT ON SEISMIC AND DYNAMIC QUALIFICATION OF SAFETY-RELATED ELECTRIC AND MECHANICAL EQUIPMENT
NRC-33	01/31/83	REGION IV RESPONSE TO R.J. GARY LETTER ON SYSTEMATIC ASSESSMENT OF LICENSEE PERFORMANCE (SALP)
NRC-34	07/06/83	SUBMITTAL OF INTERIM STAFF EVALUATION OF THE ALTERNATE SHUTDOWN DESIGN FOR THE CPSES
NRC-35	01/24/84	SER UNRESOLVED ISSUES REQUIRING RESOLUTION PRIOR TO LICENSING CPSES UNIT 1
NRC-36	01/24/84	SER OUTSTANDING ISSUE (1), "PROTECTION AGAINST EFFECTS ASSOCIATED WITH THE POSTULATED RUPTURE OF PIPING OUTSIDE CONTAINMENT"
NRC-37	02/13/84	ADDITIONAL INFORMATION ON ENVIRONMENTAL QUALIFICATION
NRC-38	05/17/84	TRANSMITTAL OF PROPOSED SUPPLEMENT TO APPENDIX C OF THE SER FOR COMANCHE PEAK STEAM ELECTRIC STATION (UNITS 1 AND 2)
NRC-39	09/12/84	NRC STAFF CONTROL ROOM DESIGN REVIEW REPORT FOR THE CPSES

Source Document	Date	Document Title
NRC-40	09/18/84	COMANCHE PEAK REVIEW
NRC-41	11/13/84	ACCEPTABILITY OF ASME CODE RELIEF REQUESTS PERTAINING TO THE PRESERVICE INSPECTION (PSI) PROGRAM FOR COMANCHE PEAK STEAM ELECTRIC STATION, UNIT 1
NRC-42	11/19/84	ISSUANCE OF SUPPLEMENT NO. 6 TO THE COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2 SAFETY EVALUATION REPORT
NRC-43	06/05/85	USE OF ASME CODE CASES N-397 AND N-411 FOR THE CPSES (UNITS 1 AND 2)
NRC-44	06/07/85	SUMMARY OF MEETING BETWEEN NRC STAFF AND TUGCO TO DISCUSS THE COMANCHE PEAK FIRE PROTECTION PROGRAM
NRC-45	06/10/85	ISSUANCE OF SUPPLEMENT NO. 11 TO NUREG-0797 COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2
NRC-46	07/24/85	RESPONSE TO L.D. BUTTERFIELD'S MAY 16, 1985 REQUEST FOR COMMENTS ON THE WESTINGHOUSE OWNERS GROUP (WOG) GUIDELINES FOR PREPARING SUBMITTALS REQUESTING NRC APPROVAL OF REACTOR TRIP TECH. SPEC. CHANGES
NRC-47	09/25/85	USE OF ASME CODE CASES N-397 AND N-411 FOR THE CPSES (UNITS 1 AND 2)
NRCT-1	09/18/84	NRC-152 TECHNICAL REVIEW TEAM BRIEFING: COMANCHE PEAK REVIEW
NRCT-2	11/01/84	SUMMARY OF MEETING TO DISCUSS THE APPLICANTS' PLAN FOR RESOLUTION OF REQUESTS FOR ADDITIONAL INFORMATION FROM THE COMANCHE PEAK TECHNICAL REVIEW TEAM EFFORT DESCRIBED IN LETTER DATED 09/18/84
NRCT-3	12/20/84	TRANSCRIPT CYGNA/NRC MEETING - INDEPENDENT ASSESSMENT PROGRAM
NRCT-4	01/10/85	MEETING WITH CYGNA ON CPSES INDEPENDENT ASSESSMENT PROGRAM (PHASE 3)
NRCT-5	01/15/85	MEETING WITH TUGCO CONCERNING THE MOTION FOR SUMMARY DISPOSITION ON QA/QC PROGRAM FOR DESIGN OF PIPING AND PIPE SUPPORTS FOR COMANCHE PEAK

Source Document	Date	Document Title
NRCT-6	01/17/85	MEETING TO DISCUSS TECHNICAL REVIEW TEAM STAFF FINDINGS - COMANCHE PEAK
NRCT-7	02/07/85	SUMMARY OF MEETING WITH CASE, TUGCO AND NRC CONTENTION 5 PANEL CONCERNING COMANCHE PEAK STEAM ELECTRIC STATION AND TECHNICAL ISSUES RAISED IN THE ASLB HEARINGS THURSDAY, FEBRUARY 7, 1985
NRCT-8	02/26/85	MEETING BETWEEN TEXAS UTILITIES AND THE NUCLEAR REGULATORY COMMISSION REGARDING COMANCHE PEAK STEAM ELECTRIC STATION - PIPING AND SUPPORT DESIGN
NRCT-9	02/27/85	MEETING BETWEEN TEXAS UTILITIES AND THE NUCLEAR REGULATORY COMMISSION REGARDING COMANCHE PEAK STEAM ELECTRIC STATION - PIPING AND SUPPORT DESIGN
NRCT-10	03/06/85	MEETING BETWEEN TEXAS UTILITIES AND THE NUCLEAR REGULATORY COMMISSION REGARDING CPSES - TRT TESTING PROGRAM ISSUES
NRCT-11	03/07/85	MEETING BETWEEN TEXAS UTILITIES AND THE NUCLEAR REGULATORY COMMISSION REGARDING CPSES - MECHANICAL AND MISCELLANEOUS
NRCT-12	04/26/85	CYGNA BRIEFING TO NRC MANAGEMENT ON COMANCHE PEAK STEAM ELECTRIC STATION INDEPENDENT ASSESSMENT PROGRAM
NRCT-13	06/06/84	TELEPHONE CONFERENCE CALL (06/06/84) TO DISCUSS VARIOUS MOTIONS FOR SUMMARY DISPOSITION ON PIPE SUPPORT DESIGN AND QA ISSUES WHICH HAVE BEEN SUBMITTED BY THE APPLICANT
NRCT-14	06/08/84	MEETING IN BETHESDA ON TECHNICAL DATA AND SUPPORTING MOTIONS FOR SUMMARY DISPOSITIONS
NRCT-15	06/11/84	TELEPHONE CONFERENCE (NRC, CASE, TUGCO) TO DISCUSS MOTIONS FOR SUMMARY DISPOSITION ON PIPE SUPPORT DESIGN AND DESIGN QA

Source Document	Date	Document Title
NRCT-16	10/23/84	MEETING TO DISCUSS THE APPLICANT'S PLAN FOR RESOLUTION OF REQUESTS FOR ADDITIONAL INFORMATION FROM THE COMANCHE PEAK TECHNICAL REVIEW TEAM (TRT) EFFORT
NRCT-17	03/23/85	MEETING TO CONDUCT FEEDBACK DISCUSSION WITH MESSRS. WALSH AND DOYLE REGARDING CONCERNS ABOUT THE COMANCHE PEAK PLANT
NRCT-18	04/19/84	MEETING WITH CYGNA ENERGY SERVICES ON INDEPENDENT ASSESSMENT PROGRAM (IAP) FOR COMANCHE PEAK
NRCT-19	07/03/84	MEETING BETWEEN NRC STAFF AND CYGNA - 07/03/84
NRCT-20	03/05/85	MEETING BETWEEN TEXAS UTILITIES AND THE NUCLEAR REGULATORY COMMISSION REGARDING COMANCHE PEAK STEAM ELECTRIC STATION - QA/QC, APPLICANTS' PROGRAM PLAN
NRCT-21	06/20/84	NRC MEETING TO DISCUSS SUBMITTED SUMMARY DISPOSITIONS
NRCT-22	10/19/84	TUGCO MEETING WITH NRC STAFF
NRCT-23	11/13/84	PREHEARING BRIEFING
NRCT-24	08/06/84	DISCUSSION ON MOTIONS FOR SUMMARY DISPOSITION FILED BY APPLICANT, COMANCHE PEAK
NRCT-25	08/08/84	QUESTIONS ON SUMMARY DISPOSITIONS FILED BY TEXAS UTILITIES ON COMANCHE PEAK
NRCT-26	08/09/84	(HEARING TRANSCRIPT) IN THE MATTER OF COMANCHE PEAK, TEXAS UTILITY
NRCT-27	08/23/84	COMANCHE PEAK MEETING BETWEEN NUCLEAR REGULATORY COMMISSION STAFF AND TEXAS UTILITIES - MOTIONS FOR SUMMARY DISPOSITION
NRCT-28	06/13/85	NRC/TUGCO MEETING OF 06/13/85 AND 06/14/85
NRCT-29	10/02/85	PUBLIC HEARING RE: HOMOGENEOUS HARDWARE POPULATION FOR CONSTRUCTION ADEQUACY REVIEW AND SWEC REANALYSIS PROGRAM.
NRCT-30	06/13/85	NRC/TUGCO MEETING - VOLUME I - MORNING SESSION

ATTACHMENT A — *Continued*

Source Document	Date	Document Title
NRCT-31	06/13/85	NRC/TUGCO MEETING - VOLUME II - AFTERNOON SESSION
NRCT-32	06/14/85	NRC/TUGCO MEETING - VOLUME I - MORNING SESSION
NRCT-33	06/14/85	NRC/TUGCO MEETING - VOLUME II - AFTERNOON SESSION
NRCT-34	06/18/85	MEETING ON RECALCULATION OF SEISMIC RESPONSE SPECTRA: COMANCHE PEAK
NRCT-35	08/14/85	SUMMARY OF MEETING BETWEEN THE NRC COMANCHE PEAK INTIMIDATION PANEL, THE APPLICANT, AND THE INTERVENER TO BRIEF THE COMANCHE PEAK PANEL ON THE ALLEGED INTIMIDATION ISSUES AT COMANCHE PEAK
NRCT-36	09/17/85	MEETING BETWEEN NRC STAFF AND TEXAS UTILITIES GENERATING COMPANY TO DISCUSS THE OFFICIAL INSPECTION OF PAINTED SUPPORT WELDS
NRCT-37	10/18/85	SUMMARY OF 10/2-3/85 MEETING - BASIS FOR ESTABLISHING THE HOMOGENEOUS HARDWARE POPULATIONS FOR THE CONSTRUCTION ADEQUACY REVIEW, AND THE STONE AND WEBSTER PIPE AND PIPE SUPPORT REANALYSIS PROGRAM
NRCT-38	11/05/85	TUGCO MEETING WITH NRC - CPRT MONTHLY STATUS - NOVEMBER 5-6, 1985 - VOLUME I
NRCT-39	11/06/85	TUGCO MEETING WITH NRC - CPRT MONTHLY STATUS - NOVEMBER 5-6, 1985 - VOLUME II
NRCT-40	11/05/85	HANDOUTS FROM PUBLIC MEETING IN GRANBURY NOVEMBER 5-6, 1985
NRCT-41	11/12/85	TRANSCRIPT OF PUBLIC HEARING HELD IN DALLAS, TEXAS
NRCT-42	12/18/85	TUGCO MEETING WITH NRC - CPRT MONTHLY STATUS
NRCT-43	02/06/86	TUGCO-NRC PUBLIC MEETING, ARLINGTON, TEXAS
TUGC-1	08/05/83	APPLICANTS' PROPOSED FINDINGS OF FACT IN THE FORM OF A PARTIAL INITIAL DECISION
TUGC-2	08/29/83	TRANSMITTAL OF "DIRECTOR'S DECISION UNDER 10CFR2.206" DENYING PETITION FILED BY MRS. ELLIS ON BEHALF OF CASE

Source Document	Date	Document Title
TUGC-3	08/30/83	APPLICANTS' MOTION TO ESTABLISH SCHEDULE FOR SPECIAL PROCEEDING, FURTHER PROCEEDINGS (IF NECESSARY), AND FOR CLOSING RECORD AND FOR EXPEDITED REPLY
TUGC-4	08/31/83	APPLICANTS' (1) ANSWER TO CASE'S MOTION TO SUPPLEMENT THE RECORD (REGARDING WALSH/DOYLE ALLEGATIONS) (2) REQUEST FOR EXPEDITED RULING AND (3) MOTION FOR NOTICE OF INTENT TO IMPOSE SANCTIONS
TUGC-5	09/06/83	APPLICANTS' REPLY TO CASE'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW (WALSH/DOYLE ALLEGATIONS)
TUGC-6	10/28/83	APPLICANTS' BRIEF REGARDING BOARD INQUIRY INTO APPLICABILITY OF AWS AND ASME CODES TO WELDING ON PIPE SUPPORTS AT COMANCHE PEAK
TUGC-7	05/16/84	APPLICANTS' MOTION FOR SUMMARY DEPOSIT REGARDING ALLEGED ERRORS MADE IN DETERMINING DAMPING FACTORS FOR OBE AND SSE LOADING CONDITIONS
TUGC-8	05/17/84	APPLICANTS' MOTION FOR SUMMARY DISPOSITION OF CERTAIN CASE ALLEGATIONS REGARDING AWS AND ASME CODE PROVISIONS RELATED TO DESIGN ISSUES
TUGC-9	05/18/84	APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING THE EFFECTS OF GAPS ON STRUCTURAL BEHAVIOR UNDER SEISMIC LOADING CONDITIONS
TUGC-10	05/18/84	APPLICANTS' MOTION FOR SUMMARY DISPOSITION OF CASE ALLEGATION REGARDING SECTION PROPERTY VALUES
TUGC-11	05/20/84	APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING UPPER LATERAL RESTRAINT BEAM
TUGC-12	05/20/84	APPLICANTS' MOTION FOR SUMMARY DISPOSITION OF CASE'S ALLEGATIONS REGARDING SAFETY FACTORS
TUGC-13	05/21/84	APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING USE OF GENERIC STIFFNESSES INSTEAD OF ACTUAL STIFFNESSES IN PIPING ANALYSIS

ATTACHMENT A — *Continued*

Source Document	Date	Document Title
TUGC-14	05/23/84	APPLICANTS' MOTION FOR SUMMARY DISPOSITION OF CASE'S ALLEGATIONS REGARDING U-BOLTS ACTING AS TWO-WAY RESTRAINTS
TUGC-15	06/02/84	APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING DESIGN OF RICHMOND INSERTS AND THEIR APPLICATION TO SUPPORT DESIGN
TUGC-16	06/17/84	APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING STABILITY OF PIPE SUPPORTS
TUGC-17	06/18/84	APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING CONSIDERATION OF LOCAL DISPLACEMENTS AND STRESSES
TUGC-18	06/22/84	APPLICANTS' MOTION FOR SUMMARY DISPOSITION OF CASE ALLEGATIONS REGARDING DIFFERENTIAL DISPLACEMENT OF LARGE-FRAMED, WALL-TO-WALL, AND FLOOR-TO-CEILING PIPE SUPPORTS
TUGC-19	06/29/84	APPLICANTS' MOTION FOR SUMMARY DISPOSITION OF CASE'S ALLEGATIONS REGARDING CINCHING DOWN OF U-BOLTS
TUGC-20	07/03/84	APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING ALLEGATIONS CONCERNING QUALITY ASSURANCE PROGRAM FOR DESIGN OF PIPING AND PIPE SUPPORTS FOR COMANCHE PEAK STEAM ELECTRIC STATION
TUGC-21	07/09/84	APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING ALLEGATIONS CONCERNING CONSIDERATION OF FORCE DISTRIBUTION IN AXIAL RESTRAINTS
TUGC-22	08/31/84	CORRECTIONS TO THE RICHMOND INSERT MOTION FOR SUMMARY DISPOSITION
TUGC-23	09/19/84	APPLICANTS' REPLY TO CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING CONSIDERATION OF FRICTION FORCES
TUGC-24	09/21/84	APPLICANTS' REPLY TO CASE'S ANSWER TO APPLICANTS' MOTION REGARDING ALLEGED ERRORS MADE IN DETERMINING DAMPING FACTORS FOR OBE AND SSE LOADING CONDITIONS

ATTACHMENT A — *Continued*

Source Document	Date	Document Title
TUGC-25	09/28/84	APPLICANTS' REPLY TO CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING LOCAL DISPLACEMENTS AND STRESSES
TUGC-26	10/01/84	APPLICANTS' REPLY TO CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING DIFFERENTIAL DISPLACEMENTS OF LARGE-FRAMED, WALL-TO-WALL, AND FLOOR-TO-CEILING PIPE SUPPORTS
TUGC-27	10/26/84	APPLICANTS' REPLY TO CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING THE UPPER LATERAL RESTRAINT BEAM
TUGC-28	10/26/84	APPLICANTS' REPLY TO (1) CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING THE EFFECTS OF GAPS AND (2) BOARD CHAIRMAN'S "PRELIMINARY VIEWS" REGARDING ADDITIONAL PLEADINGS
TUGC-29	11/02/84	APPLICANTS' REPLY TO CASE'S PARTIAL ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING SAFETY FACTORS
TUGC-30	11/12/84	APPLICANTS' REPLY TO CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING SECTION PROPERTIES
TUGC-31	06/06/83	APPLICANT'S RESPONSE TO BOARD INQUIRY REGARDING ITERATIVE DESIGN PROCESS FOR PIPING
TUGC-32	09/14/82	TESTIMONY OF KENNETH L. SCHEPPELE, ROGER F. REEDY, PETER S. Y. CHANG, JOHN C. FINNERAN, AND GARY KRISHNAN REGARDING WALSH ALLEGATIONS
TUGC-33	09/14/82	SUPPLEMENTAL TESTIMONY OF KENNETH L. SCHEPPELE, ROGER F. REEDY, PETER S. Y. CHANG, JOHN C. FINNERAN, AND GARY KRISHNAN REGARDING DOYLE ALLEGATIONS
TUGC-34	09/13/84	DISCUSSION BETWEEN CYGNA ENERGY SERVICES AND TEXAS UTILITIES GENERATING COMPANY AND EBASCO SERVICES, INC.
TUGC-35	05/21/85	TEXAS UTILITIES CPRT MEETING - CYGNA ENERGY SERVICES 05/21/85 AND 05/22/85

Source Document	Date	Document Title
TUGC-36	10/01/82	COMANCHE PEAK STEAM ELECTRIC STATION, DESIGN AND CONSTRUCTION, SELF-INITIATED EVALUATION
TUGC-37	08/01/78	LETTER, H.R. ROCK TO H.C. SCHMIDT RE: PRESSURIZER DISCHARGE PIPING CLASSIFICATION
TUGC-38	08/17/78	LETTER, H.R. ROCK TO H.C. SCHMIDT RE: LICENSING QUESTION
TUGC-39	08/24/78	LETTER, H.R. ROCK TO H.C. SCHMIDT RE: CONFIRMATION OF INSTRUCTIONS - CLASSIFICATION OF PRESSURIZER SAFETY RELIEF VALVE DISCHARGE PIPING
TUGC-40	03/19/79	LETTER, R.J. GARY TO W.C. SEIDLE RE: UNIT NO. 1 REACTOR VESSEL NOZZLE WELD METAL DEFECTS
TUGC-41	08/10/79	LETTER, R.J. GARY TO W.C. SEIDLE RE: PIPE SUPPORTS
TUGC-42	09/11/79	LETTER, R.J. GARY TO W.C. SEIDLE RE: PIPE WALL THICKNESS
TUGC-43	01/23/80	LETTER, R.J. GARY TO W.C. SEIDLE RE: PIPING MINIMUM WALL
TUGC-44	03/28/80	LETTER, R.J. GARY TO W.C. SEIDLE RE: PIPING MINIMUM WALL
TUGC-45	04/21/80	LETTER, R.J. GARY TO W.C. SEIDLE RE: CLASS V PIPING SUPPORTS
TUGC-46	04/15/80	LETTER, R.J. GARY TO W.C. SEIDLE RE: PIPING MINIMUM WALL
TUGC-47	06/19/80	LETTER, R.J. GARY TO W.C. SEIDLE RE: PIPING MINIMUM WALL
TUGC-48	07/14/80	LETTER, R.J. GARY TO W.C. SEIDLE RE: CLASS V PIPING SUPPORTS
TUGC-49	09/18/80	LETTER, R.J. GARY TO W.C. SEIDLE RE: CLASS V PIPING SUPPORTS
TUGC-50	10/21/80	LETTER, R.J. GARY TO W.C. SEIDLE RE: DIESEL GENERATOR PIPE SUPPORTS
TUGC-51	12/16/80	LETTER, R.J. GARY TO W.C. SEIDLE RE: PIPING MINIMUM WALL
TUGC-52	01/12/81	LETTER, R.J. GARY TO W.C. SEIDLE RE: DIESEL GENERATOR PIPE SUPPORTS

ATTACHMENT A — *Continued*

Source Document	Date	Document Title
TUGC-53	04/13/81	LETTER, J.S. MARSHALL TO R.L. TEDESCO RE: PRESERVICE INSPECTION AND TESTING OF SNUBBERS
TUGC-54	07/29/81	LETTER, R.J. GARY TO G.L. MADSEN RE: DIESEL GENERATOR PIPE SUPPORTS
TUGC-55	06/03/81	LETTER, R.J. GARY TO G.L. MADSEN RE: PIPING MINIMUM WALL
TUGC-56	10/02/81	LETTER, R.J. GARY TO G.L. MADSEN RE: DIESEL GENERATOR PIPE SUPPORTS
TUGC-57	03/31/82	LETTER, H.C. SCHMIDT TO S.B. BURWELL RE: FUNCTIONAL CAPABILITY OF CLASS 2 AND 3 BENDS AND ELBOWS
TUGC-58	08/16/82	LETTER, R.J. GARY TO H.R. DENTON RE: DESIGN CERTIFICATION
TUGC-59	05/13/82	LETTER, H.C. SCHMIDT TO S. BURWELL RE: STEAM GENERATOR LEVEL CONTROL
TUGC-60	03/08/83	LETTER, H.C. SCHMIDT TO B.J. YOUNGBLOOD RE: ACCIDENT MONITORING - STEAM GENERATOR SAFETY VALVE POSITION INDICATION
TUGC-61	03/29/83	LETTER, R.J. GARY TO G.L. MADSEN RE: VENDOR INSTALLED HVAC SYSTEM (SDAR-106 CP-83-06)
TUGC-62	06/21/83	LETTER, R.J. GARY TO G.L. MADSEN RE: COMPONENT COOLING WATER CLASS V PIPING (QA FILE: CP-83-11, SDAR-111)
TUGC-63	07/22/83	ALTERNATE SHUTDOWN - INTERIM STAFF EVALUATION
TUGC-64	08/31/83	RESPONSE TO NRC NOTICE OF VIOLATION - INSPECTION REPORT NO. 83-23, FINDING NO. 1
TUGC-65	10/06/83	SER TABLES ON EQUIPMENT QUALIFICATION
TUGC-66	01/05/84	LETTER, H.C. SCHMIDT TO B.J. YOUNGBLOOD RE: HIGH/MODERATE ENERGY PIPE BREAK ANALYSIS
TUGC-67	02/17/84	LETTER, R.J. GARY TO B.J. YOUNGBLOOD RE: REQUEST FOR PARTIAL EXEMPTION
TUGC-68	03/08/84	HUMAN FACTORS CONTROL ROOM DESIGN REVIEW - FINAL REPORT
TUGC-69	04/06/84	TUGCO COMMENTS ON CYGNA'S INDEPENDENT ASSESSMENT PROGRAM

Source Document	Date	Document Title
TUGC-70	06/29/84	LETTER, H.C. SCHMIDT TO B.J. YOUNGBLOOD RE: EQUIPMENT ENVIRONMENTAL QUALIFICATION - JUSTIFICATIONS FOR INTERIM OPERATION
TUGC-71	09/28/84	LETTER, J.W. BECK TO B.J. YOUNGBLOOD RE: IMPACT OF TEMPERATURE DUE TO MAIN STEAM LINE BREAK OUTSIDE CONTAINMENT ON EQUIPMENT THAT REQUIRES ENVIRONMENTAL QUALIFICATION
TUGC-72	01/17/85	LETTER, J.W. BECK TO B.J. YOUNGBLOOD RE: ENGINEERING AND CONSTRUCTION STATUS REPORT
TUGC-73	02/14/85	LETTER, J.W. BECK TO B.J. YOUNGBLOOD RE: MAIN STEAM LINE BREAKS OUTSIDE CONTAINMENT
TUGC-74	04/09/85	LETTER, J.W. BECK TO B.J. YOUNGBLOOD RE: FINAL DRAFT TECHNICAL SPECIFICATIONS
TUGC-75	04/23/85	LETTER, J.W.BECK TO B.J. YOUNGBLOOD RE: TEMPORARY CHANGES TO PROCEDURES
TUGC-76	05/02/85	LETTER, J.W. BECK TO V.S. NOONAN RE: ARBITRARY INTERMEDIATE PIPE BREAKS
TUGC-77	06/07/85	LETTER, J.W. BECK TO V.S. NOONAN RE: NRC GENERIC LETTER 83-28
TUGC-78	07/10/85	LETTER, W.G. COUNSEL TO V.S. NOONAN RE: RESOLUTION OF TMI ACTION ITEMS II.K.3.30 AND II.K.3.31 RELATED TO SMALL BREAK LOCA ANALYSIS
TUGC-79	07/15/85	LETTER, W.G. COUNSEL TO V.S. NOONAN RE: CLARIFICATION TO TEXAS UTILITIES LETTER TXX-4426
TUGC-80	10/14/85	LETTER, W.G. COUNSEL TO V.S. NOONAN RE: RESPONSE TO GENERIC LETTER 85-06 (ANTICIPATED TRANSIENTS WITHOUT SCRAM)
TUGC-81	12/20/85	LETTER, J.W. BECK TO E.H. JOHNSON RE: DAMAGE STUDY EVALUATION OF WESTINGHOUSE SDAR: CP-85-46
TUGC-82	02/28/86	LETTER, W.G. COUNSEL TO V.S. NOONAN RE: USE OF ASME CODE EDITION AND ADDENDA
TUGC-83	12/15/86	TRANSCRIPT OF CYNGA/SWEC MEETING IN GLEN ROSE, TEXAS

Source Document	Date	Document Title
TUGC-84	04/05/84	APPLICANTS' MOTION FOR SUMMARY DISPOSITION OF CERTAIN CASE ALLEGATIONS REGARDING AWS AND ASME CODE PROVISIONS RELATED TO WELDING ISSUES REQUEST FOR EXPEDITED RESPONSE
XASL-001	08/19/83	MEMORANDUM AND ORDER - MOTION FOR CLARIFICATION ON THERMAL STRESS IN PIPE SUPPORTS
XASL-002	07/06/83	MEMORANDUM AND ORDER - THERMAL STRESS IN PIPE SUPPORTS
XASL-003	10/18/84	MEMORANDUM AND ORDER - MORE DETAIL ON INDIVIDUAL PIPE SUPPORTS
XASL-004	11/10/83	AFFIDAVIT OF JACK DOYLE
XASL-005	10/06/83	PARTIAL INITIAL DECISION (CHANGE IN MATERIAL PROPERTIES FOR A500 STEEL)
XCAS-001	08/16/83	CASE'S ANSWER TO APPLICANTS' MOTION FOR CLARIFICATION OF MEMORANDUM AND ORDER ON THERMAL STRESS AND PIPE SUPPORTS
XCAS-002	07/15/83	MOTION FOR RECONSIDERATION OF BOARD'S 07/06/87 MEMORANDUM AND ORDER - THERMAL STRESS IN PIPE SUPPORTS
XCAS-003	05/09/83	CASE'S RESPONSE TO BOARD's REQUEST FOR DISCUSSION OF INTERRELATIONSHIP OF ASME APPENDIX XVII, 2271.3, TO REST OF ASME CODE
XCAS-004	10/06/84	CASE'S STATEMENT OF MATERIAL FACT AS TO WHICH THERE IS NO GENUINE ISSUE REGARDING CASE'S FIRST MOTION FOR SUMMARY DISPOSITION REGARDING CERTAIN ASPECTS OF THE IMPLEMENTATION OF APPLICANTS' DESIGN
XCAS-005	09/26/84	CASE'S ANSWER TO APPLICANTS' RESPONSE TO BOARD'S PARTIAL INITIAL DECISION REGARDING A500 STEEL
XCAS-006	05/14/84	CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION OF CERTAIN CASE ALLEGATIONS REGARDING AWS AND ASME CODE PROVISIONS RELATED TO WELDING ISSUES
XCAS-007	01/17/85	CASE'S 01/17/85 SUPPLEMENT TO CASE'S ANSWER TO APPLICANTS' MOTION FOR SUMMARY DISPOSITION REGARDING LOCAL DISPLACEMENTS AND STRESSES

ATTACHMENT A — *Continued*

Source Document	Date	Document Title
XCAS-008	11/05/84	CASES ANSWER TO APPLICANTS' RESPONSE TO BOARD REQUEST FOR INFORMATION REGARDING CINCHING DOWN U-BOLTS
XNRC-001	05/11/83	NRC STAFF RESPONSE TO BOARD INQUIRY REGARDING APPENDIX XVII OF THE ASME BOILER AND PRESSURE VESSEL CODE
XNRC-002	05/03/83	NRC STAFF REPLY TO CASE'S BRIEF REGARDING CONSIDERATION OF LOCA IN DESIGN CRITERIA FOR PIPE SUPPORTS
XNRC-003	04/29/83	NRC STAFF MOTION FOR PROTECTIVE ORDER
XNRC-004	04/20/83	NRC STAFF ANSWER TO CASE MOTIONS SEEKING ADMISSION OF DOCUMENTS
XNRC-005	06/02/82	NRC STAFF'S ANSWER SUPPORTING APPLICANTS' MOTION FOR SUMMARY DISPOSITION OF CONTENTION 5
XNRC-006	03/15/82	NRC STAFF'S ANSWER TO CFUR'S MOTION FOR VOLUNTARY DISMISSAL
XNRC-007	09/28/84	NRC STAFF RESPONSE TO APPLICANTS' AND CASE'S FINDINGS OF FACT ON WELD FABRICATION
XNRC-008	02/02/84	NRC STAFF'S RESPONSE TO CASE'S (1) DECEMBER 23, 1983 RESPONSE TO APPLICANTS' IDENTIFICATION OF ISSUES, AND (2) JANUARY 16, 1984 CLARIFICATION OF ISSUES IN 12/23/83 PLEADING
XNRC-009	02/06/84	NRC STAFF RESPONSE TO CASE'S MOTION FOR RECONSIDERATION OF BOARD'S 12/28/83 MEMORANDUM AND ORDER (QUALITY ASSURANCE FOR DESIGN)
XNRC-010	01/27/84	NRC STAFF RESPONSE TO APPLICANTS' MOTION FOR RECONSIDERATION OF MEMORANDUM AND ORDER (QUALITY ASSURANCE FOR DESIGN)
XNRC-011	12/13/83	NRC STAFF MOTION TO REOPEN RECORD TO ADMIT THE AFFIDAVIT OF DR. JAI RAJ N. RAJAN
XNRC-012	12/13/83	NRC STAFF RESPONSE TO CASE'S MOTION FOR RECONSIDERATION (AFFIDAVITS ON OPEN ITEMS RELATING TO WALSH/DOYLE ALLEGATIONS)
XNRC-013	10/28/83	NRC STAFF RESPONSE TO BOARD QUESTION REGARDING APPLICABLE WELDING CODES AT CPSES

ATTACHMENT A — *Continued*

Source Document	Date	Document Title
XNRC-014	09/12/83	NRC INSPECTION REPORT 50-445/83-24, 50-446/83-15
XNRC-015	02/17/83	LETTER FROM G. L. MADSEN, CHIEF, REACTOR PROJECT BRANCH 1, TO R. J. GARY, EXECUTIVE VICE PRESIDENT AND GENERAL MANAGER, TUGCO
XNRC-016	04/13/83	LETTER FROM COUNSEL FOR NRC STAFF TO ASLB IN THE MATTER OF TEXAS UTILITIES GENERATING COMPANY, ET AL. (COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2) DOCKET NOS. 50-445 AND 50-446
XNRC-017	03/17/83	LETTER FROM COUNSEL FOR NRC STAFF TO ASLB IN THE MATTER OF TEXAS UTILITIES GENERATING COMPANY, ET AL. (COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2) DOCKET NOS. 50-445 AND 50-446
XNRC-018	02/22/83	COUNSEL FOR NRC STAFF - IN THE MATTER OF TEXAS UTILITIES GENERATING COMPANY, ET AL. (COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2) DOCKET NOS. 50-445 AND 50-446
XNRC-019	02/08/83	LETTER FROM NRC STAFF COUNSEL TO ASLB IN THE MATTER OF TEXAS UTILITIES GENERATING COMPANY, ET AL. (COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2) DOCKET NOS. 50-445 AND 50-446
XNRC-020	02/18/82	LETTER FROM NRC STAFF COUNSEL TO ASLB IN THE MATTER OF TEXAS UTILITIES GENERATING COMPANY, ET AL. (COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2) DOCKET NOS. 50-445 AND 50-446
XNRC-021	03/27/83	LETTER AND REPORT ENTITLED "REVIEW OF CONCERNS EXPRESSED BY CITIZENS ASSOCIATION FOR SOUND ENERGY ABOUT CONDUCT OF REGION IV INVESTIGATIONS/INSPECTION TO ASLB"
XNRC-022	11/04/83	COUNSEL FOR NRC STAFF IN THE MATTER OF TEXAS UTILITIES GENERATING COMPANY, ET AL. (COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2) DOCKET NOS. 50-445 AND 50-446

Source Document	Date	Document Title
XNRC-023	11/01/83	COUNSEL FOR NRC STAFF IN THE MATTER OF TEXAS UTILITIES GENERATING COMPANY, ET AL. (COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2) DOCKET NOS. 50-445 AND 50-446
XNRC-024	10/14/83	COUNSEL FOR NRC STAFF IN THE MATTER OF TEXAS UTILITIES GENERATING COMPANY, ET AL. (COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2) DOCKET NOS. 50-445 AND 50-446
XNRC-025	12/31/84	LETTER FROM D. R. HUNTER, CHIEF, REACTOR PROJECT BRANCH 2, TO M. D. SPENCE, PRESIDENT, TUGCO
XNRC-026	05/17/84	LETTER FROM COUNSEL FOR NRC STAFF TO ASLB IN THE MATTER OF TEXAS UTILITIES ELECTRIC COMPANY, ET AL. COMANCHE PEAK STEAM ELECTRIC COMPANY, ET AL. (COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2)
XNRC-027	05/11/84	ADDENDUM TO PAGE 27 OF NRC STAFF TESTIMONY ON WELDING FABRICATION CONCERNS RAISED BY MR. AND MRS STINES.
XNRC-028	04/24/84	LETTER FROM NRC TO APPLICATNT IN THE MATTER OF THE NRC STAFF RECEIVING ALLEGATIONS OF IMPROPER CONSTRUCTION PRACTICES, ET. AL. (COMANCHE PEAK STEAM ELECTRIC COMPANY, UNIT 1 AND 2). DOCKET NS. 50-445 AND 50-446.
XTUG-001	02/18/87	APPLICANTS' INTERROGATORIES TO INTERVENER, (SET NO. 1987-4)
XTUG-002	08/02/83	APPLICANTS MOTION FOR CLARIFICATION OF MEMORANDUM AND ORDER ON THERMAL STRESS AND PIPE SUPPORTS
XTUG-003	05/11/83	APPLICANTS' SUPPLEMENTAL REPLY BRIEF REGARDING PIPE SUPPORT DESIGN
XTUG-004	05/03/83	APPLICANTS' REPLY BRIEF REGARDING CONSIDERATION OF LOCA IN DESIGN CRITERIA FOR PIPE SUPPORTS
XTUG-005	04/21/83	APPLICANTS' BRIEF REGARDING CONSIDERATION OF THERMAL STRESSES IN DESIGN OF PIPE SUPPORTS

Source Document	Date	Document Title
XTUG-006	07/03/84	APPLICANTS' STATEMENT OF MATERIAL FACTS AS TO WHICH THERE IS NO GENUINE ISSUE RE APPLICANTS' QUALITY ASSURANCE PROGRAM FOR DESIGN OF PIPING AND PIPE SUPPORTS FOR COMANCHE PEAK STEAM ELECTRIC STATION
XTUG-007	06/29/84	APPLICANTS' STATEMENT OF MATERIAL FACTS AS TO WHICH THERE IS NO GENUINE ISSUE REGARDING CONSIDERATION OF CINCHING U-BOLTS
XTUG-008	06/18/84	APPLICANTS' STATEMENT OF MATERIAL FACTS AS TO WHICH THERE IS NO GENUINE ISSUE REGARDING CONSIDERATION OF LOCAL DISPLACEMENTS AND STRESSES
XTUG-009	06/17/84	APPLICANTS' STATEMENT OF MATERIAL FACTS AS TO WHICH THERE IS NO GENUINE ISSUE REGARDING STABILITY OF PIPE SUPPORTS
XTUG-010	06/02/84	APPLICANTS' STATEMENT OF MATERIAL FACTS RELATING TO RICHMOND INSERTS AS TO WHICH THERE ARE NO MATERIAL ISSUES
XTUG-011	05/20/84	APPLICANTS' STATEMENT OF MATERIAL FACTS AS TO WHICH THERE IS NO GENUINE ISSUE
XTUG-012	05/16/84	APPLICANTS' STATEMENT OF MATERIAL FACTS AS TO WHICH THERE IS NO GENUINE ISSUE
XTUG-013	05/16/84	APPLICANTS' STATEMENT OF MATERIAL FACTS AS TO WHICH THERE IS NO GENUINE ISSUE REGARDING CONSIDERATION OF FRICTION FORCES IN THE DESIGN OF PIPE SUPPORTS WITH SMALL THERMAL MOVEMENTS
XTUG-014	05/16/84	APPLICANTS' STATEMENT OF MATERIAL FACTS AS TO WHICH THERE IS NO GENUINE ISSUE REGARDING APPLICANTS' CONSIDERATION OF DAMPING FACTORS FOR OBE AND SSE LOADING CONDITIONS
XTUG-015	06/01/83	COUNSEL FOR TUGCO - RE: TEXAS UTILITIES GENERATING CO., ET AL. (COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2) DOCKET NOS. 50-445 AND 50-446
XTUG-016	11/19/84	APPLICANTS' REPLY TO CASE'S MOTION CONCERNING INFORMATION REGARDING CINCHING DOWN U-BOLTS

Source Document	Date	Document Title
XTUG-017	11/16/84	APPLICANTS' REPLY TO CASE'S ANSWER TO APPLICANTS' RESPONSE TO BOARD'S PARTIAL INITIAL DECISION REGARDING A500 STEEL
XTUG-018	11/05/84	APPLICANTS' MOTION FOR RECONSIDERATION OF MEMORANDUM AND ORDER (MORE DETAIL ON INDIVIDUAL PIPE SUPPORTS)
XTUG-019	07/11/84	COUNSEL FOR APPLICANTS RE: TEXAS UTILITIES COMPANY, ET AL. (COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2), DOCKET NOS. 50-445 AND 50-446
XTUG-020	06/29/84	COUNSEL FOR APPLICANTS - SUBJ. TEXAS UTILITIES ELECTRIC, ET AL. (COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2 DOCKET NOS. 50-445 AND 50-446)
XTUG-021	06/17/84	LETTER FROM APPLICANTS' COUNSEL TO ASLB - SUBJ. TEXAS UTILITIES COMPANY, ET AL. (COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2) DOCKET NOS. 50-445 AND 50-446
XTUG-022	04/11/84	APPLICANTS' RESPONSE TO PARTIAL INITIAL DECISION REGARDING A500 STEEL
XTUG-023	06/02/84	LETTER FROM COUNSEL FOR APPLICANT TO ASLB IN THE MATTER OF ALLEGATIONS REGARDING SAFETY FACTORS, ET. AL. (COMANCHE PEAK STEAM ELECTRIC COMPANY, UNIT 1 AND UNIT 2) DOCKET NOS. 50-445 AND 50-446.

ATTACHMENT B

OTHER DIRs

ATTACHMENT B

The following three categories were established for DIRs which were not covered by External Source Issues/Primary DIRs. Each DIR was resolved individually. A summary of the closures follows:

CATEGORY — MISCELLANEOUS (#36)

1. DIRs with no specific concern identified. These DIRs are classified as unsubstantiated:

DIR E-0323	Subject:	Cygna desire to complete review of procedures.
	Resolution:	No concern identified.
DIR E-0812	Subject:	Overthickness in pipe.
	Resolution:	No specifics identified; only mentioned as a subject to be covered later.
DIR E-0940	Subject:	Responsiveness of SIT Report to Walsh/Doyle items.
	Resolution:	All Walsh/Doyle items are addressed by SWEC's GTIR.
DIR E-1198	Subject:	Assymetric dynamic loads on Reactor Coolant System.
	Resolution:	Issue was indicated as "undergoing staff review" in SSER 6. Limited information is provided for DAP review.
DIR E-1199	Subject:	NRC review of WECAN computer program not complete.
	Resolution:	Program not used in SWEC's requalification program.
DIR E-1200	Subject:	Resolution of [illegible] Action Items.
	Resolution:	Document (TUGCO-78) describes resolution - FSAR revision. Any further resolution required will be identified by the NRC in subsequent SSERs.
DIR E-1201	Subject:	Use of Code Cases N-397 and N-411.
	Resolution:	Per NRC letter from V.S. Noonan to W.G. Council dated 3/13/86, the NRC approves use of these Code Cases, provided listed requirements are met.

2. Concerns closed outside of DSAP IX review and/or closed as invalid. These DIRs are classified as Observations or Unsubstantiated:

DIR E-0242	Subject:	Functional capability of austenitic bends/elbows.
	Resolution:	NRC raised the issue in the SER; a method was developed and applied on a sampling basis; NRC closed it in SSER #3.
DIR E-0347	Subject:	Improper use of temporary supports, and the erection process in general, could have damaged Main Steam pipes
	Resolution:	Per ISAP V.e. Results Report the issue is closed.
DIR E-0354	Subject:	Snubber failure after steam/water hammer.
	Resolution:	Snubbers are load rated by vendors. Given that piping loads are properly determined and correct snubber size is chosen, the supports should not fail.
DIR E-0586	Subject:	Combined load evaluation for AWS weld evaluation.
	Resolution:	TUGCO satisfies CASE's question later in the external source document (NRCT-13).

DIR E-0858	Subject:	ANI is responsible for interpretation of ASME Code.
	Resolution:	DAP disagrees with Doyle. ANI does not interpret engineering related matters; the only design related responsibility is to ensure that the required analysis has been done and is properly certified.
DIR E-0936	Subject:	OBE vs. SSE loads.
	Resolution:	No error occurred. Damping values were based on Reg. Guide 1.61. The Reg. Guide damping values are noted as being conservative per recent WRC studies (WRC-300).
DIR E-1176	Subject:	Incorrectly calculated pipe stress allowable.
	Resolution:	Per ASLB-43, the allowables are shown to be correctly calculated.
DIR E-1191	Subject:	Whether or not all seismic restraints must be +/–.
	Resolution:	Third Party agrees with TUGCO's response - that uni-directional supports can be used if dead weight is larger than the +Y loads.

3. Concerns with TUGCO arguments that are not pertinent to SWEC resolutions. These DIRs are classified as Unclassified Deviations:

DIR E-0560	Subject:	Snubber capacity test results.
	Resolution:	Per CPPP-7, the allowable loads are stated in vendor LCD sheets or certified design report summaries. These test results are not used.
DIR E-0778	Subject:	Inelastic deformation in bolts used to justify shear distribution among base plate bolts.
	Resolution:	SWEC does not use bolt deformation to justify shear distribution among base plate bolts, but bases their procedure/resolution on NF-4721.
DIR E-0843	Subject:	Effects of bolt hole gaps on material and impact damping.
	Resolution:	SWEC does not use impact or material damping to justify their approach to the bolt hole gap issue, but bases their procedure/resolution on NF-4721.
DIR E-1195	Subject:	U-bolt cinching; can torqueing or paint be used for locking.
	Resolution:	Per PM-82 Rev 1, cinched U-bolts are eliminated. Jam nuts or lock nuts are used on stiff clamps.

4. Calculation/Procedural concerns. Addressed by SWEC in CPPP-6 and 7:

DIR E-0062	Subject:	STRUDL analysis guidelines.
	Resolution:	Supports analyzed using STRUDL are checked against NF Code requirements.
DIR E-0134	Subject:	Member bearing may be inappropriately considered for compression loads on welds.
	Resolution:	CPPP-7, Att. 4-2 requires compression to be considered.

DIR E-0295	Subject:	Combining SRV and seismic loads in Emergency for Main Steam pipe.
	Resolution:	CPPP-7, Table 3.5-1 and 3.5-2 requires SRV and SSE to be combined in the Faulted condition. This change in load combination required an FSAR change, which was incorporated in Amendment 61 (per DIR C-0024).
DIR E-0313, DIR E-0734, DIR E-0823, DIR E-1188	Subject:	Spring travel, frame gap, and swing angle evaluation for seismic and fluid transients.
	Resolution:	CPPP-7, Att. 4-1 requires that displacements be calculated for spring travel evaluation using Table 4.7.2-1 combinations (which include seismic and fluid transient). Frame gaps are addressed in DAP-E-P-019, and swing angles in DAP-E-P-004.
DIR E-0322	Subject:	Embedded plates - connections assumed as pinned, and stiffeners required for moment connections.
	Resolution:	CPPP-7 does not require that attachments to embedded plates be assumed as pinned, and per CPPP-6, calculated loads are transmitted to SWEC-CAP for evaluation.
DIR E-0735	Subject:	Spacing of attachments to embedded plates.
	Resolution:	Per CPPP-6, support reactions on embedded plates are transmitted to SWEC-CAP for evaluation.
DIR E-0969	Subject:	Gang supports pinned to building structures were not considered interactively between attached piping.
	Resolution:	CPPP-7, Att. 4-9 requires elimination of pinned attachments of ganged supports to building structures.
DIR E-1174	Subject:	Stresses due to reduced pipe wall thickness.
	Resolution:	Reduced wall thickness is evaluated per CPPP-7, Att. 3-14 and PM-137.

CATEGORY — GENERIC/CUMULATIVE (#37)

1. Concern with inconsistent and nonstandard criteria. Addressed by SWEC requalification program use of CPPP Procedures:

DIR E-0008	Subject:	Inconsistent criteria for STRUDL.
	Resolution:	CPPP-7 defines criteria and methods for requalification of supports. SWEC uses its own version of STRUDL, and has issued controlled user's manuals.
DIR E-0331	Subject:	Non-standard pipe support designs invalidate standard engineering assumptions and practices.
	Resolution:	CPPP-7 defines criteria and methods for requalification of supports, ensuring all supports in SWEC's scope are re-evaluated based on industry codes/standards.

DIR E-0523	Subject:	Unresolved issues related to provisions of GDC-1.
	Resolution:	Specific items were addressed under SWEC's requalification program, including: Skewed "T" joint welds, Flare bevel welds, Punching shear, and Tube-to-tube welds. (See DAP-E-P-008 and DAP-E-P-027).
DIR E-0884	Subject:	Piping analysis techniques have changed.
	Resolution:	CPPP-7 defines criteria and methods for requalification of piping. Loads generated in these analyses will be incorporated into support designs.

2. Concern with cumulative effects of specific concerns. Each specific concern was individually addressed by SWEC, thereby eliminating the cumulative effects concern:

DIR E-0658,
DIR E-0720,
DIR E-0730,
DIR E-0731

Subject:	Resolution:
SIFs	See DAP-E-P-026
Fluid/insulation weights of valves and flanges	See DAP-E-P-026
Mass point spacing	See DAP-E-P-017
Support mass	See DAP-E-P-015
Support stiffness	See DAP-E-P-005
Valve acc. generic study	See DAP-E-P-025
Flange load generic study	See DAP-E-P-025
Welded attachments	See DAP-E-P-002
SS elbow functional capability	CPPP-7, Att. 3-16
Support self-weight excitation	See DAP-E-P-020

CATEGORY — WESTINGHOUSE

Concern with seismic damping in Westinghouse piping analysis:

DIR E-0035,
DIR E-0121,
DIR E-0135,
DIR E-0230,
DIR E-0526,
DIR E-0527,
DIR E-0528,
DIR E-0583,
DIR E-0641,
DIR E-0785,
DIR E-0787,
DIR E-0972,
DIR E-0983

Subject: Loads on one support were greater for Norm/Upset than Emerg/Fault. The damping values used in the OBE/SSE analysis of a 3" pipe were questioned (2,4%)

Resolution: FSAR specifies 2% and 4% damping for OBE and SSE for 12" and larger piping; it also permits CC N-411 damping. Westinghouse memo TCX-SDI-150 notes damping used for RCL analysis is justified/documented in FSAR Sect. 1A(N)-34, and that the specific analysis in question (1-41) is based on N-411 damping. (All DIRs in this category were transferred to DIR E-0121.)

ATTACHMENT C

PROJECT MEMORANDA

ATTACHMENT C

Procedure No.	Title	Rev. No.	Date of Issue
	REVIEWED AS PART OF CPPP-7, REVISION 2		
PM-001	Pipe Support Computer Program Usage	1	01/08/86
PM-003	Design Information Request Procedure	0	11/18/85
PM-016	Qualification of Two (2) Bolt Base Plates	0	01/24/86
PM-025	Gang Hanger and Terminal Anchor Procedure - Unit 2	0	02/28/86
PM-026	Impact Testing of Integral Attachments	0	02/28/86
PM-039	Administrative Procedure for Qualifying Wall-to-Wall, Floor-to-Floor, and Corner Pipe Supports	2	07/21/86
PM-050	Procedure to Adjust the Seismic Response Acceleration for Valve Qualification	1	06/16/86
PM-051	Integral Welded Attachment (IWA) Task Group	0	05/09/86
PM-052	Through-Bolt Allowable Load Criteria	0	05/09/86
PM-053	CPPP-7, Rev. 2, Sec. 3.6.4 (Essential Systems)	0	05/15/86
PM-054	Project Engineering Assurance Engineer Responsibilities	0	05/15/86
PM-055	Weld Design Criteria for Pipe Supports	0	05/19/86
PM-056	Simplified Method for Qualification of As-Built Small Bore Piping	1	12/03/86
PM-057	Floor Slabs with 2" Concrete Topping	0	06/16/86
PM-058	Pipe Support Member Stress due to LOCA for CT and SI Systems	0	06/18/86
PM-059	Two-Bolt Baseplate Qualification Procedure	0	06/18/86
PM-060	Revised Pad Width Requirements for Attachment 4-6A of CPPP-7	0	06/18/86
PM-061	Mismatch SIFs	0	06/23/86
PM-062	Calculation of Support Loads for Non-Nuclear Safety Related Piping Attached to an ASME III Support	0	06/24/86
PM-063	Pipe Support Clearance Requirements	0	06/24/86
PM-064	As-Built Verification of Base Plate Using Drilled-In Expansion-Type Concrete Anchors	1	07/14/86
PM-065	Use of Hardened Beveled Washers	0	06/24/86
PM-066	Pipe Wall Thinning Criteria	2	10/09/86

ATTACHMENT C — *Continued*

Procedure No.	Title	Rev. No.	Date of Issue
PM-067	Suggested Distance Between Mass Points	0	06/24/86
PM-068	Weld Termination at Member Edges	0	06/24/86
PM-071	Local Stress Evaluation for Dual Trunnion Anchors	0	06/25/86
PM-072	Anchor Stiffness for APE (ST-378) Computer Program	0	06/25/86
PM-074	Code Case N318 Computer Program	1	11/21/86
PM-075	Design Considerations for E-Systems and Western Piping Stiff Clamps used on Main Steam and Feedwater Piping	0	07/07/86
PM-076	Local Stress Check in Tube Section	0	07/07/86
PM-077	Code Case 392 Computer Program	0	07/07/86
PM-079	Revised NF17 Code Check Equation Tables	0	07/14/86
PM-080	Clarification of Attachment 4-2 of CPPP-7	0	07/14/86
PM-081	New Release of STRUDAT/SANDUL	0	07/14/86
PM-082	Modifications to Cinched U-Bolts	1	12/26/86
PM-083	Procedure for Evaluating Cinched U-Bolt Supports	1	09/23/86
PM-084	Clarification of S^{**} for CT and SI Piping Systems	0	07/21/86
PM-085	Local Stress Evaluation for Pipe-to-Pipe Bearing	0	07/21/86
PM-086	CPPP-11, Administrative Control of Calculations	1	02/13/87
PM-087	Analytical Requirements for Penetration Sleeve Seals and Boots	0	07/21/86
PM-088	Correction of Typographical Errors - CPPP-7	0	07/21/86
PM-089	Elimination of Hanger Engineering Data Report (HEDR)	1	02/13/87
PM-090	Review of NCRs for Potential Reportability	1	12/16/86
PM-091	Problem Boundary Modifications	0	07/31/86
PM-092	Computer Program for Pipe Support Analyses	0	07/31/86
PM-093	Allowables For 3/8-in. Diameter Hilti Kwik Bolts with 1 5/8 in. Embedment Depth	0	07/31/86
PM-094	Revised Procedure for the Qualification of Clamp Anchors	0	07/31/86
PM-095	Cinched U-Bolt Analysis Computer Program	0	08/13/86
PM-096	Piping Decoupling Criteria	1	09/10/86

Procedure No.	Title	Rev. No.	Date of Issue
PM-097	Pipe Support Welded Tube Steel Joints	0	08/20/86
PM-098	Local Stress Evaluation for Uncinched U-Bolt Supports	0	08/20/86
PM-099	Allowables for Hilti Anchors Having Edge Distance Less Than 5D	0	08/20/86
PM-100	Additional Direction for Self-Weight Computer Input	0	08/20/86
PM-102	Local Pipe Stresses Due to Longitudinal Bearing Loads	1	10/09/86
PM-103	Allowable Valve Accelerations	0	08/21/86
PM-104	Stress Intensification Factors	0	08/26/86
PM-105	Thermal Expansion Range Stress for Run Pipe Local Stress Evaluation	0	08/28/86
PM-106	Proposed Modification Reports	0	09/09/86
PM-107	Reactor Coolant Loop (RCL) Movements	0	09/10/86
PM-108	Local Stress Evaluation Procedure	1	10/01/86
PM-109	Local Member Stress Induced by Nuts Bearing Against Tube Steel Wall	0	09/08/86
PM-110	Allowable Loads for A193 Grade B7 Threaded Rods	0	09/10/86
PM-111	Procedure for Modeling Tie-Back Supports	0	09/08/86
PM-112	Thermal Expansion of Long Tube Steel	0	09/18/86
PM-113	Additional Plastic Moments for Interface Anchors	0	09/30/86
PM-114	Cinched U-Bolt Computer Program Clarification	0	09/30/86
PM-115	Code Case N318-2 and N413 Usage	0	09/30/86
PM-116	Self-Weight Excitation Loads for Tie-Back Supports	0	09/30/86
PM-117	New Release of SANDUL	0	09/30/86
PM-118	Calculation Transmittals and Distribution Requirements	0	10/09/86
PM-119	Allowable Stress Range for Expansion Stresses S_A	0	10/09/86
PM-120	Small Bore Pipe Strap Stiffness	0	10/09/86
PM-121	Loads and Movements Required to be Shown on Pipe Support Drawings	0	10/09/86
PM-122	Effect of Construction Tolerance on Pipe Support Stiffness	0	10/20/86

Procedure No.	Title	Rev. No.	Date of Issue
PM-123	Effective Fillet Weld Length for Trunnion-to-Elbow Connection	0	10/20/86
PM-124	Procedures for Qualifying Decoupled Vent/Drain and Free-End Connections	0	10/20/86
PM-126	SA, PSM, and PSC - Memos	0	10/20/86
	REVIEWED AS PART OF ISSUE RESOLUTION		
PM-039	Administrative Procedure for Qualifying Wall-to-Wall, Floor-to-Floor, and Corner Pipe Supports	3	6-02-87
PM-103	Allowable Valve Accelerations	0	8-21-86
PM-110	Allowable Loads for A193 Grade B7 Threaded Rods	0	4-14-87
PM-133	Final Reconciliation Check List	1	5-27-87
PM-135	Sections of CPPP-7, Rev. 3, Which Require Confirmation	0	2-23-87
PM-137	Wall Thinning Criteria	0	3-18-87
PM-138	Dynamic Analysis of Fluid Transient Loading	0	3-31-87
PM-139	Procedure for Evaluating Pipe Stresses at Stiff Clamp Supports	0	3-31-87
PM-140	Flare Bevel Groove Welds	1	05-01-87
PM-141	Unequal Shear Loading Effect on Richmond Inserts and Threaded Rods Used in Conjunction with Tube Steel		3-25-87
PM-146	The Use of Galvanized Nuts on CPSES	0	4-20-87
PM-151	PSAP RELAP 5, and REPIPE Computer Programs	0	5-01-87
PM-154	Axial Restraints with Lugs	0	5-07-87
PM-155	SIF Evaluation of Branch Connections	0	6-08-87
PM-157	Break/Crack Postulation, Pipe Stress Analysis, and Pipe Qualification Requirements for Class 5 High and Moderate Energy Lines - Units 1 and 2	0	5-13-87
PM-162	Circular Trunnion Attachments to Elbows	0	5-22-87
PM-163	CPPP-7 Piping and Pipe Supports Code Applicability Changes	0	5-27-87
PM-164	Overall Final Assessment Review of Piping Systems	1	6-19-87
PM-165	Screening Procedure - Fluid Transient Cutoff Loads	1	6-25-87

ATTACHMENT C — *Continued*

Procedure No.	Title	Rev. No.	Date of Issue
PM-166	Pipe Stress and Support System Review Checklist	0	5-28-87
PM-167	Use of Computer Program PITRIFE (ME-211)	0	6-03-87
PM-170	Revised Procedure for Qualification of Elbows with Branch Connections	0	6-08-87
PM-178	Resolution of TERA Fluid Transients Issues	0	6-25-87

ATTACHMENT D

ABBREVIATIONS AND ACRONYMS LIST

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ABBREVIATIONS AND ACRONYMS LIST

Abbreviation or Acronym	Explanation
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ARS	Amplified Response Spectra
ASLB	Atomic Safety and Licensing Board
ASME	American Society of Mechanical Engineers
AWS	American Welding Society
CAP	Corrective Action Program
CASE	Citizens Association for Sound Energy
CFR	Code of Federal Regulations
CPPP	Comanche Peak Project Procedures
CPRT	Comanche Peak Response Team
CPSES	Comanche Peak Steam Electric Station
CVCS	Chemical and Volume Control System
DAP	Design Adequacy Program
DIR	Discrepancy/Issue Resolution Report
DOF	Degrees of Freedom
DSAP	Discipline Specific Action Plan
ESIS	Exernal Source Issue Summary
FSAR	Final Safety Analysis Report
FW	Feedwater
GENX	Stone & Webster Generic Calculation Number
GIR	Generic Issues Report
Hz	Hertz (Cycles per Second)
IRR	Issue Resolution Report
ISAP	Issue Specific Action Plan
KSI	KIPs (Thousand Pounds) Per Square Inch
LOCA	Loss of Coolant Accident
MS	Main Steam
N/A	Not Applicable
N/C	Not Checked
NRC	United States Nuclear Regulatory Commission

Abbreviation or Acronym	Explanation
OBE	Operating Base Earthquake
PCI	Prestressed Concrete Institute
QA	Quality Assurance
RLCA	R.L. Cloud Associates
RTL	Review Team Leaders
RV	Relief Valves
S/RV	Safety/Relief Valve
SAT	Satisfactory
SER	Safety Evaluation Report
SSER	Supplemental Safety Evaluation Report
SIF	Stress Intensification Factors
SRSS	Square Root Sum of the Squares
SRT	Senior Review Team
SSE	Safe Shutdown Earthquake
SWEC	Stone and Webster Engineering Corporation
TRT	Technical Review Team
TU	Texas Utilities
TUGCO	Texas Utilities Generating Company
UNSAT	Unsatisfactory
WRC	Welding Research Counsil
ZPA	Zero Period Acceleration