COMANCHE PEAK
STEAM ELECTRIC STATION

UNIT 1 and COMMON

CORRECTIVE ACTION PROGRAM

PROJECT STATUS REPORT

HEATING, VENTILATION AND AIR CONDITIONING
(H V A C)

TUELECTRIC

Generating Division

Revision 0

TU ELECTRIC
COMANCHE PEAK STEAM ELECTRIC STATION
UNIT 1 AND COMMON

EBASCO SERVICES INCORPORATED

PROJECT STATUS REPORT

HEATING, VENTILATION AND AIR CONDITIONING (HVAC)

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EXECUTIVE SUMMARY

This Project Status Report (PSR) summarizes the systematic validation process for safety-related Heating, Ventilation and Air Conditioning (HVAC) duct, HVAC supports[1] and HVAC systems implemented by Ebasco Services Incorporated (Ebasco) at Comanche Peak Steam Electric Station (CPSES) Unit 1 and Common[2]. This Project Status Report (PSR) presents the results of the design validation and describes the Post Construction Hardware Validation Program (PCHVP). Ebasco activities are governed by the TU Electric Corrective Action Program (CAP) which required Ebasco to:

1. Establish a consistent set of CPSES safety-related HVAC duct, HVAC supports and HVAC systems 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 safety-related systems, structures and components, and direct the corrective actions recommended by the Comanche Peak Response Team (CPRT) and those determined by Corrective Action Program (CAP) investigations to be necessary to demonstrate that safety-related systems, structures and components are in conformance with the design criteria.

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1 Unless otherwise noted, HVAC duct includes the HVAC plenums and HVAC air handling units; and HVAC supports includes HVAC duct supports and HVAC equipment supports.

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

4. Assure that the validation resolves the safety-related HVAC duct, HVAC supports and HVAC systems related design and hardware issues identified by the Comanche Peak Response Team (CPRT), external sources[3] and the Corrective Action Program (CAP).

5. Validate that the design of safety-related HVAC duct, HVAC supports and HVAC 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 Unit 1 and Common safety-related HVAC duct, HVAC supports and HVAC systems has been developed and used by Ebasco for the design validation process. This set of design criteria is in conformance with the CPSES licensing commitments. To provide added assurance of the conservatism of the analytical methods, design criteria and of the design adequacy of the HVAC duct and HVAC supports, engineering studies were performed and a comprehensive testing program was conducted.

Ebasco established design control procedures to implement the design criteria and engineering methods 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 which have been implemented throughout the HVAC portion of the Corrective Action Program (CAP).

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3 External source issues are identified by the following:

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

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

- o Design Adequacy Program (DAP)
- o Quality of Construction Program (QOC)

Ebasco has performed analyses to validate the design of as-built CPSES Unit 1 and Common HVAC duct and HVAC supports. The results are documented in the HVAC structural Design Validation Package (DVP) which includes 4109 supports and 3873 duct segments, plenums and air handling units. Ebasco has performed analyses to validate the design of CPSES Unit 1 and Common HVAC systems. The results are documented in the HVAC systems Design Validation Package (DVP). The as-built hardware for safety-related HVAC duct, HVAC supports and HVAC systems is being validated to the design by the Post Construction Hardware Validation Program (PCHVP).

Engineering methodologies have been incorporated into the Ebasco design procedures and the Post Construction Hardware Validation Program (PCHVP) procedures which have resolved the HVAC duct, HVAC supports and HVAC systems related design and hardware issues identified by the Comanche Peak Response Team (CPRT) and external sources. Consequently, the validated design of the CPSES safety-related HVAC duct, HVAC supports and HVAC systems has resolved these issues. The resolution of issues which were identified during the performance of the HVAC portion of the Corrective Action Program (CAP), which were determined to be reportable under the provisions of 10CFR50.55(e), are described in Appendix B of this Project Status Report (PSR).

The Post Construction Hardware Validation Program (PCHVP) assures that the safety-related HVAC duct, HVAC supports and HVAC systems are installed in conformance with the validated design. Ebasco has reviewed and revised the CPSES Unit 1 and Common HVAC duct, HVAC supports and HVAC systems related installation specification, and reviewed the revised construction procedures, and Quality Control (QC) inspection procedures to assure that the validated design requirements are implemented. The Post Construction Hardware Validation Program (PCHVP) for safety-related HVAC duct, HVAC supports and HVAC systems, including the inspections, engineering walkdowns and engineering evaluations, implements the corrective actions recommended by the Comanche Peak Response Team (CPRT), as well as those required by the Corrective Action Program (CAP) investigations.

Ebasco will provide to TU Electric a complete set of validated design documentation for CPSES Unit 1 and Common safety-related HVAC duct, HVAC supports and HVAC systems including calculations, specifications, drawings, design changes, inter-discipline transmittals and hardware modifications. This documentation can provide the basis for CPSES configuration control[4] to facilitate maintenance and operation throughout the life of the plant.

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4 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.

In-depth quality and technical audits performed by Ebasco Quality Assurance (QA), TU Electric Quality Assurance (QA), and the independent Engineering Functional Evaluation (EFE) verify that the implementation of the Corrective Action Program (CAP) is in conformance with the applicable 10CFR50, Appendix B quality assurance requirements.

The CPSES Unit 1 and Common HVAC portion of the Corrective Action Program (CAP) validates:

- o The design of the safety-related HVAC duct, HVAC supports and HVAC systems complies with the CPSES Unit 1 and Common licensing commitments.
- o The as-built safety-related HVAC duct, HVAC supports and HVAC systems comply with the validated design.
- o The safety-related HVAC duct, HVAC supports and HVAC systems comply with the CPSES licensing commitments and will perform their safety-related functions.

ABBREVIATIONS AND ACRONYMS

AISC	American Institute of Steel Construction
ANI	Authorized Nuclear Inspector
ANSI	American National Standards Institute
ARS	Amplified Response Spectra
ASLB	Atomic Safety and Licensing Board
AWS	American Welding Society
CAP	Corrective Action Program
CAR	Corrective Action Request
CASE	Citizens Association for Sound Energy
CAT	Construction Appraisal Team (NRC)
CCL	Corporate Consulting and Development Company, Ltd.
CFR	Code of Federal Regulations
CPE	Comanche Peak Engineering
CPRT	Comanche Peak Response Team
CPSES	Comanche Peak Steam Electric Station
CYGNA	CYGNA Energy Services
DAP	Design Adequacy Program
DBCP	Design Basis Consolidation Program
DBD	Design Basis Document
DIR	Discrepancy Issue Report (CPRT)
DR	Deficiency Report
DVP	Design Validation Package
Ebasco	Ebasco Services Incorporated
EFE	Engineering Functional Evaluation
ERDA	Energy Research and Development Administration
ESM	Equivalent Static Method
FSAR	Final Safety Analysis Report
FVM	Field Verification Method
HVAC	Heating, Ventilation and Air Conditioning
IAP	Independent Assessment Program (CYGNA)
Impell	Impell Corporation
IR	Inspection Report
IRR	Issue Resolution Report
ISAP	Issue Specific Action Plan
NCR	Nonconformance Report
NRC	United States Nuclear Regulatory Commission
NSSS	Nuclear Steam Supply System
NUREG	NRC Document
OBE	Operating Basis Earthquake
OSP	Office of Special Projects (NRC)
PCHVP	Post Construction Hardware Validation Program

PSR	Project Status Report
QA	Quality Assurance
QC	Quality Control
QOC	Quality of Construction and QA/QC Adequacy Program (CPRT)
RIL	Review Issue List
RSM	Response Spectra Method
SDAR	Significant Deficiency Analysis Report (TU Electric)
SER	Safety Evaluation Report (NRC, NUREG-0797)
SIP	Systems Interaction Program
SIT	Special Inspection Team (NRC)
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SRSS	Square Root of the Sum of the Squares
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 and Webster Engineering Corporation
SWEC-PSAS	Stone and Webster Engineering Corporation-Pipe Stress and Support Project
TAP	Technical Audit Program (TU Electric)
TERA	Tenera, L.P.
TRT	Technical Review Team (NRC)
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 52 and 53). This review identified that the Comanche Peak Response Team (CPRT) findings were 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) to validate the CPSES safety-related designs.[1,2] 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 non-safety-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 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 & Controls	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, Ventilation and Air Conditioning (HVAC)	Ebasco
Equipment Qualification	Impell

A Design Basis Consolidation Program (DBCP) (Reference 10) was developed to define the methodology by which Ebasco performed the design and hardware validation. The approach of this Design Basis Consolidation Program (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 established from the licensing commitments and consolidated in the Design Basis Documents (DBDs). 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 design criteria. The design validation effort for each of the eleven Corrective Action Program (CAP) disciplines is documented in Design Validation Packages (DVPs). The DVPs provide the documented assurance (e.g., calculations and drawings) that the validated design meets the licensing commitments, including resolution of 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), or identifies modifications that are necessary to bring the hardware into compliance with the validated design.

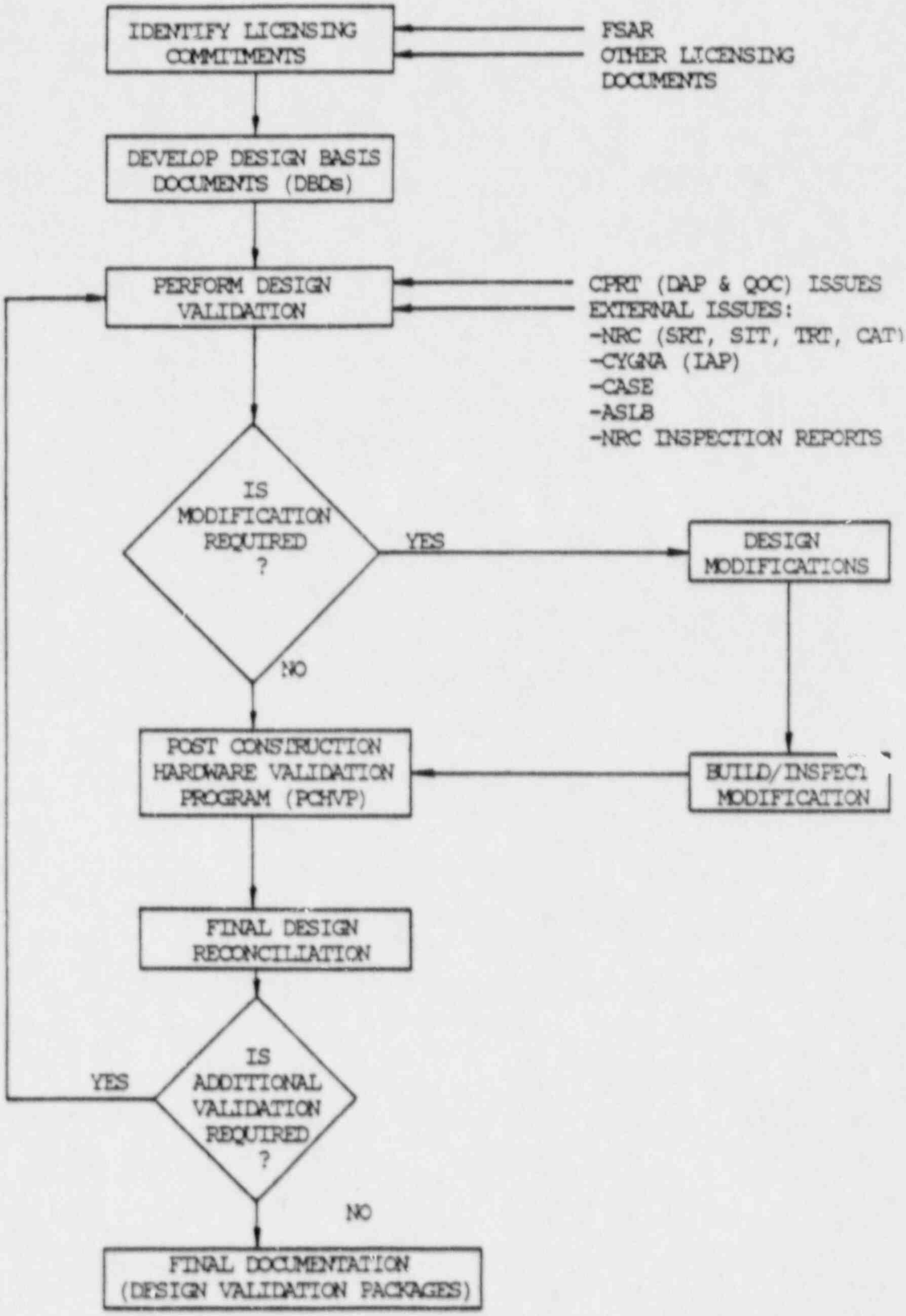
The results of the performance of the Corrective Action Program (CAP) for each discipline are described in a Project Status Report (PSR). This PSR describes the results for the HVAC portion of the Corrective Action Program (CAP).

Ebasco has performed a comprehensive design validation of safety-related HVAC duct, HVAC supports and HVAC systems for CPSES Unit 1 and Common in order to demonstrate that the design complies with licensing commitments. Ebasco is performing the Post Construction Hardware Validation Program (PCHVP) to demonstrate that the as-built safety-related HVAC duct, HVAC supports and HVAC systems comply with the validated design. The validation process was conducted in accordance with the Ebasco Design Basis Consolidation Program (DBCP), which controls the implementation of the Ebasco portion of the TU Electric Corrective Action Program (CAP). The HVAC portion of the Corrective Action Program (CAP) is shown schematically in Figure 1-1. The design bases for safety-related HVAC duct, HVAC supports and HVAC systems are contained within a consolidated set of CPSES Design Basis Documents (DBDs) (References 11 and 28 to 41).

The methodology used for implementing both the design and hardware related validations for CPSES Unit 1 and Common safety-related HVAC duct, HVAC supports and HVAC systems is presented in this Project Status Report (PSR).

This Project Status Report (PSR) for safety-related HVAC duct, HVAC supports and HVAC systems describes the validation effort from the early stages of design criteria establishment through the development and implementation of the detailed design and design control procedures. This Project Status Report (PSR) traces the updating of the procurement and installation specifications, construction procedures and Quality Control (QC) inspection procedures; the implementation of the Post Construction Hardware Validation Program (PCHVP) used to validate the as-built safety-related HVAC duct, HVAC supports and HVAC systems design; and the completion of the CPSES Unit 1 and Common HVAC Design Validation Packages (DVPs).

FIGURE 1-1
CORRECTIVE ACTION PROGRAM (CAP)
HVAC



2.0 PURPOSE

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

3.0 SCOPE

The scope of the HVAC portion of the Corrective Action Program (CAP) implemented for CPSES Unit 1 and Common includes safety-related and Seismic Category I[1] HVAC duct[3], HVAC supports[3] and HVAC systems; and Seismic Category II[2] HVAC duct and HVAC supports. The safety-related HVAC systems are as follows:

- Containment Ventilation
- Containment Air Cleanup
- Safeguards Building Ventilation
- Diesel Generator Area Ventilation
- Electrical Area HVAC
- Mainsteam and Feedwater Area Air Conditioning
- Auxiliary Building Ventilation
- Fuel Handling Building Ventilation
- Control Room Air Conditioning
- Uncontrolled Access Area Ventilation
- Primary Plant Ventilation
- Safety Chilled Water
- Service Water Intake Structure Ventilation
- Uninterruptible Power Supply Area Air Conditioning

Portions of the above systems are non-safety-related.

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1 Systems, structures 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 3).

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

3 Unless otherwise noted, HVAC duct includes the HVAC plenums and HVAC air handling units; and HVAC supports include HVAC duct supports and HVAC equipment supports.

Non-safety-related, non-seismic[4] HVAC duct and HVAC supports are addressed as part of the Systems Interaction Program (SIP) and are described in the Systems Interaction Program (SIP) Project Status Report (PSR) (Reference 7) (Supplement A to the Mechanical PSR).

The HVAC portion of the CPSES Corrective Action Program (CAP) is shown schematically in Figure 1-1 and is discussed below. The program required:

1. Establishment of HVAC duct, HVAC supports and HVAC systems design criteria which comply with licensing commitments.

2. Development of the Design Basis Documents (DBDs) for HVAC duct, HVAC supports and HVAC systems, which contain the design criteria.

3. Implementation of design and hardware validations, consisting of analyses, identification and implementation of necessary modifications, and field verifications as identified in the Post Construction Hardware Validation Program (PCHVP). The as-built configuration of HVAC duct, HVAC supports and HVAC systems is validated to the design by Quality Control (QC) inspections, engineering walkdowns and engineering evaluations.

4. Resolution of the design and hardware related issues of CPSES HVAC duct, HVAC supports and HVAC systems and implementation of a Corrective Action Program (CAP) for closure of these issues. These issues include Comanche Peak Response Team (CPRT) and external issues (See Section 4.0).

5. Development of validated design documentation to form the basis for configuration control of CPSES Unit 1 and Common HVAC duct, HVAC supports and HVAC systems. The validated design documentation (calculations, design drawings and specifications) and Design Basis Documents (DBDs) can be utilized by 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 and the Design Basis Documents (DBDs) were developed.

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4 Those portions of systems, structures or components whose continued function is not required, and whose failure will not reduce the functioning of any Seismic Category I system, structure or component required to satisfy the requirements of NRC Regulatory Guide 1.29 to an unacceptable safety level and will not result in incapacitating injury to occupants of the control room, are designated as non-seismic.

Section 5.1.2 describes the design validation process, interfaces with other disciplines and the final reconciliation process.

Section 5.1.3 describes the Post Construction Hardware Validation Program (PCHVP) process and the procedures for field validation (inspections, engineering walkdowns and engineering evaluations) being implemented to validate that the as-built HVAC duct, HVAC supports and HVAC systems 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 HVAC portion of the Corrective Action Program (CAP).

Section 5.3 describes the Quality Assurance (QA) Program implemented for the validation process, including the Engineering Functional Evaluation (EFE) audits and the TU Electric Quality Assurance (QA) audits.

Section 5.4 describes the transfer of a complete set of the validated design documentation and design procedures to TU Electric Comanche Peak Engineering (CPE). This set of documentation and procedures can provide the basis for CPSES configuration control throughout the life of the plant.

Appendix A of this Project Status Report (PSR) describes the details of Corrective Action Program (CAP) resolution of the HVAC related 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 HVAC portion of the Corrective Action Program (CAP). These are issues that have been determined to be reportable under the provisions of 10CFR50.55(e). These issues are identified in Significant Deficiency Analysis Reports (SDARs) initiated by TU Electric.

4.0 SPECIFIC ISSUES

The HVAC Corrective Action Program (CAP) resolved all related Comanche Peak Response Team (CPRT) issues and external issues. This section presents a listing of HVAC related issues addressed in this Project Status Report (PSR). Technical review, resolution, corrective and preventive actions for Comanche Peak Response Team (CPRT) and external issues are described in Appendix A. Technical review, resolution, corrective and preventive actions for issues identified during the performance of the Corrective Action Program (CAP), which were determined to be reportable under the provisions of 10CFR50.55(e), are described in Appendix B.

The issues contained in Subappendices A1 through A7 and A19 were raised by the Comanche Peak Response Team (CPRT) (References 49, 50 and 54). Issues A4 and A5 were also raised by the NRC in Inspection Reports. The issues contained in Subappendices A8 through A11 were raised by the NRC in Inspection Reports. The issue contained in Subappendix A12 was raised by the NRC Construction Assessment Team (CAT). The issues contained in Subappendices A13 and A14 were raised by CASE. The issue contained in Subappendix A15 was raised by the NRC Technical Review Team (TRT). The issues contained in Subappendices A16 and A17 are included in the CYGNA Energy Services (CYGNA) Review Issue List (RIL) (Reference 51). The first nine issues contained in Subappendix A18 are HVAC issues which were identified by the original HVAC designer to Ebasco. The last issue contained in Subappendix A18 was raised by the Comanche Peak Response Team (CPRT) (Reference 55). The issues contained in Subappendices A2 through A5, A7, A10 and A12 through A18 were part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-85-54 in letter number TXX-5043, dated September 26, 1986 from TU Electric to the NRC.

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

Issue No.	Issue Title
A1	Determination of Heat Loads for Equipment Sizing
A2	Lack of Construction Details for Fabrication and Installation of Ducts and Plenums
A3	Inaccurate HVAC Duct Support Detail Drawings and Their Effect on the Duct Support Designs
A4	Inadequate Program for the Installation and Quality Control (QC) Verification of HVAC Duct Supports
A5	Groove Welds
A6	Lack of Documentation for Receipt Inspection by the Original HVAC Duct Support Contractor
A7	Insufficient Thread Engagement and Pretensioning of Richmond Insert Bolts on HVAC Duct Supports
A8	Battery Room Ventilation
A9	Battery Room Explosion Proof Thermostats
A10	Inspection Reports Dated Prior to Issue of As-Built Drawings

Issue No.	Issue Title
A11	Welder Qualification
A12	NRC CAT Inspection Results
A13	Seismic Design of HVAC Supports
A14	HVAC Duct Axial Restraint
A15	Seismic Interaction of HVAC Duct
A16	CYGNA Conduit and Cable Tray Issues
A17	CASE/CYGNA Cable Tray Issues
A18	Other HVAC Issues
A19	Environmental Conditions and Requirements

Issues identified during the performance of the HVAC portion of the Corrective Action Program (CAP) which have been determined to be reportable under the provisions of 10CFR50.55(e) are listed below (issue numbers correspond to subappendix numbers in Appendix B):

Issue No.	Issue Title
B1	SDAR CP-87-124 Xomox Valves
B2	SDAR CP-88-08 Class 1E Battery Room Temperature

5.0 CORRECTIVE ACTION PROGRAM (CAP) METHODOLOGY AND RESULTS

This section of the Project Status Report (PSR) addresses the program methodology for the HVAC portion of the Corrective Action Program (CAP), including the establishment of design criteria in conformance with CPSES licensing commitments, the development of procedures, the implementation of the design validation process and the Post Construction Hardware Validation Program (PCHVP), as well as the results of the HVAC portion of the Corrective Action Program (CAP) and corrective and preventive actions implemented to assure that the HVAC design and hardware remain in compliance with the licensing commitments throughout the life of the plant.

5.1 METHODOLOGY AND WORK PERFORMED

The methodology and work performed by Ebasco in implementing the HVAC portion of the Corrective Action Program (CAP) for HVAC duct, HVAC supports and HVAC systems are discussed in the following sections.

5.1.1 Licensing Commitments, Design Criteria, Procedures and Design Basis Documents (DBDs)

The licensing commitments for the HVAC duct, HVAC supports and HVAC systems were identified by Ebasco through an extensive review of CPSES licensing documentation (such as the FSAR, CPSES Safety Evaluation Report (SER) and its Supplements (SSERs), NRC Regulatory Guides, NRC Inspection and Enforcement Bulletins, the AISC "Specification for the Design of Steel Structures" (Reference 6), and TU Electric/NRC correspondence). Based on these licensing commitments, design criteria were established which set forth requirements for validation of HVAC duct, HVAC supports, and HVAC systems. The design criteria are documented in the Design Basis Documents (DBDs) (See Table 5-1). In addition, Ebasco developed design procedures for HVAC duct and supports (See Table 5-1). These Design Basis Documents (DBDs) and design procedures are based on the following:

- o Design criteria
- o Resolution of Comanche Peak Response Team (CPRT) and external issues
- o Ebasco experience gained through the design of HVAC duct, HVAC supports and HVAC systems for several recently licensed and operating United States nuclear power plants
- o Regulatory and Professional Society Guidance such as applicable codes and standards

The results of extensive testing and engineering studies (detailed analytical evaluations) were implemented in the procedures used in the HVAC duct and HVAC support design validation.

5.1.1.1 Verification of Design Criteria, Procedures and Design Basis Documents (DBDs)

To provide added confidence in the conservatism of the analytical methods and design criteria as defined in the Design Basis Documents (DBDs) and design procedures and in the design adequacy of the HVAC duct and HVAC supports, engineering studies were performed, and a comprehensive testing program was conducted. The testing program provides confirmation of the HVAC duct and duct support combined seismic response, design criteria (e.g., duct allowable stresses) and analytical methods. The engineering studies were performed to develop and substantiate the methodology defined in the HVAC design procedures.

Testing Program

The objectives of the testing program were:

1. To confirm, through correlation with frequency and static testing of full-scale duct and individual duct components, that the duct design parameters, namely the duct stiffnesses and strength, used in the design validation were conservative;

2. To provide qualitative and quantitative data on the behavior and load capacity of the duct when subjected to loads up to and above the CPSES design criteria. This data is then used to support the analytical methods used in design validation.

The duct frequency and static tests were performed on full-scale samples representative of as-built duct spans and configurations. The samples used in the static tests contained gaskets, joints and openings similar to the as-built conditions.

Duct Frequency Tests

In 1981, three (3) different test specimens representative of CPSES Unit 1 and Common duct sizes and spans were subjected to random excitation in the two transverse directions of the duct specimen in order to determine their resonant frequencies and mode shapes. The tests were performed at the Corporate Consulting and Development Company, Ltd. (CCL) testing laboratory in accordance with the CCL test procedure (Reference 18). The main objective of the tests was to obtain the parameters that determine the stiffnesses of the duct to be used in the structural analysis of the duct and duct support combination in the design validation. The mathematical representation of the duct properties was derived from the measured duct frequencies to assure their adequacy in predicting the duct frequencies in the analysis. The results of the duct frequency test evaluation were reported in the Corporate Consulting and Development Company, Ltd. (CCL) Test Report (Reference 19) and have been reviewed and validated by Ebasco (Reference 13).

Duct Static Tests

In 1987, full scale static tests of duct specimens were performed which provided data for the determination of the ultimate strength of the duct as constructed at CPSES Unit 1 and Common. These data were used to derive the allowable stress limits for the design validation of the duct. A total of 67 duct specimens were tested to destruction with loads and deformations continuously recorded. The duct specimens included straight, T-branch and elbow configurations. Several specimens had openings similar to the as-built conditions of duct registers and grills, to simulate the effects of the openings on the duct strength. The duct specimen sizes were representative of CPSES Unit 1 and Common configurations. The specimens were subjected to bending loads; axial loads with simultaneous application of internal pressure; and combined loading which included the simultaneous application of bending, axial and internal pressure loads. These tests were performed by Corporate Consulting and Development Company, Ltd. (CCL) at their testing laboratory in accordance with the Ebasco specification (Reference 15) and the Ebasco approved CCL test procedure (Reference 4).

The following conclusions were determined from the duct frequency and duct static test results:

1. The duct stiffnesses and strength used in the design validation were conservative.

2. The load capacities and data collected confirmed the analytical methods used in the design validation.

Engineering Studies

Engineering studies were performed by Ebasco during the development of the HVAC design procedures and throughout the design validation process. The objectives of these engineering studies were:

1. To establish and document the basis of design criteria;

2. To provide the basis, through detailed analytical evaluations, for engineering assumptions and technical methods;

3. To resolve, through detailed analytical evaluations, specific Comanche Peak Response Team (CPRT) issues and external issues;

4. To provide added confidence in the conservatism of the analytical methods and design criteria as defined in the procedures.

In addition, technical audits have been performed to provide additional assurance that the design criteria are technically correct and embody the HVAC licensing commitments, and that all HVAC related Comanche Peak Response Team (CPRT) and external issues have been resolved. To assure that the licensing commitments related to HVAC design have been identified, and appropriate design criteria have been established, the Ebasco Corporate Quality Assurance (QA) and the Comanche Peak Response Team (CPRT) conducted audits and overview, respectively. Ebasco Quality Assurance (QA) audits were performed as described in Section 5.3. The Comanche Peak Response Team (CPRT) overview is being performed by the Engineering Functional Evaluation (EFE) and TU Electric Quality Assurance (QA) Technical Audit Program (TAP) as described in Section 5.3.

The TU Electric Quality Assurance (QA) Technical Audit Program (TAP) is auditing the Corrective Action Program (CAP) to assure that the design criteria are reconciled with the licensing commitments. Ebasco's resolution of the Comanche Peak Response Team (CPRT) and external issues is described in Appendix A of this Project Status Report (PSR). Ebasco's resolution of the issues identified during the performance of the Corrective Action Program (CAP) is described in Appendix B of this Project Status Report.

5.1.2 Design Validation Process

Sections 5.1.2.1 and 5.1.2.2 discuss the validation process for HVAC duct and HVAC supports. Section 5.1.2.3 discusses the validation process for HVAC systems. Section 5.1.2.4 discusses the resolution of HVAC duct, HVAC supports and HVAC systems related design issues. Section 5.1.2.5 discusses technical interfaces with other organizations. Section 5.1.2.6 discusses the final reconciliation process.

5.1.2.1 Design Validation Input Data for HVAC Duct and HVAC Supports

The following documents were the source of input information for the design validation process:

1. As-Built Drawings: As-built information was obtained by engineering walkdowns conducted by experienced Ebasco personnel trained in accordance with Field Verification Methods (FVMs) (References 14 and 23). The results were used to create as-built drawings of the HVAC duct and HVAC supports. To provide additional assurance of the accuracy of the as-built drawings, TU Electric Quality Control (QC) personnel verified these drawings to the as-built hardware on a sample basis as specified in the Field Verification Methods (FVMs) (References 14 and 23) and in accordance with an approved Quality Control (QC) inspection procedure (Reference 2). These drawings provide information for determining the duct routing, the location of the supports on the duct run, support identification number, number and size of duct

supported by the support, location of duct transitions (change in direction and/or size), location of in-line components and support geometry (member sizes, dimensions, anchor bolt information, weld joints and orientation of the support relative to the duct).

2. HVAC Installation Specification: The HVAC installation specification (Reference 1) provides validated design input data including design internal air pressure. This specification also provides installation details used in the design validation process.

3. Amplified Response Spectra (ARS): The ARS (CPSES seismic design information) was used as input to the design validation of the HVAC duct and HVAC supports.

5.1.2.2 Analytical Methods for Design Validation of HVAC Duct and HVAC Supports

The as-built drawings of HVAC duct and HVAC supports were used to develop mathematical models of the supports and/or the supports and duct combination. Hand calculations and/or computer analyses were performed to determine the individual design loads and also the combined design loads on supports and duct in accordance with the design criteria as specified in the Design Basis Document (DBD) (Reference 11). The loads determined were deadweight loads, pressure loads, thermal loads and seismic loads.

Deadweight loads include the weight (deadweight) of HVAC supports, HVAC duct, and in-line components in HVAC duct, such as dampers. These weights were determined from the as-built drawings and vendor documentation (e.g., HVAC duct span length, configuration, insulation).

Pressure loads are derived from HVAC duct internal design air pressures which were determined during the HVAC systems design validation (See Section 5.1.2.3) and are provided in the HVAC installation specification (Reference 1).

The effects of operating thermal loads and accident thermal loads were validated in an engineering study. The result showed that, due to the presence of gaskets, flexible companion flanges and duct expansion joints, combined with the flexibility of base angles and anchorages, the HVAC duct and HVAC supports can accomodate the thermal displacements without reduction in seismic load resistance or loss of function.

The seismic load is produced during the Operating Basis Earthquake (OBE) or the Safe Shutdown Earthquake (SSE) as defined by the CPSES Amplified Response Spectra (ARS). HVAC duct and HVAC support seismic loads were determined by using either of the following analytical methods:

Equivalent Static Method (ESM)

The Equivalent Static Method (ESM) utilized an individual model of each support for support design validation. After generating a three dimensional computer model of the support, which included contributory duct weight (deadweight), a frequency analysis was performed to obtain the fundamental (lowest) frequency of the support in the transverse, longitudinal and vertical directions. This frequency was then combined with the calculated fundamental frequency of the duct in the corresponding direction to calculate the combined frequency of duct and support.

The combined frequency was used to determine the seismic acceleration value in each direction from the Amplified Response Spectra (ARS). This acceleration from the ARS was conservatively increased by 50 percent, and used to determine the equivalent static loads applied to the support in each direction.

Response Spectra Method (RSM)

Design validation of HVAC duct and HVAC supports by the Response Spectra Method (RSM) utilized three dimensional models. Significant components of the HVAC duct and HVAC supports were modeled in sufficient detail to accurately predict the combined duct and support response[1] to the design loads. More specifically, duct components (including straight ducts, bends, tees, crosses, and reducers) and support components (including duct-to-support connections, support members, member connections and support anchorages) were included in the models. Significant connection eccentricities existing in HVAC duct and HVAC supports were also modeled. A detailed description of the modeling procedures used in the Response Spectra Method (RSM) approach is provided in References 8, 9 and 16.

Using the above model, the dynamic responses of HVAC duct and HVAC supports, due to seismic loading, were calculated. Separate analyses were performed for the Operating Basis Earthquake (OBE)

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1 Response includes accelerations, displacements, forces, loads and stresses.

and Safe Shutdown Earthquake (SSE) load cases using structural damping values in accordance with the design criteria specified in the Design Basis Document (DBD) (Reference 11). All frequencies of vibrations up to 33 cycles per second were considered in the analyses. The modal responses for each frequency were combined in accordance with NRC Regulatory Guide 1.92 (Reference 22). The N-S, E-W and vertical directions of earthquake were considered to act simultaneously and the responses were combined using the square root of the sum of the squares (SRSS) method.

The design criteria as specified in the Design Basis Document (DBD) (Reference 11) were utilized in combining the individual loads for Seismic Category I and Seismic Category II HVAC duct and HVAC supports. The resulting stresses were then compared to the allowable stress limits specified in the Design Basis Document (DBD) (Reference 11). Modifications were developed for the HVAC duct and HVAC supports which did not comply with the allowable stress limits. These modifications assure that these HVAC duct and HVAC supports comply with the allowable stress limits as specified in the Design Basis Document (DBD) (Reference 11). Hardware modifications are being implemented.

5.1.2.3 Validation of HVAC Systems Design

The design validation of the HVAC systems was performed by comparison of the design documents (calculations, drawings and specifications) with the design criteria specified in the Design Basis Documents (DBDs) (References 28 through 41). Where the existing design did not satisfy the design criteria, it was modified to satisfy the design criteria. Hardware modifications are being implemented. The validation is documented in the HVAC systems Design Validation Package (DVP) which contains the following:

- o Design Basis Documents (DBDs) which specify the design criteria and how the criteria have been satisfied
- o Design Documents (i.e., calculations, drawings and specifications)
- o Other related documents (e.g., design interface requirements, Significant Deficiency Analysis Reports (SDARs), and Comanche Peak Response Team (CPRT) and external issues resolution documents).

Calculations

Seventy-three (73) new safety-related HVAC calculations were developed which included:

- Heat load calculations for the applicable plant operating modes, which included heat loads due to solar transmission and radiation, occupancy, electrical heat losses (including electrical equipment, motors, lighting and cables) and mechanical equipment and piping

- Temperature and relative humidity calculations for the applicable plant operating modes

- Calculations for design air and chilled water flow rates which form the basis for system balancing

- Cooling coil and chiller heat removal calculations

- Refrigeration system cooling requirements

- HVAC process set point calculations

Drawings

CPSES Unit 1 and Common HVAC Systems flow diagrams and duct layout drawings were reviewed and validated to comply with the design criteria as specified in the Design Basis Documents (DBDs) (References 28 through 41). The following items were considered in the review of the drawings:

- Consistency with the system design calculations

- Nuclear safety classification

- Nuclear safety classification boundary isolation configuration

- HVAC equipment redundancy, and valve/damper configuration for compliance with the single failure criterion

- Interface requirements with other fluid systems

Review of HVAC Equipment Capacities

Procurement specifications and vendor component documentation were reviewed for interface compliance with the validated system design. The heat removal capacities of the HVAC equipment such as cooling coils, air conditioning equipment and refrigeration chillers were validated based on design flow rates and temperatures. The vendor documentation was also reviewed to provide validated design inputs to other organizations for interfacing activities.

5.1.2.4 Resolution of HVAC Duct, HVAC Supports and HVAC Systems Related Design Issues

The issues listed in Section 4.0 (described in Appendix A and Appendix B) were evaluated by Ebasco. Implementation of the Ebasco design and design control procedures resolved the HVAC issues. The resolutions were incorporated into the HVAC installation specification and the Design Basis Documents (DBDs), as well as the CPSES Unit 1 and Common Quality Control (QC) inspection procedures and construction procedures. The resolution of these issues was reviewed by TU Electric Comanche Peak Engineering (CPE).

The issue resolution and implementation processes were as follows:

1. For each issue that affected the HVAC duct, HVAC supports and HVAC systems validation effort, Ebasco reviewed the associated documentation to gain an understanding of the background. Ebasco then defined their understanding of the issue;

2. With the issue thus defined, Ebasco developed and executed an action plan to resolve the issue (Reference 43); and

3. The resolutions were implemented in appropriate Ebasco project procedures used for the HVAC portion of the Corrective Action Program (CAP). Compliance with these procedures is assured by the Ebasco Quality Assurance (QA) Program.

Additionally, walkdowns of the HVAC duct and HVAC supports were conducted to obtain as-built information for CPSES Unit 1 and Common. The walkdowns were conducted by experienced Ebasco personnel trained in the Field Verification Methods (FVMs) (References 14 and 23). The as-built information was reviewed by Ebasco to determine whether there were additional issues related to the functional behavior of the HVAC duct, HVAC supports or HVAC systems that should be evaluated by the Corrective Action Program (CAP).

5.1.2.5 Interfaces

The HVAC validation process involved internal interfaces among Ebasco design disciplines, as well as external interfaces with TU Electric and other organizations involved in the Corrective Action Program (CAP). Organizational interfaces as shown in Figure 5-1 include those with other Ebasco disciplines, TU Electric, SWEC-PSAS, Westinghouse, SWEC and Impell. Interfaces with these organizations are procedurally controlled to assure:

- Consistency of design criteria
- Completeness of the information incorporated in each Design Validation Package (DVP)

- o Proper transfer of design data between interfacing organizations
- o Uniform application of design control procedures
- o Coordination of corrective and preventive actions

5.1.2.6 Final Reconciliation Process

The purpose of the final reconciliation process is to consolidate the design validation results, hardware modifications, preoperational test results and inspection documentation to assure consistency of the HVAC design. The final reconciliation of HVAC design incorporates the following:

- o The Post Construction Hardware Validation Program (PCHVP) results
- o Resolution of the HVAC hardware related Comanche Peak Response Team (CPRT) and external issues.

Final reconciliation also includes confirmation that the interfacing organizations have accepted the HVAC results as compatible with their validated design. Interfacing organizations are depicted on Figure 5-1.

In addition, open items, observations, and deviations related to the HVAC portion of the Corrective Action Program (CAP) that were identified by the TU Electric Technical Audit Program (TAP) and Engineering Functional Evaluation (EFE) are resolved prior to the completion of the final reconciliation. Open items from TU Electric Significant Deficiency Analysis Reports (SDARs) (10CFR50.55(e)) are also resolved during the final reconciliation. At the conclusion of final reconciliation, the CPSES Unit 1 and Common Design Validation Packages (DVPs) are compiled.

5.1.3 Post Construction Hardware Validation Program (PCHVP)

The Post Construction Hardware Validation Program (PCHVP) (Reference 12) 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 5-2.

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 (QC) inspection or engineering walkdown, for accessible components. Quality Control (QC) 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 5-2 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 modifications 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 the 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 were evaluated by Third Party personnel in accordance with Appendix E to the Comanche Peak Response Team (CPRT) Program Plan (Reference 42). 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 5-2 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 a hardware final acceptance attribute that is more stringent than the original acceptance attribute or the 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 (QC) 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 above 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 Corrective Action Program (CAP) 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:

- o Historical documents (e.g., specifications, procedures and inspection results)
- o Comanche Peak Response Team (CPRT) and external issues
- o Construction practices
- o Quality records
- o Test results
- o Audit reports
- o Authorized Nuclear Inspector (ANI) records
- o Surveillance reports
- o NCRs, DRs, SDARs and CARs
- o Inspections conducted to date
- o Results of Third Party reviews
- o Purchasing documents
- o Construction packages
- o 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:

- o A written description of the attribute;
- o A written justification by the Corrective Action Program (CAP) responsible engineer for acceptance of the attribute;
- o A written explanation of the logic utilized to conclude that the attribute need not be field validated;

- o A chronology demonstrating that the attribute has not been significantly altered by redesign;
- o All documents viewed to support the disposition;
- o 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 represent 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 do 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 (EFE) being performed by an independent team comprised of Stone & Webster, Impell and Ebasco engineering personnel working under the Stone & Webster Quality Assurance (QA) Program and subject to oversight directed by the Comanche Peak Response Team's (CPRT) Senior Review Team (SRT). The Post Construction Hardware Validation Program (PCHVP) will provide reasonable assurance that the validated design has been implemented for safety-related hardware.

To provide assurance that the as-built hardware complies with the validated design, the Post Construction Hardware Validation Program (PCHVP) for HVAC duct, HVAC supports and HVAC systems developed a matrix of final acceptance attributes (Table 5-2) based on the validated installation specification. The Field Verification Methods (FVMs) (including those used to obtain as-built information utilized as input for the design validation) were then reviewed to determine whether the final acceptance attributes had been addressed. This review concluded that all final acceptance attributes requiring physical validation were included in the Field Verification Methods (FVMs).

A brief description of the Field Verification Methods (FVMs) implemented in the HVAC portion of the Post Construction Hardware Validation Program (PCHVP) is given below:

- FVM-029

  Field Verification Method (FVM) CPE-EB-FVM-CS-029 (Reference 14) was developed to control the collection of as-built data for CPSES Unit 1 and Common HVAC duct and HVAC duct supports. Note: This does not include HVAC air handling units, plenums and equipment supports which is included in FVM-066.

- FVM-066

  Field Verification Method (FVM) CPE-EB-FVM-CS-066 (Reference 23) was developed to control the collection of as-built data for CPSES Unit 1 and Common HVAC air handling units, plenums and equipment supports.

- FVM-068

  Field Verification Method (FVM) CPE-SWEC-FVM-CS-068 (Reference 27) was developed to control the clearances between various commodity items for CPSES Unit 1 and Common.

- FVM-112

  Field Verification Method (FVM) CPE-EB-FVM-CS-112 (Reference 47) was developed to review the as-built conditions of tornado vent fire dampers for CPSES Unit 1 and Common.

Procedures have been developed by other Corrective Action Program (CAP) organizations who are responsible for the installation specifications for the following CPSES Unit 1 and Common HVAC features:

- HVAC equipment - Mechanical (References 44 and 45) and Impell (Reference 46)

- Piping and Inline Components - Mechanical (References 17 and 44)

5.2 RESULTS

5.2.1 Design Validation Results

The validation of the CPSES Unit 1 and Common HVAC design has been completed as described in this Project Status Report (PSR). This effort included:

HVAC Duct and HVAC Supports

- o Validation of 4109 HVAC supports
- o Validation of 3871 HVAC duct segments, plenums and air handling units
- o Development of 4109 as-built drawings for HVAC supports
- o Development of 3871 as-built drawings for HVAC duct segments, plenums and air handling units
- o Development of 1074 new calculations for HVAC supports
- o Development of 1074 new calculations for HVAC duct segments, plenums and air handling units
- o Resolution of 7 Tenera, L.P. (TERA) Discrepancy Issue Reports (DIRs)

HVAC Systems

- o Development of 73 new calculations
- o Review of more than 2400 design drawings to validate HVAC design interfaces
- o Validation of 11 installation and procurement specifications
- o Validation of 16 flow diagrams
- o Resolution of 126 Tenera, L.P. (TERA) Discrepancy Issue Reports (DIRs)

The HVAC design validation identified the following hardware modifications:

HVAC duct and HVAC supports

- o More than 800 modifications to HVAC duct and HVAC supports resulting from design calculations

HVAC Systems

- o Addition of a safety-related ventilation system for an area containing a safety-related motor control center
- o Addition of safety-related electric unit heaters in the Class 1E battery rooms to maintain space temperature at 70°F minimum under required plant operating conditions including loss of offsite power.
- o Modifications to the ventilation system which serves the safety related battery rooms to reduce hydrogen build-up
- o Modifications to the Control Room Air Conditioning System ductwork to provide design air flow.

The design validation effort, in conjunction with the design modifications, results in a HVAC design and associated documentation that is in conformance with CPSES licensing commitments and provides assurance that the HVAC duct, HVAC supports and HVAC systems are designed to perform their safety-related functions.

5.2.2 Post Construction Hardware Validation Program (PCHVP) Results

The Post Construction Hardware Validation Program (PCHVP) is being implemented through the validation of final acceptance attributes for systems and components for CPSES Unit 1 and Common as discussed in Section 5.1.3.

5.3 QUALITY ASSURANCE (QA) PROGRAM

The activities of the HVAC portion of the Corrective Action Program (CAP) in CPSES Unit 1 and Common were performed in accordance with Ebasco's Quality Assurance (QA) Program, as applicable.

Ebasco implements its Corporate Nuclear Quality Assurance Program described in Ebasco's Topical Report ETR-1001 (Reference 20) which is in conformance with 10CFR50, Appendix B and has been approved by the NRC. Ebasco's corporate program, ETR-1001, addresses completion of a nuclear power plant including design, procurement, and construction. The corporate Topical Report has been modified to make it project specific; sections that did not apply to the HVAC portion of the Corrective Action Program (CAP) scope of services were deleted. Ebasco's Nuclear Quality Assurance (QA) Program as modified for CPSES Unit 1 and Common has been reviewed and approved by TU Electric's Quality Assurance (QA) organization.

Ebasco developed and issued a Manual of Procedures (Reference 5) specifically related to TU Electric CPSES work. This manual includes specific procedures to supplement the Ebasco standard Engineering, Nuclear, Project and Procurement Procedure Manuals. The Manual of Procedures includes procedures for the design validation effort performed under Ebasco's Quality Assurance (QA) Program.

Separate procedures are issued to direct the precise organization and format for documents that validate designs. These procedures are issued so calculation documentation will be provided in a uniform and complete manner. A design validation checklist was developed for this project and has been used to document Ebasco responses to questions identified for design validation in ANSI N45.2.11 and NRC Regulatory Guide 1.64 (Reference 21).

In accordance with this Quality Assurance (QA) Program, Design Basis Documents (DBDs), detailed procedures, and project specific QA Programs covering the essentials of the HVAC program were developed. These documents were distributed to Ebasco supervisory engineers and were readily available to HVAC design validation personnel. The issuance of design criteria, validation procedures and major revisions thereto was followed with training programs for the applicable personnel. In particular, HVAC design validation personnel on the project received training in the design procedures and the design control procedures.

An Ebasco Quality Assurance (QA) Manager, who reports through the Quality Assurance Department to Ebasco's Corporate Quality Programs Vice President and who has management experience in auditing and QA Program procedure development for engineering activities, was assigned to the project in the earliest stages of the project. This reporting responsibility assures independence of Quality Assurance (QA) functions. Quality Assurance (QA) personnel provide assurance that the QA Program properly addresses project activities and assist project personnel to understand and properly implement the QA Program.

To date, more than 11,100 man-hours have been expended by Ebasco in activities directly attributable to the overall Project Quality Assurance (QA) Program (i.e., training, procedure development, auditing, and the project QA supervisory staff).

The adequacy and implementation of the Ebasco Quality Assurance (QA) Program was extensively audited internally by Ebasco's Quality Assurance (QA) Engineering Audit Group, and externally by TU Electric Quality Assurance (QA) and the Nuclear Regulatory Commission. A total of 13 audits were performed by these organizations from August 1986 to date for CPSES Unit 1 and Common as follows:

Ebasco - Audit Group	- 3
TU Electric - QA	- 9
NRC	- 1

The Ebasco Quality Assurance (QA) Program, the TU Electric Quality Assurance (QA) Program and NRC audits collectively evaluated the technical adequacy of the engineering product (e.g., calculations, drawings and specifications) and assessed the adequacy and implementation of the Ebasco Quality Assurance (QA) Program.

Ebasco's Quality Assurance (QA) Program requires that QA Audits of safety-related project activities be performed periodically. A summary of the audit details for the Ebasco Quality Assurance (QA) Program is provided in Section 5.3.1.

TU Electric Quality Assurance (QA) conducted technical audits as part of the TU Electric Technical Audit Program (TAP)[2]. The details of calculations, drawings, procedural compliance and technical interface were evaluated. These technical audits have resulted in enhancements to the procedures and methods and thus, contributed to the overall quality of the HVAC portion of the Corrective Action Program (CAP) at CPSES Unit 1 and Common.

In addition to the audits described above, TU Electric has initiated the Engineering Functional Evaluation (EFE). The EFE began auditing the HVAC portion of the Corrective Action Program (CAP) in May 1987. The Engineering Functional Evaluation (EFE) is an overview program which is performing an independent in-depth technical evalution of the Corrective

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

Action Program (CAP) to provide additional assurance that the CAP is effectively implemented. The Engineering Functional Evalution (EFE) is conducted under the SWEC Quality Assurance (QA) Program and is directed by a Program Manager who reports to the SWEC Chief Engineer, Engineering Assurance. The Engineering Functional Evalution (EFE) is performed by highly qualified and experienced engineers from SWEC, Impell and Ebasco who have not been involved with previous engineering and design work at CPSES. The Engineering Functional Evaluation (EFE) is performed in a formal, preplanned and fully documented manner to provide objective evidence of completion of the planned scope of the evaluation and to provide documentation of its results and conclusions. The Engineering Functional Evaluation (EFE) is comparable in scope, level of effort and personnel qualifications to integrated, independent design inspections and verifications conducted at other nuclear plants.

The audits described above collectively represent very detailed and complete assessments of the following:

- o Adequacy of the Quality Assurance (QA) Program
- o Implementation of the Quality Assurance (QA) Program
- o Technical adequacy of the design criteria and procedures
- o Implementation of the design criteria and procedures

As such, these audits identified items in design criteria, procedures, calculations and project documentation and training for which action was required to clarify or improve the design validation process and assure continued compliance with procedures. Each item identified through the audit process was reviewed in detail to determine the extent of the condition, the cause of the condition and any corrective or preventive action required. Complete responses were provided for each item identified. Subsequent audits verify that appropriate corrective and preventive actions are implemented to address the previously identified audit items.

In addition to the Quality Assurance (QA) audits, a rigorous Quality Control (QC) inspection program is in place for CPSES Unit 1 and Common. The Quality Control (QC) inspection program provides review of the HVAC duct and HVAC support as-built walkdowns. Inspection procedures identify the attributes which Quality Control (QC) inspectors must inspect before a particular installation is acceptable.

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

5.3.1 Summary of Ebasco Quality Assurance (QA) Audits

To date, Ebasco Quality Assurance (QA) has performed 3 audits of the HVAC portion of the Corrective Action Program (CAP). A tabulation of Ebasco Quality Assurance (QA) audits is presented in Table 5-3. The following list of audit subjects describes the depth of auditing that has been performed:

1. Adequacy of the Ebasco Project Design Procedures
2. Adequacy of the Ebasco Project Procedures
3. Calculations - Documentation
4. Compliance with Project Procedures
5. Construction Support Activities
6. Document Control
7. Indoctrination and Training
8. Licensing Activities
9. Records Maintenance
10. Maintenance of Project Procedure Manuals
11. Personnel Qualification and Experience Verification
12. Inputs to HVAC Duct, HVAC Supports and HVAC Systems Analyses

5.3.2 Summary of Audits by TU Electric Quality Assurance (QA), by NRC-VPB and Inspections by NRC-OSP

In addition to the Ebasco internal Quality Assurance (QA) Audits, Ebasco was audited by the TU Electric Technical Audit Program (TAP) and the NRC.

To date, TU Electric's Quality Assurance (QA) Technical Audit Program (TAP) has performed 8 audits of Ebasco. Each location performing HVAC duct, HVAC supports and HVAC systems related work for CPSES has been audited at least once. The list of audit subjects in Section 5.3.1 is representative for these audits. A tabulation of the TU Electric Technical Audit Program (TAP) audits is presented in Table 5-3.

In August 1986 the NRC-Vendor Program Branch (VPB) performed an audit of Ebasco's implementation of Ebasco's approved Nuclear Quality Assurance (QA) Program. Their inspection was specifically related to Ebasco's Quality Assurance (QA) Program implementation on the Comanche Peak

Project. Their report, #99900505/86-01, indicated that the NRC inspectors found no instance where the implementation of Ebasco's Quality Assurance (QA) Program for CPSES failed to meet NRC requirements.

The NRC-Office of Special Projects (OSP) conducted inspections (Reference 48) of HVAC systems in the New York office beginning in August 1987. The inspections involved technical evaluations of the design validation process and focused primarily on the review of calculations and Design Basis Documents (DBDs), and their compliance with licensing commitments. In addition, the NRC-Office of Special Projects (OSP) inspections (Reference 48) included a review of activities performed under the Engineering Functional Evaluation (EFE).

5.4 CORRECTIVE AND PREVENTIVE ACTION

Ebasco has developed Design Basis Documents (DBDs) and updated the HVAC installation specification to implement the corrective actions resulting from the HVAC portion of the Corrective Action Program (CAP). These Design Basis Documents (DBDs) contain the design criteria for validating the HVAC design of CPSES Unit 1 and Common. As a result of the HVAC portion of the Corrective Action Program (CAP), the CPSES Unit 1 and Common HVAC duct, HVAC supports and HVAC systems are validated as being capable of performing their safety-related functions.

This validation is documented in the drawings, calculations and specifications which are contained in the Design Validation Packages (DVPs). This validated design documentation will be provided to TU Electric at the completion of the Corrective Action Program (CAP). The Design Basis Documents (DBDs) used for validation will also be provided to Comanche Peak Engineering (CPE). The validated design documentation and Design Basis Documents (DBDs) can provide the basis for configuration control of CPSES HVAC design and can be utilized by TU Electric to facilitate operation, maintenance and future modifications in accordance with licensing commitments following issuance of an operating license.

Interfaces between organizations have been identified and addressed in detail within project procedures. Those HVAC interfaces are discussed in Section 5.1.2.5.

TU Electric Comanche Peak Engineering (CPE) is developing a program to assure a complete and orderly transfer of the engineering and design function from Ebasco to CPE. The program provides for the identification of those tasks presently being performed by Ebasco which are to be transferred to Comanche Peak Engineering (CPE) and the identification of all procedures, programs, training, and staffing requirements. The program is based upon three prerequisites: (a) the Corrective Action Program (CAP) effort to support plant completion is finished for the particular task; (b) the HVAC Design Validation Packages (DVPs) are complete; and (c) any required preventive action taken, as discussed in Appendix A and Appendix B, is complete.

FIGURE 5-1

CORRECTIVE ACTION PROGRAM (CAP)

TECHNICAL INTERFACES

HVAC

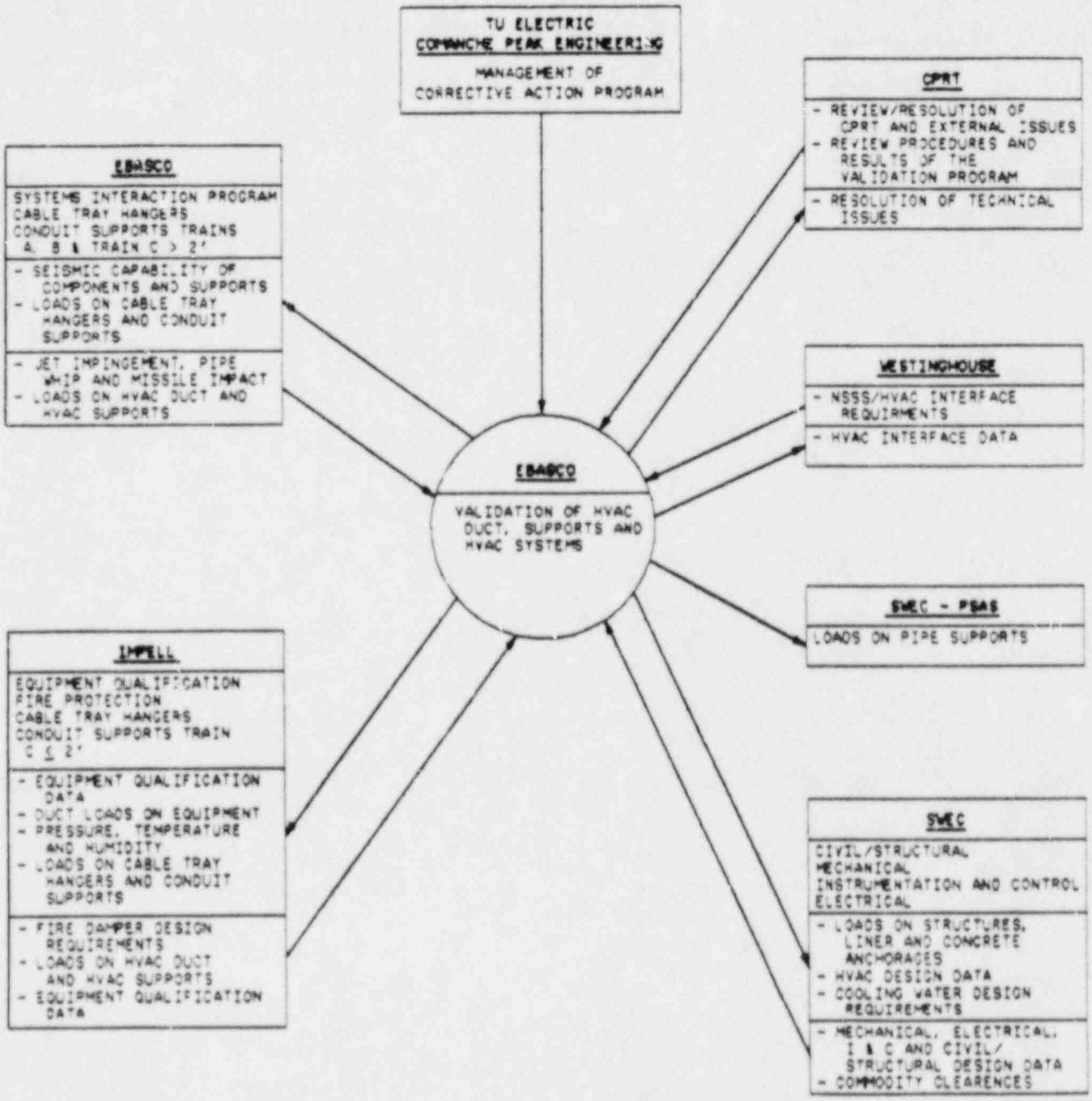

FIGURE 5-2

POST CONSTRUCTION HARDWARE VALIDATION PROGRAM (PCHVP)

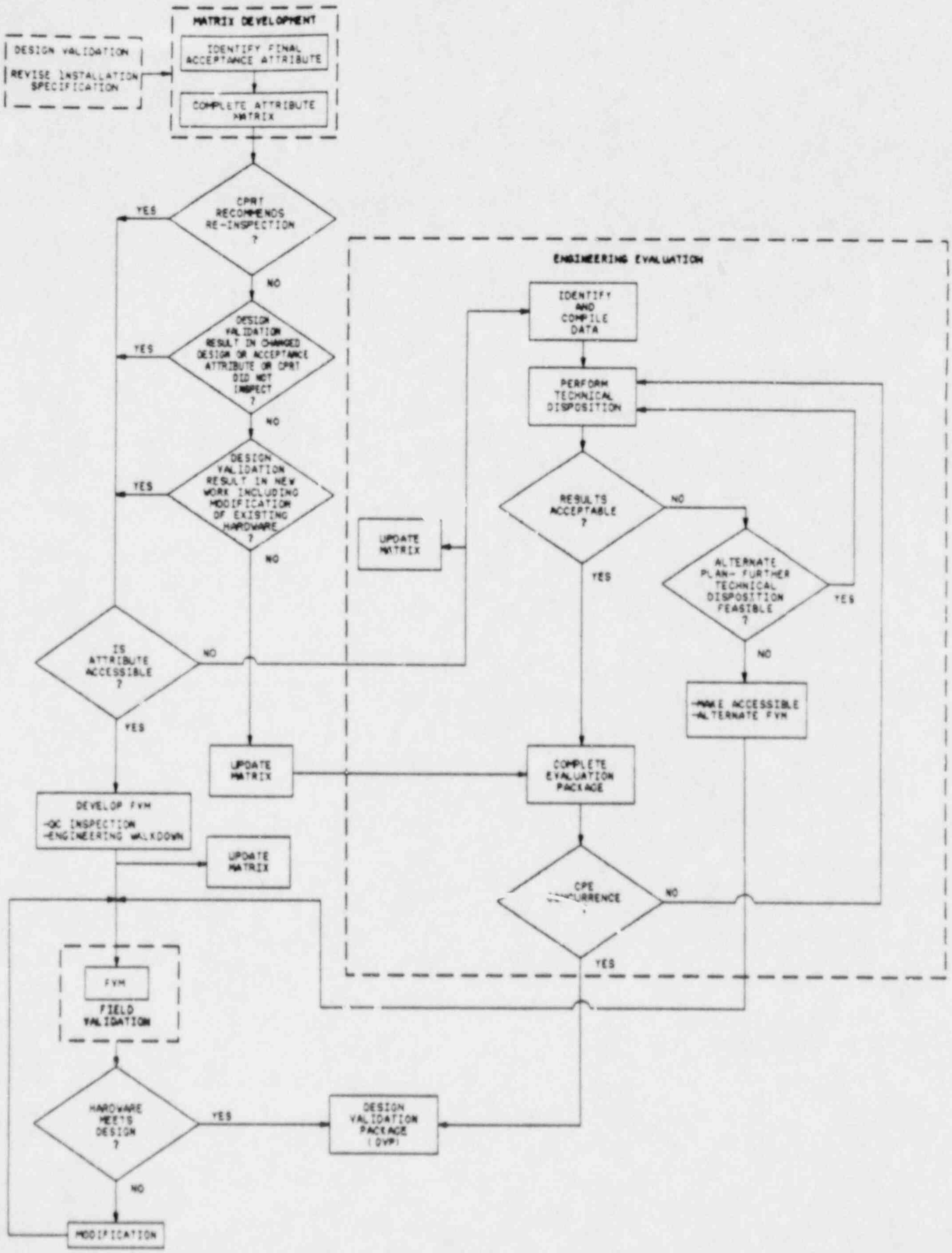

TABLE 5-1

HVAC DESIGN PROCEDURES AND DESIGN BASIS DOCUMENTS (DBDs)

Document No.	Title
SAG.CP23	Seismic Design Criteria for Seismic Category I HVAC Ducts and Duct Supports (Reference 8)
SAG.CP24	General Instructions For Seimic Category I HVAC Duct and Duct Support Analysis (Reference 9)
SAG.CP30	Seismic Design Criteria For Air Handling Units, Plenums, Equipment Supports (Reference 16)
SAG.CP31	Design Criteria For Seismic Category II HVAC Duct and Duct Supports (Reference 25)
SAG.CP32	General Instructions For Seismic Category II HVAC Duct and Duct Support Analysis (Reference 24)
DBD-ME-300	Containment Ventilation Systems (Reference 28)
DBD-ME-301	Containment Air Cleanup Systems (Reference 29)
DBD-ME-302	Safeguards Building Ventilation System (Reference 30)
DBD-ME-302A	Diesel Generator Area Ventilation System (Reference 31)
DBD-ME-302B	Electrical Area HVAC System (Reference 32)
DBD-ME-302C	Mainsteam and Feedwater Area Air Conditioning System (Reference 33)
DBD-ME-303	Auxiliary Building Ventilation System (Reference 34)
DBD-ME-303-01	Fuel Handling Building Ventilation System (Reference 35)

TABLE 5-1
(Continued)

Document No.	Title
DBD-ME-304	Control Room Air Conditioning System (Reference 36)
DBD-ME-305	Uncontrolled Access Area Ventilation System (Reference 37)
DBD-ME-309	Primary Plant Ventilation System (Reference 38)
DBD-ME-311	Safety Chilled Water System (Reference 39)
DBD-ME-312	Service Water Intake Structure Ventilation System (Reference 40)
DBD-ME-313	Uninterruptible Power Supply Area Air Conditioning System (Reference 41)
DBD-CS-086	HVAC Duct and Duct Supports (Reference 11)
---	Ebasco CPSES Manual of Procedures (Reference 5)

TABLE 5-2

POST CONSTRUCTION HARDWARE VALIDATION PROGRAM (PCHVP)
HVAC ATTRIBUTE MATRIX

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Air Handling Units/ Plenums - Configuration	Longitudinal Seam Types	CPE-EB-FVM-CS-066 (Reference 23)
	Duct Size	CPE-EB-FVM-CS-066
	Gage Thickness	CPE-EB-FVM-CS-066
	Duct Piece Length	CPE-EB-FVM-CS-066
	Duct Tee and Branch Connection Configuration	CPE-EB-FVM-CS-066
	Duct Closure Plate Configuration	CPE-EB-FVM-CS-066
	Duct Flex Connectors Location and Length	CPE-EB-FVM-CS-066
	Duct Layout Configuration	CPE-EB-FVM-CS-066
	Duct Support Location	CPE-EB-FVM-CS-066
	Duct Support Span	CPE-EB-FVM-CS-066
	Reinforcing Configuration	CPE-EB-FVM-CS-066
	Reinforcing Size	CPF-EB-FVM-CS-066
	Reinforcing Type (Lapped, Butted)	CPE-EB-FVM-CS-066
	Reinforcing Location (Spacing)	CPE-EB-FVM-CS-066
	Tie Rod Location	CPE-EB-FVM-CS-066
	Tie Rod Size	ECE 9.04-05 (Reference 26)
	Gaskets Existence All Around	CPE-EB-FVM-CS-066

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Air Handling Units/ Plenums - Configuration (Con't)	Housing-Bolt Hole Spacing Configuration (Used and Unused)	CPE-EB-FVM-CS-066
	Housing-Dimensions	CPE-EB-FVM-CS-066
	Housing-Location and Configuration of Attachments	CPE-EB-FVM-CS-066
	Housing-Electrical Connection Location	CPE-EB-FVM-CS-066
	Housing-Location of Work Points	CPE-EB-FVM-CS-066
	Housing-Member Length	CPE-EB-FVM-CS-066
	Housing-Member Size	CPE-EB-FVM-CS-066
	Housing-Member Shape	CPE-EB-FVM-CS-066
	Housing-Member Location	CPE-EB-FVM-CS-066
	Housing-Member Orientation	CPE-EB-FVM-CS-066
	Housing-Number of Bolt Holes in a Cross Section	CPE-EB-FVM-CS-066
	Housing-Water Connection Configuration	CPE-EB-FVM-CS-066
	Housing-Copes, Cutouts (Sizes and Locations)	CPE-EB-FVM-CS-066
	Accessory Mounting Configuration	ECE 9.04-05
	Component Mounting Configuration	ECE 9.04-05
	Component Tag Number	CPE-EB-FVM-CS-066
	Component and Accessory Locations	CPE-EB-FVM-CS-066

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Air Handling Units/ Plenums - Configuration (Con't)	Extractor Stiffener Configuration	CPE-EB-FVM-CS-066
	Location of Additional Attachments and Support Spans	CPE-EB-FVM-CS-066
	Other Commodity Attachment Configuration	CPE-EB-FVM-CS-066
HVAC Air Handling Units/ Plenums-Bolted Base Member	Hole to End Distance	CPE-EB-FVM-CS-066
	Gage Dimension	CPE-EB-FVM-CS-066
	Presence of Gap Between Base Member and Concrete	CPE-EB-FVM-CS-066
	Bolt Hole Visible	CPE-EB-FVM-CS-066
HVAC Air Handling Units/ Plenums-Bolting	Amount of Gap Under Bolt Head	CPE-EB-FVM-CS-066
	Bolt Size	CPE-EB-FVM-CS-066
	Configuration	CPE-EB-FVM-CS-066
	Gage Dimension	CPE-EB-FVM-CS-066
	Existence of Hardened Washers for High Strength Bolts	ECE 9.04-05
	Hole Location on Member	CPE-EB-FVM-CS-066
	Hole to End of Member Distance	CPE-EB-FVM-CS-066
	Bolt Hole Visible and Washer Size	CPE-EB-FVM-CS-066
	Thread Engagement	CPE-EB-FVM-CS-066

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Air Handling Units/ Plenums - Bolting (Con't)	Tightness	CPE-EB-FVM-CS-066
	Number and Size of Unused Bolt Holes	CPE-EB-FVM-CS-066
HVAC Air Handling Units/ Plenums-Hilti Bolts	Skewness	CPE-EB-FVM-CS-066
	Amount of Gap Under Nut	CPE-EB-FVM-CS-066
	Diameter	CPE-EB-FVM-CS-066
	Marking (Length)	CPE-EB-FVM-CS-066
	Bolt Projection from Concrete Surface	CPE-EB-FVM-CS-066
	Thread Engagement	CPE-EB-FVM-CS-066
	Torque	CPE-EB-FVM-CS-066
	Presence of Torque Seal	CPE-EB-FVM-CS-066
	Type (Regular/Super)	CPE-EB-FVM-CS-066
	Washer Installed	CPE-EB-FVM-CS-066
HVAC Air Handling Units/ Plenums-Richmond Inserts	Amount of Gap Under Bolt Head or Nut	CPE-EB-FVM-CS-066
	Presence of Double Nuts for Threaded Rods	CPE-EB-FVM-CS-066
	Length of Bolt or Threaded Rod	CPE-EB-FVM-CS-066
	Material (Marking of Bolt or Threaded Rod)	CPE-EB-FVM-CS-066
	Size of Bolt or Threaded Rod	CPE-EB-FVM-CS-066
	Bolt Thread Engagement	CPE-EB-FVM-CS-066
	Presence of Torque Seal	CPE-EB-FVM-CS-066

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Air Handling Units/ Plenums - Richmond Inserts (Con't)	Tightness	CPE-EB-FVM-CS-066
HVAC Air Handling Units/ Plenums-Flanges	Type	CPE-EB-FVM-CS-066
	Alignment	CPE-EB-FVM-CS-066
	Bolt Edge Distance	CPE-EB-FVM-CS-066
	Number and Size of Unused Bolt Holes	CPE-EB-FVM-CS-066
	Bolt Hole Spacing (Used and Unused)	CPE-EB-FVM-CS-066
	Bolt Hole Visible and Washer Size	CPE-EB-FVM-CS-066
	Bolt Location	CPE-EB-FVM-CS-066
	Bolt Size	CPE-EB-FVM-CS-066
	Bolt Spacing	CPE-EB-FVM-CS-066
	Bolt Thread Engagement	CPE-EB-FVM-CS-066
	Compression of Lock Washers	CPE-EB-FVM-CS-066
	Configuration	CPE-EB-FVM-CS-066
	Location	CPE-EB-FVM-CS-066
	Size	CPE-EB-FVM-CS-066
HVAC Air Handling Units/ Plenums - Welds	Housing - Type	CPE-EB-FVM-CS-066
	Housing - Size, Profile	CPE-EB-FVM-CS-066
	Housing - Length	CPE-EB-FVM-CS-066
	Housing - Location	CPE-EB-FVM-CS-066

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Air Handling Units/ Plenums - Welds (Con't)	Presence of Fusion	CPE-EB-FVM-CS-066
	Presence of Arc Strikes	CPE-EB-FVM-CS-066
	Presence of Cracks	CPE-EB-FVM-CS-066
	Presence of Craters	CPE-EB-FVM-CS-066
	Presence of Overlap	CPE-EB-FVM-CS-066
	Presence of Porosity	CPE-EB-FVM-CS-066
	Presence of Slag	CPE-EB-FVM-CS-066
	Presence of Undercut	CPE-EB-FVM-CS-066
	Presence of Fillet Gaps (Structural to Structural and Structural to Sheet Metal)	CPE-EB-FVM-CS-066
	Housing - Presence of Attachment to Sheet Metal	CPE-EB-FVM-CS-066
	Duct-Fit Up (Structural to Structural)	CPE-EB-FVM-CS-066
	Duct Flange-Angle to Angle Size and Length	CPE-EB-FVM-CS-066
	Duct Flange-Angle to Duct Length and Spacing	CPE-EB-FVM-CS-066
	Duct Flange-Corner Tab Length	CPE-EB-FVM-CS-066
	Duct Reinforcing-Angle to Duct Length and Spacing	CPE-EB-FVM-CS-066
	Duct-Continuous Splice Welds	CPE-EB-FVM-CS-066
	Duct Tie Rods - Size and Length	CPE-EB-FVM-CS-066

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Air Handling Units/ Plenums - Welds (Con't)	Duct Reinforcing-Angle to Angle Size and Length	CPE-EB-FVM-CS-066
HVAC Air Handling Units/ Plenums - General	Presence of Damage	CPE-EB-FVM-CS-066
	Clearances	CPE-SWEC-FVM-CS-068 (Reference 27)
	Cleanliness	CPE-EB-FVM-CS-066
	Presence of Touch-up Coatings	CPE-EB-FVM-CS-066
	Concrete Anchorage-Bolt Spacing on Plate	CPE-EB-FVM-CS-066
	Presence of Insulation	ECE 9.04-05
HVAC Duct Supports - General	Support Identification	CPE-EB-FVM-CS-029 (Reference 14)
	Presence of Damage	CPE-EB-FVM-CS-029
	Clearances	CPE-SWEC-FVM-CS-068
	Presence of Touch-up Coatings	CPE-EB-FVM-CS-029
HVAC Duct Supports - Configuration	Member Shape	CPE-EB-FVM-CS-029
	Member Size (Thickness)	CPE-EB-FVM-CS-029
	Member Orientation	CPE-EB-FVM-CS-029
	Plumbness, Levelness and Skewness	CPE-EB-FVM-CS-029
	Member Length	CPE-EB-FVM-CS-029
	Copes, Cutouts (Sizes and Locations)	CPE-EB-FVM-CS-029
	Bolt Hole Size (Unused)	CPE-EB-FVM-CS-029

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Duct Supports - Configuration (Con't)	Bolt Hole Spacing (Used and Unused)	CPE-EB-FVM-CS-029
	Number of Bolt Holes in a Cross Section	CPE-EB-FVM-CS-029
	Location of Additional Attachments and Support Spans	CPE-EB-FVM-CS-029
	Location and Configuration of Attachments	CPE-EB-FVM-CS-029
	Location of Work Points	CPE-EB-FVM-CS-029
	Duct Attached to Support	CPE-EB-FVM-CS-029
	Presence of Duct/Support Gaps	CPE-EB-FVM-CS-029
HVAC Duct Supports - Welds	Presence of Cracks	CPE-EB-FVM-CS-029
	Presence of Overlap	CPE-EB-FVM-CS-029
	Presence of Slag	CPE-EB-FVM-CS-029
	Presence of Arc Strikes	CPE-EB-FVM-CS-029
	Presence of Porosity	CPE-EB-FVM-CS-029
	Presence of Undercut	CPE-EB-FVM-CS-029
	Presence of Craters	CPE-EB-FVM-CS-029
	Presence of Fusion	CPE-EB-FVM-CS-029
	Type of Weld	CPE-EB-FVM-CS-029
	Size, Profile	CPE-EB-FVM-CS-029
	Length	CPE-EB-FVM-CS-029
	Location	CPE-EB-FVM-CS-029

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Duct Supports - Welds (Con't)	Presence of Fillet Gaps (Structural to Structural and Structural to Sheet Metal)	CPE-EB-FVM-CS-029
HVAC Duct Supports - Bolting	Number and Size of Unused Bolt Holes	CPE-EB-FVM-CS-029
	Presence of Hardened Washers for High Strength Bolts	ECE 9.04-05
	Hole Location (On Members)	CPE-EB-FVM-CS-029
	Bolt Hole Visible	CPE-EB-FVM-CS-029
	Hole to End of Member Distance	CPE-EB-FVM-CS-029
	Gage Dimension	CPE-EB-FVM-CS-029
	Bolt Size	CPE-EB-FVM-CS-029
	Bolt Tightness	CPE-EB-FVM-CS-029
	Thread Engagement	CPE-EB-FVM-CS-029
	Configuration	CPE-EB-FVM-CS-029
	Amount of Gap Under Bolt Head	CPE-EB-FVM-CS-029
HVAC Duct Supports - Bolted Base Member	Bolt Hole Visible	CPE-EB-FVM-CS-029
	Hole to End of Member Distance	CPE-EB-FVM-CS-029
	Gage Dimension	CPE-EB-FVM-CS-029
	Presence of Gap Between Base Member and Concrete	CPE-EB-FVM-CS-029
HVAC Duct Supports - Hilti Bolts	Concrete Anchorage Bolt Spacing on Plate	CPE-EB-FVM-CS-029

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Duct Supports - Hilti Bolts (Con't)	Type (Regular or Super)	CPE-EB-FVM-CS-029
	Marking (Length Code)	CPE-EB-FVM-CS-029
	Diameter	CPE-EB-FVM-CS-029
	Thread Engagement	CPE-EB-FVM-CS-029
	Projection from Concrete Surface	CPE-EB-FVM-CS-029
	Skewness	CPE-EB-FVM-CS-029
	Amount of Gap Under Nut	CPE-EB-FVM-CS-029
	Torque	CPE-EB-FVM-CS-029
	Presence of Torque Seal	CPE-EB-FVM-CS-029
	Washer Installed	CPE-EB-FVM-CS-029
HVAC Duct Supports - Richmond Inserts	Size of Bolt or Threaded Rod	CPE-EB-FVM-CS-029
	Material (Marking of Bolt or Threaded Rod)	CPE-EB-FVM-CS-029
	Tightness	CPE-EB-FVM-CS-029
	Amount of Gap Under Bolt Head or Nut	CPE-EB-FVM-CS-029
	Length of Bolt or Threaded Rod	CPE-EB-FVM-CS-029
	Presence of Torque Seal	CPE-EB-FVM-CS-029

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Duct Supports - Richmond Inserts (Con't)	Bolt Thread Engagement	CPE-EB-FVM-CS-029
	Presence of Double Nuts for Threaded Rods	CPE-EB-FVM-CS-029
HVAC Duct - General	Presence of Damage	CPE-EB-FVM-CS-029
	Presence of Insulation	ECE 9.04-05
	Clearances	CPE-SWEC-FVM-CS-068
	Cleanliness	CPE-EB-FVM-CS-029
	Presence of Touch-up Coatings	CPE-EB-FVM-CS-029
HVAC Duct - Configuration	Component Mounting Configuration	ECE 9.04-05
	Accessory Mounting Configuration	ECE 9.04-05
	Longitudinal Seam Type	CPE-EB-FVM-CS-029
	Duct Size	CPE-EB-FVM-CS-029
	Gage Thickness	CPE-EB-FVM-CS-029
	Piece Length	CPE-EB-FVM-CS-029
	Tee and Branch Connection Configuration	CPE-EB-FVM-CS-029
	Closure Plate Configuration	CPE-EB-FVM-CS-029
	Flex Connectors (Location and Length)	CPE-EB-FVM-CS-029
	Duct Layout Configuration	CPE-EB-FVM-CS-029
	Support Location	CPE-EB-FVM-CS-029

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Duct - Configuration (Con't)	Support Span	CPE-EB-FVM-CS-029
	Configurations of Other Commodity Attachments	CPE-EB-FVM-CS-029
	Component and Accessory Location	CPE-EB-FVM-CS-029
	Component Identification	CPE-EB-FVM-CS-029
	Presence of Extractor Stiffeners	CPE-EB-FVM-CS-029
	Gasket Existence All Around	CPE-EB-FVM-CS-029
	Tie Rod Size	ECE-9.04-05
	Tie Rod Location	CPE-EB-FVM-CS-029
	Reinforcing Size	CPE-EB-FVM-CS-029
	Reinforcing Location (Spacing)	CPE-EB-FVM-CS-029
	Reinforcing Type (Lapped, Butted)	CPE-EB-FVM-CS-029
	Reinforcing Configuration	CPE-EB-FVM-CS-029
HVAC Duct - Flanges	Type	CPE-EB-FVM-CS-029
	Size	CPE-EB-FVM-CS-029
	Location	CPE-EB-FVM-CS-029
	Bolt Spacing	CPE-EB-FVM-CS-029
	Bolt Location	CPE-EB-FVM-CS-029
	Bolt Size	CPE-EB-FVM-CS-029

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Duct - Flanges (Con't)	Bolt-Edge Distance	CPE-EB-FVM-CS-029
	Bolt Hole Visible and Washer Size	CPE-EB-FVM-CS-029
	Number and Size of Unused Bolt Holes	CPE-EB-FVM-CS-029
	Bolt Hole Spacing (Used and Unused)	CPE-EB-FVM-CS-029
	Alignment	CPE-EB-FVM-CS-029
	Thread Engagement	CPE-EB-FVM-CS-029
	Compression of Lock Washers	CPE-EB-FVM-CS-029
	Configuration	CPE-EB-FVM-CS-029
HVAC Duct - Welds	Tie Rods - Size and Length	CPE-EB-FVM-CS-029
	Reinforcing-Angle to Duct Length and Spacing	CPE-EB-FVM-CS-029
	Reinforcing-Angle to Angle Size and Length	CPE-EB-FVM-CS-029
	Flange-Angle to Duct Length and Spacing	CPE-EB-FVM-CS-029
	Flange-Angle to Angle Size and Length	CPE-EB-FVM-CS-029
	Flange - Corner Tab Length	CPE-EB-FVM-CS-029
	Continuous Splice Welds	CPE-EB-FVM-CS-029

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Duct - Welds (Con't)	Presence of Fillet Gap (Structural to Structural and Structural to Sheet Metal)	CPE-EB-FVM-CS-029
	Presence of Craters	CPE-EB-FVM-CS-029
	Presence of Undercut	CPE-EB-FVM-CS-029
	Presence of Porosity	CPE-EB-FVM-CS-029
	Presence of Overlap	CPE-EB-FVM-CS-029
	Presence of Cracks	CPE-EB-FVM-CS-029
	Presence of Arc Strikes	CPE-EB-FVM-CS-029
	Presence of Fusion	CPE-EB-FVM-CS-029
	Presence of Slag	CPE-EB-FVM-CS-029
HVAC Equipment Supports - General	Presence of Damage	CPE-EB-FVM-CS-066
	Presence of Touch up Coatings	CPE-EB-FVM-CS-066
	Clearances	CPE-SWEC-FVM-CS-068
	Support Identification	CPE-EB-FVM-CS-066
HVAC Equipment Supports - Configuration	Member Shape	CPE-EB-FVM-CS-066
	Member Size (Thickness)	CPE-EB-FVM-CS-066
	Member Orientation	CPE-EB-FVM-CS-066
	Configuration-Plumbness, Levelness and Skewness	CPE-EB-FVM-CS-066
	Member Length	CPE-EB-FVM-CS-066
	Copes, Cutouts (Sizes and Locations)	CPE-EB-FVM-CS-066

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Equipment Supports - Configuration (Con't)	Bolt Hole Size (Used and Unused)	CPE-EB-FVM-CS-066
	Bolt Hole Spacing (Used and Unused)	CPE-EB-FVM-CS-066
	Number of Bolt Holes in a Cross-Section	CPE-EB-FVM-CS-066
	Location of Additional Attachments and Support Spans	CPE-EB-FVM-CS-066
	Configuration and Location of Attachments	CPE-EB-FVM-CS-066
	Location of Work Points	CPE-EB-FVM-CS-066
HVAC Equipment Supports - Welds	Presence of Fillet Gaps	CPE-EB-FVM-CS-066
	Type	CPE-EB-FVM-CS-066
	Size, Profile	CPE-EB-FVM-CS-066
	Length	CPE-EB-FVM-CS-066
	Location	CPE-EB-FVM-CS-066
	Presence of Craters	CPE-EB-FVM-CS-066
	Presence of Undercut	CPE-EB-FVM-CS-066
	Presence of Porosity	CPE-EB-FVM-CS-066
	Presence of Overlap	CPE-EB-FVM-CS-066
	Presence of Cracks	CPE-EB-FVM-CS-066
	Presence of Arc Strikes	CPE-EB-FVM-CS-066
	Presence of Fusion	CPE-EB-FVM-CS-066
	Presence of Slag	CPE-EB-FVM-CS-066

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Equipment Supports - Bolting	Number and Size of Unused Bolt Holes	CPE-EB-FVM-CS-066
	Presence of Hardened Washers for High Strength Bolts	ECE 9.04-05
	Hole Location (On Members)	CPE-EB-FVM-CS-066
	Bolt Hole Visible and Washer Size	CPE-EB-FVM-CS-066
	Hole to End of Member Distance	CPE-EB-FVM-CS-066
	Gage Dimension	CPE-EB-FVM-CS-066
	Bolt Size	CPE-EB-FVM-CS-066
	Bolt Tightness	CPE-EB-FVM-CS-066
	Thread Engagement	CPE-EB-FVM-CS-066
	Configuration	CPE-EB-FVM-CS-066
	Amount of Gap Under Bolt Head	CPE-EB-FVM-CS-066
HVAC Equipment Supports - Hilti Bolts	Bolt Spacing on Plate	CPE-EB-FVM-CS-066
	Type (Regular or Super)	CPE-EB-FVM-CS-066
	Marking (Length Code)	CPE-EB-FVM-CS-066
	Diameter	CPE-EB-FVM-CS-066
	Thread Engagement	CPE-EB-FVM-CS-066
	Projection from Concrete Surface	CPE-EB-FVM-CS-066

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
HVAC Equipment Supports - Hilti Bolts (Con't)	Skewness	CPE-EB-FVM-CS-066
	Amount of Gap Under Nut	CPE-EB-FVM-CS-066
	Torque	CPE-EB-FVM-CS-066
	Presence of Torque Seal	CPE-EB-FVM-CS-066
	Washer Installed	CPE-EB-FVM-CS-066
HVAC Equipment Supports - Richmond Inserts	Size of Bolt or Threaded Rod	CPE-EB-FVM-CS-066
	Material (Marking of Bolt or Threaded Rod)	CPE-EB-FVM-CS-066
	Tightness	CPE-EB-FVM-CS-066
	Presence of Torque Seal	CPE-EB-FVM-CS-066
	Amount of Gap Under Bolt Head or Nut	CPE-EB-FVM-CS-066
	Length of Bolt or Threaded Rod	CPE-EB-FVM-CS-066
	Bolt Thread Engagement	CPE-EB-FVM-CS-066
	Presence of Double Nuts for Threaded Rods	CPE-EB-FVM-CS-066
HVAC Equipment Supports - Bolted Base Member	Bolt Hole Visible	CPE-EB-FVM-CS-066
	Hole to End of Member Distance	CPE-EB-FVM-CS-066
	Gage Dimension	CPE-EB-FVM-CS-066
	Amount of Gap between Base Member and Concrete	CPE-EB-FVM-CS-066
Tornado Vent Fire Dampers - General	Presence of U.L. Mark on Hold Open Device	CPE-EB-FVM-CS-112 (Reference 47)

TABLE 5-2
(Continued)

Construction Work Category	Final Acceptance Attribute	PCHVP Attribute Validation Method
Tornado Vent Fire Dampers - General	Presence of U.L. Label on Damper	CPE-EB-FVM-CS-112
	Identification of Fusible Link Actuation Temperature	CPE-EB-FVM-CS-112
	Presence of Damage on Negator Springs and Tracks	CPE-EB-FVM-CS-112

TABLE 5-3

SUMMARY OF AUDITS

Ebasco Quality Assurance (QA) Audits

Audit Number	Auditing Organization	Date of Audit	Location	Audit Report Transmittal	Audit Response Transmittal
2854	Ebasco QA	Jan 14-21, 1987	New York	Mar 5, 1987	1 finding corrected during audit; no response was required
2880	Ebasco QA	Nov 11-12, 1987	New York	Dec 14, 1987	No findings; no response was required
2883	Ebasco QA	Dec 16-17, 1987	New York	Dec 30, 1987	No findings; no response was required

TU Electric Quality Assurance (QA) Audits

Audit Number	Auditing Organization	Date of Audit	Location	Report Transmittal	Response Transmittal
ATP-87-02	TU Elec TAP	Feb 9-13, 1987	Site	Mar 16, 1987	May 28, 1987
ATP-87-23	TU Elec TAP	June 15-19, 1987	New York	July 2, 1987	Aug 5, 1987
ATP-87-31	TU Elec TAP	July 20-24, 1987	New York	Aug 13, 1987	Sept 4, 1987
ATP-87-51	TU Elec TAP	Sept 28-Oct 2, 1987	New York	Oct 30, 1987	Nov 23, 1987
ATP-87-52	TU Elec TAP	Oct 12-16, 1987	New York	Nov 13, 1987	No findings; no response was required
ATP-87-538	TU Elec TAP	Nov 30-Dec 18, 1987	Site	Dec 31, 1987	Jan 15, 1988

TABLE 5-3
(Continued)

TU Electric Quality Assurance (QA) Audits

Audit Number	Auditing Organization	Date of Audit	Location	Audit Report Transmittal	Audit Response Transmittal
ATP-87-541	TU Elec TAP	Nov 9-Dec 16, 1987	Site	Dec 31, 1987	Feb 2, 1988
ATP-88-80	TU Elec TAP	Jan 25-29, 1987	New York	Feb 12, 1988	In progress
TCP-87-45	TU Elec QA	Dec 7-14, 1987	Site	Jan 5, 1988	In progress

6.0 REFERENCES

1. TU Electric Specification 2323-MS-85, "HVAC Ducts, Louvers and Accessories", Revision 6.

2. TU Electric NEO Quality Assurance Department Instruction NQI-3.09-M-006, "Verification/Inspection of Seismic HVAC Systems", Revision 2.

3. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.29, "Seismic Design Classification", Revision 2, February 1976.

4. Corporate Consulting and Development Company, Ltd., "Test Report for Static Load Tests of HVAC Ductwork for Comanche Peak Steam Electric Station (CPSES)", CCL Report No. A-749-87, October 23, 1987, with Addendum 1 dated January 7, 1988.

5. Ebasco CPSES Manual of Procedures.

6. American Institute of Steel Construction (AISC), Manual of Steel Construction 7th Edition, including Supplements 1, 2, and 3.

7. TU Electric CPSES Unit 1 and Common, "Systems Interaction Program, (Supplement A, Mechanical Project Status Report)", Revision 0.

8. Ebasco Document SAG.CP23, "Seismic Design Criteria for Seismic Category I HVAC Ducts and Duct Supports for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 1, June 5, 1987.

9. Ebasco Document SAG.CP24, "General Instructions for Seismic Category I HVAC Duct and Duct Support Analysis for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 4, December 15, 1987.

10. TU Electric CPSES Unit 1 & 2, "Design Basis Consolidation Program Plan", Ebasco Services, Inc., Revision 1, April 11, 1987.

11. CPSES Design Basis Document DBD-CS-086, "HVAC Duct and Duct Supports", Revision 1, December 31, 1987.

12. TU Electric Engineering and Construction Procedure EC 9.04, "Post Construction Hardware Validation Program", Revision 2, September 30, 1987.

13. Ebasco Calculation HVAC Volume I - Book 15, "HVAC Duct Qualification Methodology", Revision 0.

14. CPE-EB-FVM-CS-029, "Procedure for Seismic HVAC Duct and Duct Hanger As-Built Verification in Unit 1 and Common Areas", Revision 6.

15. Ebasco Document SAG.CP33, "Specification for Static Testing of HVAC Ducts for Comanche Peak Steam Electric Station Units 1 & 2", Revision 4, October 21, 1987.

16. Ebasco Document SAG.CP30, "Seismic Design Criteria for Air Handling Units, Plenums and Equipment Supports", Revision 0, June 29, 1987.

17. CPE-SWEC-FVM-EE/ME/IC/CS-090, "Post Construction Hardware Validation Program Quality Control Reinspections", Revision 2, October 15, 1987.

18. Corporate Consulting and Development Company, Ltd, Report No. A-413-81, "Duct Test Data", February 19, 1982.

19. Corporate Consulting and Development Company, Ltd, Report No. A-414-81, "Duct Test Evaluation", February 19, 1982.

20. Ebasco Nuclear Quality Assurance Program Manual ETR-1001, Revision 13 dated May 15, 1987.

21. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.64, "Quality Assurance Requirements for the Design of Nuclear Power Plants", Revision 2, June 1976.

22. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.92, "Combining Model Responses and Spatial Components in Seismic Response Analysis", Revision 1, February, 1976.

23. CPE-EB-FVM-CS-066, "Procedure for As-Built Verification of Seismic HVAC Air Handling Units, Plenums and Equipment Supports in Units 1 and Common Areas", Revision 2.

24. Ebasco Document SAG.CP32, "General Instructions for Seismic Category II HVAC Duct and Duct Support Analysis", Revision 2, December 15, 1987.

25. Ebasco Document SAG.CP31, "Design Criteria for Seismic Category II HVAC Duct and Duct Supports", Revision 2, October 1, 1987.

26. TU Electric Engineering and Construction Engineering Procedure ECE 9.04-05, "Post Construction Hardware Validation Program Engineering Evaluation", Revision 0, October 2, 1987.

27. CPE-SWEC-FVM-CS-068, "Field Verification Method - Commodity Clearance", Revision 0, July 30, 1987.

28. CPSES Design Basis Document DBD-ME-300, "Containment Ventilation Systems", Revision 1, December 22, 1987.

29. CPSES Design Basis Document DBD-ME-301, "Containment Air Cleanup Systems", Revision 1, December 22, 1987.

30. CPSES Design Basis Document DBD-ME-302, "Safeguards Building Ventilation System", Revision 1, December 22, 1987.

31. CPSES Design Basis Document DBD-ME-302A, "Diesel Generator Area Ventilation System", Revision 1, December 22, 1987.

32. CPSES Design Basis Document DBD-ME-302B, "Electrical Area HVAC System", Revision 3, February 4, 1988.

33. CPSES Design Basis Document DBD-ME-302C, "Mainsteam and Feedwater Area Air Conditioning System", Revision 1, December 22, 1987.

34. CPSES Design Basis Document DBD-ME-303, "Auxiliary Building Ventilation System", Revision 1, December 22, 1987.

35. CPSES Design Basis Document DBD-ME-303-01, "Fuel Handling Building Ventilation System", Revision 1, December 22, 1987.

36. CPSES Design Basis Document DBD-ME-304, "Control Room Air Conditioning System", Revision 1, December 22, 1987.

37. CPSES Design Basis Document DBD-ME-305, "Uncontrolled Access Area Ventilation System", Revision 1, December 22, 1987.

38. CPSES Design Basis Document DBD-ME-309, "Primary Plant Ventilation System", Revision 2, February 12, 1988.

39. CPSES Design Basis Document DBD-ME-311, "Safety Chilled Water System", Revision 1, December 22, 1987.

40. CPSES Design Basis Document DBD-ME-312, "Service Water Intake Structure Ventilation System", Revision 1, December 22, 1987.

41. CPSES Design Basis Document DBD-ME-313, "Uninterruptible Power Supply Area Air Conditioning System", Revision 1, December 22, 1987.

42. Comanche Peak Response Team Program Plan and Issue-Specific Action Plans, Appendix D, CPRT Sampling Policy, Applications and Guidelines, Revision 1, January 31, 1986, and Appendix E, Resolution of Discrepancies Identified by the CPRT, Revision 3, June 18, 1987.

43. TU Electric Document, "Evaluation and Resolution of Generic Technical Issues for HVAC Systems (Including Ducts and Duct Supports)", Revision 0, December 15, 1986.

44. TU Electric Engineering and Construction Engineering Procedure, ECE 9.04, "Control of the Post Construction Hardware Validation Program Manual", Revision 1, October 7, 1987.

45. CPE-SWEC-FVM-EE/ME/IC/CS-089, "Post Construction Hardware Validation (PCHV) Program Engineering Walkdowns", Revision 2, October 15, 1987.

46. CPE-IM-FVM-EQ-057, "Equipment Qualification Walkdowns", Revision 2, September 21, 1987.

47. CPE-EB-FVM-CS-112, "Procedure for As-Built Walkdown of Tornado Vent Fire Dampers in Unit 1 and Common Areas", Revision 0, December 10, 1987.

48. NRC Letter No. 50/445/87-19, 50/446/87-15 to TU Electric, October 15, 1987.

49. Tenera, L.P. (TERA) Mechanical Issue Resolution Report (IRR) DAP-E-M-504, Revision 0.

50. TU Electric Comanche Peak Response Team Issue Specific Action Plan (ISAP) VII.c Appendices 15 and 31.

51. CYGNA Cable Tray Supports Review Issues List (RIL) Comanche Peak Steam Electric Station (CPSES) Independent Assessment Program (IAP) - All Phases, Revision 14, transmitted to TU Electric by CYGNA Energy Services in letter No. 84056.114, dated August 10, 1987.

52. TU Electric Letter No. TXX 6631, W.G. Counsil to U.S. Nuclear Regulatory Commission, Comanche Peak Programs, August 20, 1987.

53. TU Electric Letter No. TXX 6500, W.G. Counsil to U.S. Nuclear Regulatory Commission, Comanche Peak Programs, June 25, 1987.

54. Tenera, L.P. (TERA) Environmental Qualification Issue Resolution Report (IRR) DAP-E-EIC-503, Revision 0.

55. TU Electric Comanche Peak Response Team Issue Specific Action Plan (ISAP) VII.c Appendix 16.

APPENDIX A

COMANCHE PEAK RESPONSE TEAM (CPRT) AND EXTERNAL ISSUES

This appendix contains a comprehensive summary of the Ebasco evaluation, resolution and corrective and preventive action for all the Comanche Peak Response Team (CPRT) and external issues which are related to the HVAC duct, HVAC supports and HVAC systems designs. Specific references to the design criteria, specifications, procedures and tests which have resolved the issues are provided.

To report the resolution of the Comanche Peak Response Team (CPRT) and external issues, an individual subappendix was developed for each issue. Each subappendix includes: a definition of the issue; issue resolution; and corrective and preventive action.

The issues contained in Subappendices A1 through A7, and A19 were raised by the Comanche Peak Response Team (CPRT)[1, 2]. Issues A4 and A5 were also raised by the NRC in Inspection Reports. The issues contained in Subappendices A8 through A11 were raised by the NRC in Inspection Reports. The issue contained in Subappendix A12 was raised by the NRC Construction Assessment Team (CAT). The issues contained in Subappendices A13 and A14 were raised by CASE. The issue contained in Subappendix A15 was raised by the NRC Technical Review Team (TRT). The issues contained in Subappendices A16 and A17 are included in the CYGNA Energy Services (CYGNA) Review Issue List (RIL)[3]. The first nine issues contained in Subappendix A18 are HVAC issues which were identified by the original HVAC designer to Ebasco. The last issue contained in Subappendix A18 was raised by the Comanche Peak Response Team (CPRT)[2]. The issues contained in Subappendices A2 through A5, A7, A10 and A12 through A18 were part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-85-54 in letter number TXX-5043, dated September 26, 1986 from TU Electric to the NRC.

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1 Tenera, L.P. (TERA) Mechanical Issue Resolution Report (IRR) DAP-E-M-504, Revision 0, and Environmental Qualification IRR DAP-E-EIC-503, Revision 0.

2 TU Electric Comanche Peak Response Team (CPRT) Issue Specific Action Plan (ISAP) VII.c Appendices 15, 16 and 31.

3 CYGNA Conduit and Cable Tray Review Issue List (RIL) Comanche Peak Steam Electric Station (CPSES) Independent Assessment Program (IAP) - All Phases, Revision 14, transmitted to TU Electric by CYGNA Energy Services in letter No. 84056.114, dated August 10, 1987.

The preventive action is embodied in the procedures, the specifications and the Design Basis Documents (DBDs), developed and used in the HVAC portion of the Corrective Action Program (CAP). These procedures, specifications and Design Basis Documents (DBDs), resolve all related Comanche Peak Response Team (CPRT) and external issues. Implementation of these preventive actions can assure that the HVAC portion of the design and hardware for CPSES Unit 1 and Common will continue to comply with the licensing commitments throughout the life of the plant as described in Section 5.4.

Comanche Peak Response Team (CPRT) and external issues contained in Appendix A are listed below:

Issue No.	Issue Title
A1	Determination of Heat Loads for Equipment Sizing
A2	Lack of Construction Details for Fabrication and Installation of Ducts and Plenums
A3	Inaccurate HVAC Duct Support Detail Drawings and Their Effect on the Duct Support Designs
A4	Inadequate Program for the Installation and Quality Control (QC) Verification of HVAC Duct Supports
A5	Groove Welds
A6	Lack of Documentation for Receipt Inspection by the Original HVAC Duct Support Contractor
A7	Insufficient Thread Engagement and Pretensioning of Richmond Insert Bolts on HVAC Duct Supports
A8	Battery Room Ventilation
A9	Battery Room Explosion Proof Thermostats
A10	Inspection Reports Dated Prior to Issue of As-Built Drawings
A11	Welder Qualification
A12	NRC CAT Inspection Results
A13	Seismic Design of HVAC Supports
A14	HVAC Duct Axial Restraint
A15	Seismic Interaction of HVAC Duct
A16	CYGNA Conduit and Cable Tray Issues
A17	CASE/CYGNA Cable Tray Issues
A18	Other HVAC Issues
A19	Environmental Conditions and Requirements

SUBAPPENDIX A1

DETERMINATION OF HEAT LOADS FOR EQUIPMENT SIZING (IRR DAP-E-M-504)

1.0 Definition of the Issue

The issue was that the original design of the safety-related HVAC systems:

- o may not have considered all applicable heat loads in system and component sizing calculations;
- o may not have adequately sized equipment;
- o may not have included applicable plant operating modes;
- o contained calculation errors in some equipment sizing calculations;
- o may have utilized improper design inputs.

2.0 Issue Resolution

Ebasco resolved this issue by establishing the design criteria for safety-related HVAC equipment sizing which required that all applicable heat loads and plant operating modes be considered. These design criteria are specified in the Design Basis Documents (DBDs) (References 4.2 through 4.15). Ebasco then performed new calculations to determine the heat loads for equipment sizing in accordance with Ebasco design control procedures (Reference 4.1). These procedures require that these calculations be checked and independently reviewed to assure accuracy and the use of proper design inputs. Equipment sizing was then validated using the results of the new heat load calculations.

3.0 Corrective and Preventive Action

- o No additional issues were identified during the review and resolution of this issue.
- o This issue was determined to be reportable under the provisions of 10CFR50.55(e). This issue was part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-85-43 in letter number TXX-4659, dated December 20, 1985 from TU Electric to the NRC.

3.1 Corrective Action

The design criteria for equipment sizing were established which required that all applicable heat loads and plant operating modes be considered. These design criteria are specified in the Design Basis Documents (DBDs) (References 4.2 through 4.15). Ebasco then performed new calculations to determine the heat loads for equipment sizing in accordance with Ebasco design control procedures (Reference 4.1). These procedures require that these calculations be checked and independently reviewed to assure accuracy and the use of proper design inputs. Equipment sizing was then validated using the results of the new heat load calculations.

3.2 Preventive Action

The design criteria for sizing of safety-related HVAC equipment, which require that all applicable heat loads and plant operating modes be considered, have been included in the Design Basis Documents (DBDs) (References 4.2 through 4.15). The Ebasco design control procedures (Reference 4.1) require that the calculations be checked and independently reviewed to assure accuracy and the use of proper design inputs.

4.0 References

4.1 Ebasco CPSES Manual of Procedures

4.2 CPSES Design Basis Document DBD-ME-300, "Containment Ventilation System", Revision 1, December 22, 1987.

4.3 CPSES Design Basis Document DBD-ME-301, "Containment Air Cleanup Systems", Revision 1, December 22, 1987.

4.4 CPSES Design Basis Document DBD-ME-302, "Safeguards Building Ventilation System", Revision 1, December 22, 1987.

4.5 CPSES Design Basis Document DBD-ME-302A, "Diesel Generator Area Ventilation System", Revision 1, December 22, 1987.

4.6 CPSES Design Basis Document DBD-ME-302B, "Electrical Area HVAC System", Revision 3, February 4, 1988.

4.7 CPSES Design Basis Document DBD-ME-302C, "Mainsteam and Feedwater Area Air Conditioning System", Revision 1, December 22, 1987.

4.8 CPSES Design Basis Document DBD-ME-303, "Auxiliary Building Ventilation System", Revision 1, December 22, 1987.

4.9 CPSES Design Basis Document DBD-ME-303-01, "Fuel Handling Building Ventilation System", Revision 1, December 22, 1987.

4.10 CPSES Design Basis Document DBD-ME-304, "Control Room Air Conditioning System", Revision 1, December 22, 1987.

4.11 CPSES Design Basis Document DBD-ME-305, "Uncontrolled Access Area Ventilation System", Revision 1, December 22, 1987.

4.12 CPSES Design Basis Document DBD-ME-309, "Primary Plant Ventilation System", Revision 2, February 12, 1988.

4.13 CPSES Design Basis Document DBD-ME-311, Safety Chilled Water System", Revision 1, December 22, 1987.

4.14 CPSES Design Basis Document DBD-ME-312, "Service Water Intake Structure Ventilation System", Revision 1, December 22, 1987.

4.15 CPSES Design Basis Document DBD-ME-313, "Uninterruptable Power Supply Area Air Conditioning System", Revision 1, December 22, 1987.

SUBAPPENDIX A2

LACK OF CONSTRUCTION DETAILS FOR FABRICATION AND INSTALLATION OF DUCT AND PLENUMS (ISAP VII.c, APPENDIX 15)

1.0 Definition of the Issue

The issue was that for safety-related HVAC duct and plenums, several hardware installations existed where the installation specification and drawings did not contain sufficient construction details describing the fabrication or installation of the hardware.

2.0 Issue Resolution

Ebasco resolved this issue by establishing design criteria for safety-related HVAC duct and plenums in the Design Basis Document (DBD) (Reference 4.1). Ebasco developed design procedures (References 4.6, 4.7 and 4.9) which incorporate the design criteria. Ebasco performed engineering walkdowns in accordance with Field Verification Methods (FVMs) (References 4.4 and 4.8) to develop new drawings of as-built configurations of HVAC duct and plenums. Ebasco validated the duct and plenums by performing calculations in accordance with the design procedures (References 4.6, 4.7 and 4.9). Design changes were identified for HVAC duct and plenums if the calculations determined that the design criteria were not satisified. These design changes are being implemented.

Ebasco revised the HVAC installation specification (Reference 4.3) to incorporate sufficient details for fabrication and installation for HVAC duct and plenums. The construction procedures and Quality Control (QC) inspection procedures (References 4.2, 4.5, 4.10 and 4.12) were revised to incorporate the requirements of the HVAC installation specification (Reference 4.3).

3.0 Corrective and Preventive Action

- No additional issues were identified during the review and resolution of this issue.
- This issue was determined to be reportable under the provisions of 10CFR50.55(e). This issue was part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-85-54.

3.1 Corrective Action

Safety-related HVAC duct and plenums were validated to comply with the design criteria by performing calculations in accordance with Ebasco design procedures (References 4.6, 4.7 and 4.9) using new as-built drawings. Design changes were identified as necessary and are being implemented. The installation specification was revised to incorporate sufficient details for fabrication and installation of the HVAC duct and plenums. Construction procedures (References 4.5 and 4.12) and Quality Control (QC) Inspection procedures (References 4.2 and 4.10) were updated to be consistent with the HVAC installation specification (Reference 4.3).

3.2 Preventive Action

The revised and validated HVAC installation specification (Reference 4.3), the revised construction procedures (References 4.5 and 4.12) and Quality Control (QC) inspection procedures (Reference 4.2 and 4.10) assure that HVAC duct and plenums are properly installed. In addition Ebasco design and design control procedures (References 4.6, 4.7, 4.9 and 4.11) assure that the HVAC drawings contain sufficient construction details.

4.0 References

4.1 CPSES Design Basis Document DBD-CS-086, "HVAC Duct and Duct Supports", Revision 1, December 31, 1987.

4.2 TU Electric NEO Quality Assurance Department Instruction NQI-3.09-M-006, Verification/Inspection of Seismic HVAC Systems", Revision 2.

4.3 TU Electric Specification 2323-MS-85, "HVAC Ducts, Louvers and Accessories", Revision 6.

4.4 CPE-EB-FVM-CS-029, "Procedure for Seismic HVAC Duct and Duct Hanger As-Built Verification in Unit 1 and Common Areas", Revision 6.

4.5 TU Electric Construction Department Procedure CHV-101, "HVAC - Detailing, Fabrication, Installation, Rework and Repair", Revision 2.

4.6 Ebasco Document SAG.CP23, "Seismic Design Criteria for Seismic Category I HVAC Ducts and Duct Supports for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 1, June 5, 1987.

4.7 Ebasco Document SAG.CP24, "General Instructions for Seismic Category I HVAC Duct and Duct Support Analysis for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 4, December 15, 1987.

4.8 CPE-EB-FVM-CS-066, "Procedure for As-Built Verification of Seismic HVAC Air Handling Units, Plenums and Equipment Supports in Units 1 and Common Areas", Revision 2.

4.9 Ebasco Document SAG.CP30, "Seismic Design Criteria for Air Handling Units, Plenums and Equipment Supports", Revision 0, June 29, 1987.

4.10 TU Electric NEO Quality Assurance Department Procedure NQA-3.09-6.01 , "Quality Control Inspection of Safety Related HVAC Systems", Revision 2.

4.11 Ebasco CPSES Manual of Procedures.

4.12 TU Electric Construction Department Procedure CHV-106, "Qualitative Walkdown of HVAC Supports and Ducts (Unit 1 and Common Areas)", Revision 4.

SUBAPPENDIX A3

INACCURATE HVAC DUCT SUPPORT DETAIL DRAWINGS AND THEIR EFFECT ON THE DUCT SUPPORT DESIGNS (ISAP VII.c, APPENDIX 31)

1.0 Definition of the Issue

The issue was that some of the original safety-related duct support drawings did not accurately reflect the installed condition with regard to duct to support attachments, support configuration, member size and weld details.

2.0 Issue Resolution

Ebasco resolved this issue by establishing design criteria for safety-related HVAC duct supports in the Design Basis Document (DBD) (Reference 4.1). Ebasco developed design procedures (References 4.6 and 4.7) which incorporate the design criteria. Ebasco performed a walkdown in accordance with a Field Verification Method (FVM) (Reference 4.4) to develop new drawings of as-built configurations of HVAC duct supports. Ebasco validated these duct supports by performing calculations in accordance with design procedures (References 4.6 and 4.7). Design changes were identified for HVAC duct supports if the calculations determined that the design criteria were not satisfied. These design changes are being implemented.

3.0 Corrective and Preventive Action

- o No additional issues were identified during the review and resolution of this issue.
- o This issue was determined to be reportable under the provisions of 10CFR50.55(e). This issue was part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-85-54.

3.1 Corrective Action

Safety-related HVAC duct supports were validated to comply with the design criteria by performing calculations in accordance with Ebasco design procedures (References 4.6 and 4.7) using new as-built drawings. Design changes were identified as necessary and are being implemented.

3.2 Preventive Action

Ebasco design and design control procedures (References 4.6, 4.7 and 4.9) require that HVAC drawings for each new safety-related duct support contain sufficient construction details. The revised and validated HVAC installation specification (Reference 4.3), the revised construction procedure (Reference 4.5) and Quality Control (QC) inspection procedures (References 4.2 and 4.8) assure that HVAC duct supports are properly installed.

4.0 References

4.1 CPSES Design Basis Document DBD-CS-086, "HVAC Duct and Duct Supports", Revision 1, December 31, 1987.

4.2 TU Electric NEO Quality Assurance Department Instruction NQI-3.09-M-006, "Verification/Inspection of Seismic HVAC Systems", Revision 2.

4.3 TU Electric Specification 2323-MS-85, "HVAC Ducts, Louvers and Accessories", Revision 6.

4.4 CPE-EB-FVM-CS-029, "Procedure for Seismic HVAC Duct and Duct Hanger As-Built Verification in Unit 1 and Common Areas", Revision 6.

4.5 TU Electric Construction Department Procedure CHV-101, "HVAC - Detailing, Fabrication, Installation, Rework and Repair", Revision 2.

4.6 Ebasco Document SAG.CP23, "Seismic Design Criteria for Seismic Category I HVAC Ducts and Duct Supports for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 1, June 5, 1987.

4.7 Ebasco Document SAG.CP24, "General Instructions for Seismic Category I HVAC Duct and Duct Support Analysis for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 4, December 15, 1987.

4.8 TU Electric NEO Quality Assurance Department Procedure NQA-3.09-6.01, "Quality Control Inspection of Safety Related HVAC Systems", Revision 2.

4.9 Ebasco CPSES Manual of Procedures.

SUBAPPENDIX A4

INADEQUATE PROGRAM FOR THE INSTALLATION AND QUALITY CONTROL (QC) VERIFICATION OF HVAC DUCT SUPPORTS (ISAP VII.c, APPENDIX 31) (NRC IR 446/8602-V-17)

1.0 Definition of the Issue

The issue was that the original HVAC duct support installation contractor's program for the installation and Quality Control (QC) verification of safety-related duct supports may have been inadequate.

2.0 Issue Resolution

Ebasco resolved this issue by establishing design criteria for safety-related HVAC duct supports in the Design Basis Document (DBD) (Reference 4.1). Ebasco developed design procedures (References 4.6 and 4.7) which incorporate the design criteria. Ebasco performed a walkdown in accordance with a Field Verification Method (FVM) (Reference 4.4) to develop new drawings of as-built configurations of HVAC duct supports. Ebasco validated these duct supports by performing calculations in accordance with design procedures (References 4.6 and 4.7). Design changes were identified for HVAC duct supports if the calculations determined that the design criteria were not satisifed. These design changes are being implemented.

Ebasco revised the HVAC installation specification (Reference 4.3) for HVAC duct supports. The construction procedure and Quality Control (QC) inspection procedures (References 4.2, 4.5 and 4.8) were revised to incorporate the requirements of the HVAC installation specification (Reference 4.3). The original HVAC duct support installation contractor has been replaced and Quality Control (QC) inspections are now being performed by TU Electric Quality Control (QC).

3.0 Corrective and Preventive Action

- o No additional issues were identified during the review and resolution of this issue.
- o This issue was determined to be reportable under the provisions of 10CFR50.55(e). This issue was part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-85-54.

3.1 Corrective Action

Safety-related HVAC duct supports were validated to comply with the design criteria by performing calculations in accordance with Ebasco design procedures (References 4.6 and 4.7) using new as-built drawings. Design changes were identified as necessary and are being implemented. The installation specification was revised for fabrication and installation of the HVAC duct supports. The construction procedure (Reference 4.5) and Quality Control (QC) Inspection procedures (References 4.2 and 4.8) were updated to be consistent with the HVAC installation specification (Reference 4.3). The original HVAC duct support installation contractor has been replaced and Quality Control (QC) inspections are now being performed by TU Electric Quality Control (QC).

3.2 Preventive Action

The revised and validated HVAC installation specification (Reference 4.3), the revised construction procedure (Reference 4.5) and Quality Control (QC) inspection procedures (References 4.2 and 4.8) assure that HVAC duct supports are properly installed. In addition, Ebasco design and design control procedures (References 4.6, 4.7, and 4.9) assure that new HVAC duct support drawings contain sufficient construction details. The original HVAC duct support installation contractor has been replaced and Quality Control (QC) inspections are now being performed by TU Electric Quality Control (QC).

4.0 References

4.1 CPSES Design Basis Document DBD-CS-086, "HVAC Duct and Duct Supports", Revision 1, December 31, 1987.

4.2 TU Electric NEO Quality Assurance Department Instruction NQI-3.09-M-006, "Verification/Inspection of Seismic HVAC Systems", Revision 2.

4.3 TU Electric Specification 2323-MS-85, "HVAC Ducts, Louvers and Accessories", Revision 6.

4.4 CPE-EB-FVM-CS-029, "Procedure for Seismic HVAC Duct and Duct Hanger As-Built Verification in Unit 1 and Common Areas", Revision 6.

4.5 TU Electric Construction Department Procedure CHV-101, "HVAC - Detailing, Fabrication, Installation, Rework and Repair", Revision 2.

4.6 Ebasco Document SAG.CP23, "Seismic Design Criteria for Seismic Category I HVAC Ducts and Duct Supports for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 1, June 5, 1987.

4.7 Ebasco Document SAG.CP24, "General Instructions for Seismic Category I HVAC Duct and Duct Support Analysis for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 4, December 15, 1987.

4.8 TU Electric NEO Quality Assurance Department Procedure NQA-3.09-6.01, "Quality Control Inspection of Safety Related HVAC Systems", Revision 2.

4.9 Ebasco CPSES Manual of Procedures.

SUBAPPENDIX A5

GROOVE WELDS
(ISAP VII.c, APPENDIX 31)
(NRC IR 446/8620-V-02)
(NRC IR 446/8602-U-19)

1.0 Definition of the Issue

The issue was that the inspection documentation for weld fit-up for groove welds on safety-related HVAC duct supports may have been inadequate. Also, the groove depths and required effective throat dimensions were not specified for square groove welds in the original HVAC duct support drawings.

2.0 Issue Resolution

Ebasco resolved this issue by establishing design criteria for safety-related HVAC duct supports in the Design Basis Document (DBD) (Reference 4.1). Ebasco developed design procedures (References 4.6 and 4.7) which incorporate the design criteria. Ebasco performed an engineering walkdown in accordance with a Field Verification Method (FVM) (Reference 4.4) to develop new drawings of the as-built configuration of HVAC duct supports. Groove welds are specifically identified on the as-built HVAC duct support drawings. Ebasco validated these duct supports by performing calculations in accordance with design procedures (References 4.6 and 4.7). These calculations did not take credit for the existence of square groove welds identified on the drawings. Design changes were identified for HVAC duct supports if the calculations determined that the design criteria was not satisified. These design changes are being implemented.

3.0 Corrective and Preventive Action

- o No additional issues were identified during the review and resolution of this issue.
- o This issue was determined to be reportable under the provisions of 10CFR50.55(e). This issue was part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-85-54.

3.1 Corrective Action

Safety-related HVAC duct supports were validated to comply with the design criteria by performing calculations in accordance with Ebasco design procedures (References 4.6 and 4.7) using new as-built drawings. Design changes were identified as necessary and are being implemented.

3.2 Preventive Action

The revised and validated HVAC installation specification (Reference 4.3), the revised construction procedure (Reference 4.5) and Quality Control (QC) inspection procedures (References 4.2 and 4.8) assure that HVAC duct supports are properly installed, including requirements for groove weld fit-up inspections prior to welding. In addition Ebasco design and design control procedures (References 4.6, 4,7 and 4.9) assure that new HVAC duct support drawings contain sufficient construction details. The original HVAC installation contractor has been replaced and Quality Control (QC) inspections are now being performed by TU Electric Quality Control (QC).

4.0 References

4.1 CPSES Design Basis Document DBD-CS-086, "HVAC Duct and Duct Supports", Revision 1, December 31, 1987.

4.2 TU Electric NEO Quality Assurance Department Instruction NQI-3.09-M-006, "Verification/Inspection of Seismic HVAC Systems", Revision 2.

4.3 TU Electric Specification 2323-MS-85, "HVAC Ducts, Louvers and Accessories", Revision 6.

4.4 CPE-EB-FVM-CS-029, "Procedure for Seismic HVAC Duct and Duct Hanger As-Built Verification in Unit 1 and Common Areas", Revision 6.

4.5 TU Electric Construction Department Procedure CHV-101, "HVAC - Detailing, Fabrication, Installation, Rework and Repair", Revision 2.

4.6 Ebasco Document SAG.CP23, "Seismic Design Criteria for Seismic Category I HVAC Ducts and Duct Supports for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 1, June 5, 1987.

4.7 Ebasco Document SAG.CP24, "General Instructions for Seismic Category I HVAC Duct and Duct Support Analysis for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 4, December 15, 1987.

4.8 TU Electric NEO Quality Assurance Department Procedure NQA-3.09-6.01, "Quality Control Inspection of Safety Related HVAC Systems", Revision 2.

4.9 Ebasco CFSES Manual of Procedures.

SUBAPPENDIX A6

LACK OF DOCUMENTATION FOR RECEIPT INSPECTION BY THE ORIGINAL HVAC DUCT SUPPORT CONTRACTOR (ISAP VII.c, APPENDIX 31)

1.0 Definition of the Issue

The issue was that the original HVAC duct support installation contractor did not document receipt inspections for some material obtained from the primary site construction contractor.

2.0 Issue Resolution

Ebasco resolved this issue by reviewing the instances identified and determining that, based on the Comanche Peak Response Team (CPRT) review of the primary site construction contractor's material control program (Reference 4.1), the material obtained by the original HVAC duct support installation contractor is acceptable.

3.0 Corrective and Preventive Action

- o No additional issues were identified during the review and resolution of this issue.
- o This issue was determined not to be reportable under the provision of 10CFR50.55(e).

3.1 Corrective Action

No corrective action was required.

3.2 Preventive Action

The revised and validated HVAC installation specification (Reference 4.2) provides the HVAC duct supports material requirements. The original HVAC installation contractor has been replaced and Quality Control (QC) receipt inspections are now being performed by TU Electric Quality Control (QC). HVAC duct support material is procured in accordance with TU Electric procedures (References 4.3 and 4.4). Upon receipt on site, HVAC duct support material is inspected, and inspections are documented, by Quality Control (QC) in accordance with Reference 4.6. The material is controlled in accordance with the site construction procedure (Reference 4.5).

4.0 References

4.1 CPRT Results Report, ISAP VII.a.1, "Material Traceability", Revision 1.

4.2 TU Electric Specification 2323-MS-85, "HVAC Ducts, Louvers, and Accessories", Revision 6.

4.3 TU Electric Engineering and Construction Engineering Procedure ECE 6.02 "Preparation and Review of Procurement Documents", Revision 0, November 19, 1987.

4.4 TU Electric Engineering and Construction Engineering Procedure ECE 6.02-I2, "Engineering Review of Procurement Documents", Revision 0, June 1, 1987.

4.5 CPSES Construction Procedure CP-CPM 8.1, "Receipt, Storage and Issuance of Items", Revision 5, December 1, 1987.

4.6 TU Electric NEO Quality Assurance Department Procedure NQA-3.09-11.02, "Construction Receiving Inspection", Revision 0, October 5, 1987.

SUBAPPENDIX A7

INSUFFICIENT THREAD ENGAGEMENT AND
PRETENSIONING OF RICHMOND INSERT BOLTS ON HVAC DUCT SUPPORTS
(ISAP VII.c, APPENDIX 31)

1.0 Definition of the Issue

The issue was that some safety-related HVAC duct supports had Richmond Insert bolts installed which had less than the minimum specified thread engagement and were pretensioned causing possible damage to the insert assembly.

2.0 Issue Resolution

Ebasco resolved this issue by revising the HVAC installation specification (Reference 4.1) to incorporate the acceptance criteria established by the SWEC Civil/Structural portion of the Corrective Action Program (CAP) through a testing program for pretensioned Richmond Insert bolts with less than the minimum specified thread engagement (Reference 4.2). The Field Verification Methods (FVMs) (References 4.3 and 4.4), the construction procedure (Reference 4.5) and the Quality Control (QC) inspection procedures (References 4.6 and 4.7) were revised to incorporate the requirements of the HVAC installation specification (Reference 4.1).

The Field Verification Methods (FVMs) (References 4.3 and 4.4) require determination of the as-installed Richmond Insert bolt thread engagement lengths. As part of the Post Construction Hardware Validation Program (PCHVP) the installed Richmond Insert bolt thread engagement lengths are being measured and reconciled with the validated design. Those Richmond Insert bolts not meeting the requirements of the installation specification (Reference 4.1) are being replaced.

3.0 Corrective and Preventive Action

- No additional issues were identified during the review and resolution of this issue.
- This issue was determined to be reportable under the provisions of 10CFR50.55(e). This issue was part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-85-54.

3.1 Corrective Action

Ebasco revised the HVAC installation specification (Reference 4.1) to incorporate the acceptance criteria established by the SWEC Civil/Structural portion of the Corrective Action Program (CAP) through a testing program for pretensioned Richmond Insert bolts with less than the minimum specified thread engagement (Reference 4.2). The Field Verification Methods (FVMs) (References 4.3 and 4.4), the construction procedure (Reference 4.5) and the Quality Control (QC) inspection procedures (References 4.6 and 4.7) were revised to incorporate the requirements of the HVAC installation specification (Reference 4.1).

The Field Verification Methods (FVMs) (References 4.3 and 4.4) require determination of the as-installed Richmond Insert bolt thread engagement lengths. As part of the Post Contruction Hardware Validation Program (PCHVP) the installed Richmond Insert bolt hread engagement lengths are being measured and reconciled with the validated design. Those Richmond Insert bolts not meeting the requirements of the Field Verification Methods (FVMs) (References 4.3 and 4.4) are being replaced.

3.2 Preventive Action

The revised and validated HVAC installation specification (Reference 4.1), the revised construction procedure (Reference 4.5) and Quality Control (QC) inspection procedures (References 4.6 and 4.7) assure that HVAC duct supports and Richmond Insert bolts are properly installed. The original HVAC installation contractor has been replaced and Quality Control (QC) inspections are now being performed by TU Electric quality Control (QC).

4.0 References

4.1 TU Electric Specification 2323-MS-85, "HVAC Ducts, Louvers and Accessories", Revision 6.

4.2 CPSES Design Basis Document DBD-CS-015, "The Qualification of Embedments in Concrete", Revision 2, December 28, 1987.

4.3 CPE-EB-FVM-CS-029, "Procedure for Seismic HVAC Duct and Duct Hanger As-Built Verification in Unit 1 and Common Areas", Revision 6.

4.4 CPE-EB-FVM-CS-066, "Procedure for As-Built Verification of Seismic HVAC Air Handling Units, Plenums and Equipment Supports in Unit 1 and Common Areas", Revision 2.

4.5 TU Electric Construction Department Procedure CHV-101, "HVAC - Detailing, Fabrication, Installation, Rework and Repair", Revision 2.

4.6 TU Electric NEO Quality Assurance Department Instruction NQI-3.09-M-006, "Verification/Inspection of Seismic HVAC Systems", Revision 2.

4.7 TU Electric NEO Quality Assurance Department Procedure NQA-3.09-6.01, "Quality Control Inspection of Safety Related HVAC Systems", Revision 2.

SUBAPPENDIX A8

BATTERY ROOM VENTILATION
(NRC IR 445/8422-U-06)

1.0 Definition of the Issue

The issue was that the structural beams in the battery rooms create two large pockets in the overhead that are not directly swept by the ventilation system and could possibly allow a build-up of hydrogen emitted from the batteries.

2.0 Issue Resolution

Ebasco resolved this issue by developing a design change in accordance with the design criteria specified in the Design Basis Document (DBD) (Reference 4.1) to modify the ductwork in the battery rooms so that the ventilation system exhausts the spaces between the structural beams, thus preventing any potential build-up of hydrogen. This design change is being implemented.

3.0 Corrective and Preventive Action

- o No additional issues were identified during the review and resolution of this issue.
- o This issue was determined not to be reportable under the provisions of 10CFR50.55(e).

3.1 Corrective Action

A design change was developed in accordance with the design criteria specified in the Design Basis Document (DBD) (Reference 4.1) to modify the ductwork in the battery rooms so that the ventilation system exhausts the spaces between the structural beams, thus preventing any potential build-up of hydrogen. This design change is being implemented.

3.2 Preventive Action

The Design Basis Document (DBD) (Reference 4.1) provides the design criteria for battery room ventilation.

4.0 References

4.1 CPSES Design Basis Document DBD-ME-305, "Uncontrolled Access Area Ventilation System", Revision 1, December 22, 1987.

SUBAPPENDIX A9

BATTERY ROOM EXPLOSION PROOF THERMOSTATS (NRC IR 445/8601-U-02)

1.0 Definition of the Issue

The issue was that insufficient documentation existed to determine if the thermostats inside the battery rooms needed to be installed in explosion proof housings.

2.0 Issue Resolution

Ebasco resolved this issue by performing calculations which demonstrate that the validated design of the battery room ventilation system will maintain hydrogen concentration below 2%, thus precluding the need for explosion proof housings for the thermostats. The calculations were performed in accordance with the design criteria as specified in the Design Basis Document (DBD) (Reference 4.1) and are included in the HVAC System Design Validation Package (DVP).

3.0 Corrective and Preventive Action

- o No additional issues were identified during the review and resolution of this issue.
- o This specific issue was determined not to be reportable under the provisions of 10CFR50.55(e).

3.1 Corrective Action

Calculations were performed which demonstrate that the validated design of the battery room ventilation system will maintain hydrogen concentration below 2%, thus precluding the need for explosion proof housings for the thermostats. The calculations were performed in accordance with the design criteria as specified in the Design Basis Document (DBD) (Reference 4.1) and are included in the HVAC System Design Validation Package (DVP).

3.2 Preventive Action

Design criteria to maintain hydrogen concentration below 2% is specified in the Design Basis Document (DBD) (Reference 4.1).

4.0 References

4.1 CPSES Design Basis Document DBD-ME-305, "Uncontrolled Access Area Ventilation System", Revision 1, December 22, 1987.

SUBAPPENDIX A10

INSPECTION REPORTS DATED PRIOR TO ISSUE OF AS-BUILT DRAWINGS (NRC IR 445/8626-D-07)

1.0 Definition of the Issue

The issue was that typical duct support configuration drawings were used for inspections. However, the inspection reports did not document the specific typical duct support configurations used. As a result, there was no evidence of inspection performed to verify the duct support configuration to the subsequently developed as-built drawing.

2.0 Issue Resolution

Ebasco resolved this issue by establishing design criteria for HVAC supports in the Design Basis Document (DBD) (Reference 4.8). Ebasco developed design procedures (References 4.3 through 4.7) which incorporate the design criteria. Ebasco performed engineering walkdowns in accordance with Field Verification Methods (FVMs) (References 4.1 and 4.2) to determine the as-built configuration of HVAC supports. Ebasco then validated these supports by performing calculations in accordance with Ebasco design procedures (References 4.3 through 4.7). Design changes were identified for HVAC supports if the calculations determined that the design criteria was not satisfied. These design changes are being implemented.

3.0 Corrective and Preventive Action

- No additional issues were identified during the review and resolution of this issue.
- This issue was determined to be reportable under the provisions of 10CFR50.55(e). This issue was part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-85-54.

3.1 Corrective Action

HVAC supports were validated to comply with the design criteria by performing calculations in accordance with Ebasco design procedures (References 4.3 through 4.7) using new as-built information. Design changes were identified as necessary and are being implemented.

3.2 Preventive Action

The revised and validated HVAC installation specification (Reference 4.9), the revised construction procedures (References 4.10 through 4.12) and Quality Control (QC) inspection procedures (References 4.13 and 4.14) assure that HVAC duct supports are properly installed and inspected to the design drawings. Ebasco design and design control procedures (References 4.3 through 4.7 and 4.15) require that a design drawing be developed and issued for each duct support. The original HVAC installation contractor's Quality Control (QC) organization has been replaced. Quality Control (QC) inspections are now being performed by TU Electric Quality Control (QC).

4.0 References

4.1 CPE-EB-FVM-CS-029, "Procedure for Seismic HVAC Duct and Duct Hanger As-Built Verification in Unit 1 and Common Areas," Revision 6.

4.2 CPE-EB-FVM-CS-066, "Procedure for As-Built Verification of Seismic HVAC Air Handling Units, Plenums and Equipment Supports in Unit 1 and Common Areas", Revision 2.

4.3 Ebasco Document SAG.CP23, "Seismic Design Criteria for Seismic Category I HVAC Ducts and Duct Supports for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 1, June 5, 1987

4.4 Ebasco Document SAG.CP24, "General Instructions for Seismic Category I HVAC Duct and Duct Support Analysis for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 4, December 15, 1987.

4.5 Ebasco Document SAG.CP30, "Seismic Design Criteria for Air Handling Units, Plenums and Equipment Supports", Revision 0, June 29, 1987.

4.6 Ebasco Document SAG.CP31, "Design Criteria for Seismic Category II HVAC Duct and Duct Supports", Revision 2, October 1, 1987.

4.7 Ebasco Document SAG.CP32, "General Instructions for Seismic Category II HVAC Duct and Duct Support Analysis", Revision 2, December 15, 1987.

4.8 CPSES Design Basis Document DBD-CS-086, "HVAC Duct and Duct Supports", Revision 1, December 31, 1987.

4.9 TU Electric Specification 2323-MS-85, "HVAC Ducts, Louvers and Accessories", Revision 6.

4.10 TU Electric Construction Department Procedure CHV-101, "HVAC - Detailing, Fabrication, Installation, Rework and Repair", Revision 2.

4.11 TU Electric Construction Department Procedure ECC 10.99-HV-003, "HVAC Field Requisitions", Revision 0, April 29, 1987.

4.12 TU Electric Construction Department Procedure CHV-106, "Qualitative Walkdown of HVAC Supports and Ducts (Unit 1 and Common Areas)", Revision 4.

4.13 TU Electric NEO Quality Assurance Department Procedure NQA-3.09-6.01, "Quality Control Inspection of Safety Related HVAC Systems", Revision 2.

4.14 TU Electric NEO Quality Assurance Department Instruction NQI-3.09-M-006, "Verification/Inspection of Seismic HVAC Systems", Revision 2.

4.15 Ebasco CPSES Manual of Procedures.

SUBAPPENDIX A11

WELDER QUALIFICATION
(NRC IR 445/8626-V-08)

1.0 Definition of the Issue

The issue was that welder performance qualification records dated May 1979, June 1981 and March 1983 certify welders as being qualified in more positions and material thickness ranges than allowed by ASME Section IX for the welder qualification tests performed.

2.0 Issue Resolution

Ebasco resolved this issue by determining that AWS D1.1 (Reference 4.2) for structural steel welding and AWS D9.1 (Reference 4.3) for sheet metal welding are more appropriate for welding on HVAC ducts and HVAC supports than Section IX of the ASME Boiler and Pressure Vessel Code. Ebasco revised the HVAC installation specification (Reference 4.1) to include AWS D1.1 and AWS D9.1. Ebasco reviewed the welder qualification test results to the requirements of AWS D1.1 and AWS D9.1. This review determined that the welders were qualified for the positions and material thicknesses identified in the welder performance qualification records.

3.0 Corrective and Preventive Action

- o No additional issues were identified during the review and resolution of this issue.
- o This issue was determined not to be reportable under the provisions of 10CFR50.55(e).

3.1 Corrective Action

The HVAC installation specification (Reference 4.1) was revised to permit the use of AWS D1.1 (Reference 4.2) and AWS D9.1 (Reference 4.3) for welding of HVAC ducts and supports. Ebasco reviewed the welder qualification test results to the requirements of AWS D1.1 and AWS D9.1. This review determined that the welders were qualified for the positions and material thicknesses identified in the welder performance qualification records. Ebasco reviewed the present HVAC installation contractor's welding procedures to assure compliance with the HVAC installation specification (Reference 4.1).

3.2 Preventive Action

The original HVAC i stallation contractor has been replaced. The HVAC installation specification (Reference 4.1) has been revised to permit the use of AWS D1.1 (Reference 4.2) and AWS D9.1 (Reference 4.3) for welding of HVAC ducts and supports.

Welders are qualified by the present HVAC installation contractor in accordance with the requirements of the applicable Codes (AWS D1.1 and/or D9.1). These codes provide instructions for welder qualification which include specific requirements for welder qualification, testing, documentation, marking and identification, as well as review, approval and surveillance to assure Code compliance.

4.0 References

4.1 TU Electric Specification 2323-MS-85, "HVAC Ducts, Louvers and Accessories", Revision 5, September 15, 1987.

4.2 American Welding Society (AWS) D1.1-77, "Structural Welding Code", 1977.

4.3 American Welding Society (AWS) D9.1-80, "Specification for Welding of Sheet Metal", 1980.

SUBAPPENDIX A12

NRC CAT INSPECTION RESULTS
(CPRT-DIR #E-0278)

1.0 Definition of the Issue

The issues were that installed and Quality Control (QC) accepted HVAC duct and HVAC supports did not conform to design requirements. In addition, inspection procedures were not established or executed to verify conformance of HVAC supports to design drawings.

Also, certain aspects of HVAC installation and inspection were not adequately controlled, including improperly qualified welding procedures and improperly qualified Quality Control (QC) personnel.

2.0 Issue Resolution

Ebasco resolved this issue by establishing design criteria for HVAC duct and HVAC supports in the Design Basis Document (DBD) (Reference 4.8). Ebasco developed design procedures (References 4.3 through 4.7) which incorporate the design criteria. Ebasco performed engineering walkdowns in accordance with Field Verification Methods (FVMs) (References 4.1 and 4.2) to determine the as-built configuration of HVAC duct and HVAC supports. Ebasco then validated these duct and duct supports by performing calculations in accordance with Ebasco design procedures (References 4.3 through 4.7). Design changes were identified if the calculations determined that the design criteria was not satisfied. These design changes are being implemented.

The issue of inadequate installation and inspection controls was resolved as follows:

1. The original HVAC duct and HVAC supports installation contractor has been replaced and Quality Control (QC) inspections are now being performed by TU Electric Quality Control (QC).

2. Ebasco reviewed the present HVAC installation contractor's welding procedures to assure compliance with the HVAC installation specification (Reference 4.9).

3. The welding procedures used by the original HVAC duct and HVAC supports installation contractor were reviewed and found to be acceptable.

4. As built information was obtained by engineering walkdowns conducted in accordance with Field Verification Methods (FVMs) (References 4.1 and 4.2). To provide additional assurance of the accuracy of the as-built drawings and any required rework, reinspection of the HVAC duct and HVAC supports installed by the previous contractor is being performed by TU Electric Quality Control (QC) personnel in accordance with References 4.10 and 4.11.

3.0 Corrective and Preventive Action

- No additional issues were identified during the review and resolution of this issue.
- This issue was determined to be reportable under the provisions of 10CFR50.55(e). This issue was part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-85-54.

3.1 Corrective Action

HVAC duct and HVAC supports were validated to comply with the design criteria by performing calculations in accordance with Ebasco design procedures (References 4.3 through 4.7) using as-built information. Design changes were identified as necessary and are being implemented. The original HVAC duct and HVAC supports installation contractor has been replaced and Quality Control (QC) inspections are now being performed by TU Electric Quality Control (QC) to verify the acceptability of installed components. The welding procedures which were used by the original HVAC duct and HVAC supports installation contractor have been reviewed and found to be acceptable.

3.2 Preventive Action

The Ebasco design procedures (References 4.3 through 4.7) which incorporate the design criteria as specified in the Design Basis Document (DBD) (Reference 4.8) assure adequate design of HVAC duct and HVAC supports. The original HVAC duct and HVAC supports installation contractor has been replaced and Quality Control (QC) inspections are now being performed by the TU Electric Quality Control (QC). Ebasco reviewed the present HVAC installation contractor's welding procedures and determined that they comply with the HVAC installation specification (Reference 4.9).

4.0 References

4.1 CPE-EB-FVM-CS-029, "Procedure for Seismic HVAC Duct and Duct Hanger As-Built Verification in Unit 1 and Common Areas", Revision 6.

4.2 CPE-EB-FVM-CS-066, "Procedure for As-Built Verification of Seismic HVAC Air Handling Units, Plenums and Equipment Supports in Unit 1 and Common Areas", Revision 2.

4.3 Ebasco Document SAG.CP23, "Seismic Design Criteria for Seismic Category I HVAC Ducts and Duct Supports for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 1, June 5, 1987.

4.4 Ebasco Document SAG.CP24, "General Instructions for Seismic Category I HVAC Duct and Duct Support Analysis for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 4, December 15, 1987.

4.5 Ebasco Document SAG.CP30, "Seismic Design Criteria for Air Handling Units, Plenums and Equipment Supports", Revision 0, June 29, 1987.

4.6 Ebasco Document SAG.CP31, "Design Criteria for Seismic Category II HVAC Duct and Duct Supports", Revision 2, October 1, 1987.

4.7 Ebasco Document SAG.CP32, "General Instructions for Seismic Category II HVAC Duct and Duct Support Analysis", Revision 2, December 15, 1987.

4.8 CPSES Design Basis Document DBD-CS-086, "HVAC Duct and Duct Supports", Revision 1, December 31, 1987.

4.9 TU Electric Specification 2323-MS-85, "HVAC Ducts, Louvers and Accessories", Revision 6.

4.10 TU Electric NEO Quality Assurance Department Procedure NQA-3.09-6.01, "Quality Control Inspection of Safety Related HVAC Systems", Revision 2.

4.11 TU Electric NEO Quality Assurance Department Instruction NQI-3.09-M-006, "Verification/Inspection of Seismic HVAC Systems", Revision 2.

SUBAPPENDIX A13

SEISMIC DESIGN OF HVAC SUPPORTS
(CPRT-DIR #E-1046)

1.0 Definition of the Issue

The issue was that the seismic design of the HVAC supports may not have been adequate.

2.0 Issue Resolution

Ebasco resolved this issue by establishing design criteria for HVAC supports in the Design Basis Document (DBD) (Reference 4.8). Ebasco developed design procedures (References 4.3 through 4.7) which incorporate the design criteria. Ebasco performed engineering walkdowns in accordance with Field Verification Methods (FVMs) (References 4.1 and 4.2) to determine the as-built configuration of HVAC supports. Ebasco validated these supports for seismic design adequacy, by performing calculations in accordance with Ebasco design procedures (References 4.3 through 4.7). Design changes were identified for HVAC supports if the calculations determined that the design criteria were not satisfied. These design changes are being implemented.

3.0 Corrective Action and Preventive Action

- No additional issues were identified during the review and resolution of this issue.
- This issue was determined to be reportable under the provisions of 10CFR50.55(e). This issue was part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-85-54.

3.1 Corrective Action

HVAC supports were validated to comply with the design criteria by performing calculations in accordance with Ebasco design procedures (References 4.3 through 4.7) using as-built information. Design changes were identified as necessary and are being implemented.

3.2 Preventive Action

The Ebasco design procedures (References 4.3 through 4.7) which incorporate the design criteria as specified in the Design Basis Document (DBD) (Reference 4.8) assure adequate seismic design of HVAC supports.

4.0 References

4.1 CPE-EB-FVM-CS-029, "Procedure for Seismic HVAC Duct and Duct Hanger As-Built Verification in Unit 1 and Common Areas", Revision 6.

4.2 CPE-EB-FVM-CS-066, "Procedure for As-Built Verification of Seismic HVAC Air Handling Units, Plenums and Equipment Supports in Unit 1 and Common Areas", Revision 2.

4.3 Ebasco Document SAG.CP23, "Seismic Design Criteria for Seismic Category I HVAC Ducts and Duct Supports for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 1, June 5, 1987.

4.4 Ebasco Document SAG.CP24, "General Instructions for Seismic Category I HVAC Duct and Duct Support Analysis for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 4, December 15, 1987.

4.5 Ebasco Document SAG.CP30, "Seismic Design Criteria for Air Handling Units, Plenums and Equipment Supports", Revision 0, June 29, 1987.

4.6 Ebasco Document SAG.CP31, "Design Criteria for Seismic Category II HVAC Duct and Duct Supports", Revision 2, October 1, 1987.

4.7 Ebasco Document SAG.CP32, "General Instructions for Seismic Category II HVAC Duct and Duct Support Analysis", Revision 2, December 15, 1987.

4.8 CPSES Design Basis Document DBD-CS-086, "HVAC Duct and Duct Supports", Revision 1, December 31, 1987.

SUBAPPENDIX A14

HVAC DUCT AXIAL RESTRAINT (CPRT-DIR #E-1271)

1.0 Definition of the Issue

This issue was that an HVAC duct within the Containment Building may not have had sufficient axial restraint to prevent buckling of the duct during a seismic event.

2.0 Issue Resolution

Ebasco resolved this issue by establishing design criteria for HVAC supports in the Design Basis Document (DBD) (Reference 4.8). Ebasco developed design procedures (References 4.3 througn 4.7) which incorporate the design criteria. Ebasco performed engineering walkdowns in accordance with Field Verification Methods (FVMs) (Reference 4.1 and 4.2) to determine tne as-built configuration of HVAC supports. Ebasco validated these supports for adequacy of axial restraints by performing calculations in accordance with Ebasco design procedures (References 4.3 through 4.7). Design changes were identified for HVAC supports if the calculations determined that the design criteria were not satisfied. These design changes are being implemented.

3.0 Corrective Action and Preventive Action

- o No additional issues were identified during the review and resolution of this issue.
- o This issue was determined to be reportable under the provisions of 10CFR50.55(e). This issue was part of the conditions reported as Significant Deficiency Anlaysis Report (SDAR) CP-85-54.

3.1 Corrective Action

HVAC supports were validated to comply with the design criteria by performing calculations in accordance with Ebasco design procedures (Reference 4.3 through 4.7) using as-built information. Design changes were identified as necessary and are being implemented.

3.2 Preventive Action

The Ebasco design procedures (References 4.3 through 4.7) which incorporate the design criteria as specified in the Design Basis Document (DBD) (Reference 4.8) assure adequate seismic design of HVAC supports.

4.0 References

4.1 CPE-EB-FVM-CS-029, "Procedure for Seismic HVAC Duct and Duct Hanger As-Built Verification in Unit 1 and Common Areas", Revision 6.

4.2 CPE-EB-FVM-CS-066, "Procedure for As-Built Verification of Seismic HVAC Air Handling Units, Plenums and Equipment Supports in Unit 1 and Common Areas", Revision 2.

4.3 Ebasco Document SAG.CP23, "Seismic Design Criteria for Seismic Category I HVAC Ducts and Duct Supports for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 1, June 5, 1987.

4.4 Ebasco Document SAG.CP24, "General Instructions for Seismic Category I HVAC Duct and Duct Support Analysis for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 4, December 15, 1987.

4.5 Ebasco Document SAG.CP30, "Seismic Design Criteria for Air Handling Units, Plenums and Equipment Supports", Revision 0, June 29, 1987

4.6 Ebasco Document SAG.CP31, "Design Criteria for Seismic Category II HVAC Duct and Duct Supports", Revision 2, October 1, 1987.

4.7 Ebasco Document SAG.CP32, "General Instructions for Seismic Category II HVAC Duct and Duct Support Analysis", Revision 2, December 15, 1987.

4.8 CPSES Design Basis Document DBD-CS-086, "HVAC Duct and Duct Supports", Revision 1, December 31, 1987.

SUBAPPENDIX A15

SEISMIC INTERACTION OF HVAC DUCT (CPRT-DIR #E-0253)

1.0 Definition of the Issue

The issue was that there may have been inadequate consideration for seismic interaction of containment HVAC duct with safety-related items.

2.0 Issue Resolution

Ebasco resolved this issue by establishing design criteria for HVAC duct and HVAC supports, including the HVAC duct and HVAC supports in the containment, in the Design Basis Document (DBD) (Reference 4.6). Ebasco developed design procedures (References 4.2 through 4.5) which incorporate the design criteria. Ebasco performed engineering walkdowns in accordance with a Field Verification Method (FVM) (Reference 4.1) to determine the as-built configuration of HVAC duct and HVAC duct supports. Ebasco then validated these duct and duct supports for seismic design adequacy, by performing calculations in accordance with Ebasco design procedures (References 4.2 through 4.5). Design changes were identified for HVAC duct and HVAC duct supports if the calculations determined that the design criteria were not satisfied. These calculations, in conjunction with the design changes, assure that the containment HVAC duct and HVAC duct supports will not fail during a seismic event such that safety-related items would be adversely affected. These design changes are being implemented.

3.0 Corrective and Preventive Action

- o No additional issues were identified during the review and resolution of this issue.
- o This issue was determined to be reportable under the provisions of 10CFR50.55(e). This issue was part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-85-54.

3.1 Corrective Action

HVAC duct and HVAC duct supports, including the HVAC duct and the HVAC duct supports in the containment, were validated to comply with the seismic design criteria by performing calculations in accordance with Ebasco design procedures (References 4.2 though 4.5) using as-built information. Design changes were identified as necessary and are being implemented.

3.2 Preventive Action

The Ebasco design procedures (References 4.2 through 4.5) which incorporate the design criteria as specified in the Design Basis Document (DBD) (Reference 4.6) assure adequate seismic design of HVAC duct and HVAC duct supports.

4.0 References

4.1 CPE-EB-FVM-CS-029, "Procedure for Seismic HVAC Duct and Duct Hanger As-Built Verification in Unit 1 and Common Areas", Revision 6.

4.2 Ebasco Document SAG.CP23, "Seismic Design Criteria for Seismic Category I HVAC Ducts and Duct Supports for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 1, June 5, 1987.

4.3 Ebasco Document SAG.CP24, "General Instructions for Seismic Category I HVAC Duct and Duct Support Analysis for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 4, December 15, 1987.

4.4 Ebasco Document SAG.CP31, "Design Criteria for Seismic Category II HVAC Duct and Duct Supports", Revision 2, October 1, 1987.

4.5 Ebasco Document SAG.CP32, "General Instructions for Seismic Category II HVAC Duct and Duct Support Analysis", Revision 2, December 15, 1987.

4.6 CPSES Design Basis Document DBD-CS-086, "HVAC Duct and Duct Supports", Revision 1, December 31, 1987.

SUBAPPENDIX A16

CYGNA CONDUIT AND CABLE TRAY ISSUES

1.0 Definition of the Issue

The following issues were identified by CYGNA for conduit and cable tray disciplines. These issues were reviewed by Ebasco and issues applicable to HVAC were identified. Conduit issues are indicated and all other issues are cable tray issues. The definition of these issues is presented in Appendix A of the Cable Tray and Cable Tray Hangers Project Status Report (PSR) (Reference 4.9) and Appendix A of the Conduit Supports Trains A and B, and Train C larger than 2 inch diameter Project Status Report (PSR) (Reference 4.10).

Issues

1. Measurement of Embedment From Top of Concrete Topping (Conduit issue)
2. Bolt Hole Tolerance and Edge Distance Violation (Conduit Issue)
3. Controlling Load Case for Design
4. Seismic Response Combination Method
5. Anchor Bolt Design
6. Design of Compression Members
7. Vertical and Transverse Loading on Longitudinal Type Support
8. Support Frame Dead and Inertial Loads
9. Design of Angle Braces Neglecting Loading Eccentricity
10. Dynamic Amplification Factors
11. Reduction in Member Section Properties Due to Bolt Holes
12. System Concept
13. Validity of NASTRAN Models (Not applicable to HVAC)
14. Working Point Deviation Study
15. Reduced Spectral Accelerations
16. Non-Conformance With AISC Specifications
17. Member Substitution
18. Weld Design and Specifications
19. Embedded Plate Design
20. Tray Clamps (System to Support Connections)
21. FSAR Load Combination
22. Differences Between Installation and Design/Construction Drawings without Appropriate Documentation
23. Design Control
24. Design of Support No. 3136, Detail "5", Cable Tray Hanger Drawing 2323-S-0905 (Not applicable to HVAC)
25. Loading in STRESS Models
26. Design of Flexural Members
27. Cable Tray Qualification (System - Structural Qualification)

28. Base Angle Design
29. Support Qualification by Similarity (Not applicable to HVAC)
30. Critical Support Configurations and Loadings
31. Cumulative Effect of Review Issues

2.0 Issue Resolution

Ebasco resolved the applicable HVAC issues in Paragraph 1.0 above during the design validation process. The resolutions were incorporated into the HVAC Field Verification Methods (FVMs) (References 4.1 and 4.2), the Design Basis Document (DBD) (Reference 4.8), the design procedures (References 4.3 through 4.7) and the HVAC installation specification (Reference 4.11). In addition, Ebasco reviewed the revised construction procedures (References 4.12 through 4.14) and Quality Control (QC) inspection procedures (References 4.15 and 4.16) to assure that they comply with the HVAC installation specification (Reference 4.11).

3.0 Corrective Action and Preventive Action

- No additional issues were identified during the review and resolution of these issues.
- This issue was determined to be reportable under the provisions of 10CFR50.55(e). This issue was part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-85-54.

3.1 Corrective Action

The applicable HVAC issues in Paragraph 1.0 above were resolved during the design validation process. The resolutions were incorporated into the HVAC Field Verification Methods (FVMs) (References 4.1 and 4.2), the Design Basis Document (DBD) (Reference 4.8), the design procedures (References 4.3 through 4.7) and the HVAC installation specification (Reference 4.11). In addition, Ebasco reviewed the revised construction procedures (References 4.12 through 4.14) and Quality Control (QC) inspection procedures (References 4.15 and 4.16) to assure that they comply with the HVAC installation specification (Reference 4.11).

3.2 Preventive Action

The design procedures (References 4.3 through 4.7), which incorporate the design criteria as specified in the Design Basis Document (DBD) (Reference 4.8), assure adequate design of HVAC duct and HVAC supports. The HVAC installation specification

(Reference 4.11), the construction procedures (References 4.12 through 4.14) and the Quality Control (QC) inspection procedures (References 4.15 and 4.16) assure adequate installation and inspection of HVAC duct and HVAC supports.

4.0 <u>References</u>

4.1 CPE-EB-FVM-CS-029, "Procedure for Seismic HVAC Duct and Duct Hanger As-Built Verification in Unit 1 and Common Areas", Revision 6.

4.2 CPE-EB-FVM-CS-066, "Procedure for As-Built Verification of Seismic HVAC Air Handling Units, Plenums and Equipment Supports in Unit 1 and Common Areas", Revision 2.

4.3 Ebasco Document SAG.CP23, "Seismic Design Criteria for Seismic Category I HVAC Ducts and Duct Supports for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 1, June 5, 1987.

4.4 Ebasco Document SAG.CP24, "General Instructions for Seismic Category I HVAC Duct and Duct Support Analysis for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 4, December 15, 1987.

4.5 Ebasco Document SAG.CP30, "Seismic Design Criteria for Air Handling Units, Plenums and Equipment Supports", Revision 0, June 29, 1987.

4.6 Ebasco Document SAG.CP31, "Design Criteria for Seismic Category II HVAC Duct and Duct Supports", Revision 2, October 1, 1987.

4.7 Ebasco Document SAG.CP32, "General Instructions for Seismic Category II HVAC Duct and Duct Support Analysis", Revision 2, December 15, 1987.

4.8 CPSES Design Basis Document DBD-CS-086, "HVAC Duct and Duct Supports", Revision 1, December 31, 1987.

4.9 TU Electric CPSES Unit 1 and Common, Impell Corporation and Ebasco Services Incorporated Project Status Report (PSR), "Cable Tray and Cable Tray Hangers", Revision 0.

4.10 TU Electric CPSES Unit 1 and Common, Ebasco Services Incorporated Project Status Report (PSR), "Conduit Supports Trains A and B and Train C Larger Than 2 Inch Diameter", Revision 0.

4.11 TU Electric Specification 2323-MS-85, "HVAC Ducts, Louvers and Accessories", Revision 6.

4.12 TU Electric Construction Department Procedure CHV-101, "HVAC - Detailing, Fabrication, Installation, Rework and Repair", Revision 2.

4.13 TU Electric Construction Department Procedure CHV-106, "Qualitative Walkdown of HVAC Supports and Ducts (Unit 1 and Common Areas)", Revision 4.

4.14 TU Electric Construction Department Procedure ECC 10.99-HV-010, "HVAC Grouting of Base Members with Ceilcote 658-N Epoxy Grout", Revision 1, July 23, 1987.

4.15 TU Electric NEO Quality Assurance Department Procedure NQA-3.09-6.01, "Quality Control Inspection of Safety Related HVAC Systems", Revision 2.

4.16 TU Electric NEO Quality Assurance Department Instruction NQI-3.09-M-006, "Verification/Inspection of Seismic HVAC Systems", Revision 2.

SUBAPPENDIX A17

CASE/CYGNA CABLE TRAY ISSUES

1.0 Definition of the Issue

The following issues were identified by CASE/CYGNA for the cable tray discipline. These issues were reviewed by Ebasco and applicable HVAC issues were identified. The definition of these issues is presented in Appendix A of the Cable Tray and Cable Tray Hangers Project Status Report (PSR) (Reference 4.7).

Issues

1. System Damping Values

2. Modeling of Boundary Conditions

2.0 Issue Resolution

Ebasco resolved the applicable HVAC issues in Paragraph 1.0 above during the design validation process. The resolutions were incorporated into the Design Basis Document (DBD) (Reference 4.6) and the design procedures (References 4.1 through 4.5).

3.0 Corrective Action and Preventive Action

- o No additional issues were identified during the review and resolution of these issues.
- o This issue was determined to be reportable under the provisions of 10CFR50.55(e). This issue was part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-85-54.

3.1 Corrective Action

The applicable HVAC issues in Paragraph 1.0 above were resolved during the design validation process. The resolutions were incorporated into the Design Basis Document (DBD) (Reference 4.6) and the design procedures (References 4.1 through 4.5).

3.2 Preventive Action

The design procedures (References 4.1 through 4.5), which incorporate the design criteria as specified in the Design Basis Document (DBD) (Reference 4.6), assure adequate seismic design of HVAC duct and HVAC supports.

4.0 References

4.1 Ebasco Document SAG.CP23, "Seismic Design Criteria for Seismic Category I HVAC Ducts and Duct Supports for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 1, June 5, 1987.

4.2 Ebasco Document SAG.CP24, "General Instructions for Seismic Category I HVAC Duct and Duct Support Analysis for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 4, December 15, 1987.

4.3 Ebasco Document SAG.CP30, "Seismic Design Criteria for Air Handling Units, Plenums and Equipment Supports", Revision 0, June 29, 1987.

4.4 Ebasco Document SAG.CP31, "Design Criteria for Seismic Category II HVAC Duct and Duct Supports", Revision 2, October 1, 1987.

4.5 Ebasco Document SAG.CP32, "General Instructions for Seismic Category II HVAC Duct and Duct Support Analysis", Revision 2, December 15, 1987.

4.6 CPSES Design Basis Document DBD-CS-086, "HVAC Duct and Duct Supports", Revision 1, December 31, 1987.

4.7 TU Electric CPSES Unit 1 and Common, Impell Corporation and Ebasco Services Incorporated Project Status Report (PSR), "Cable Tray and Cable Tray Hangers", Revision 0.

SUBAPPENDIX A18

OTHER HVAC ISSUES

1.0 Definition of the Issue

1.1 The issue was that some HVAC supports had gaps in excess of 1/16 inch between the concrete and the base angle of the support. This gap between the base angle and the concrete was not included on the original contractor's as-built drawings of the support. (NRC IR 446/8602-U-18)

1.2 The issue was that in some instances gaps existed between duct and duct supports which were not identified on the original contractor's duct support as-built drawings.

1.3 The issue was that some transverse supports were constructed with the duct welded to the support member thus forming a connection which may cause longitudinal load to be transferred to transverse supports from the duct.

1.4 The issue was that original tests performed on ducts included only axial compression loads for determination of duct load capacity.

1.5 The issue was that the original HVAC test program may not have adequately addressed the effects of openings on duct section properties or duct load capacity.

1.6 The issue was that the HVAC duct sleeves, in which the original fire dampers were installed, may not have been properly designed for seismic loading.

1.7 The issue was that the original duct support design methodology for evaluating the cantilever portion of the support's base angle may not have included all applicable loadings to assure that no buckling of the vertically projected angle leg occurs.

1.8 The issue was that non-perpendicularity of drilled-in concrete expansion anchors was not included in the original contractor's as-built drawings for HVAC supports and therefore may not have been considered in the support design.

1.9 The issue was that the original construction details of the HVAC duct did not consistently meet the requirements of the SMACNA and ERDA codes which were specified in the orginal HVAC installation specification.

1.10 The issue was that loose counterweights and counterbalance arms were identified on some gravity dampers. (ISAP VII.c, Appendix 16)

2.0 Issue Resolution

Ebasco resolved these issues as follows:

2.1 Ebasco performed engineering walkdowns in accordance with Field Verification Methods (FVMs) (References 4.1 and 4.9) which identified supports with base member gaps in excess of 1/16 inch. These gaps are being grouted to comply with the requirements of the revised and validated HVAC installation specification (Reference 4.6).

2.2 Ebasco performed engineering walkdowns in accordance with a Field Verification Method (FVM) (Reference 4.1) which identified supports with gaps between the duct support and the duct. These gaps are being shimmed to comply with the requirements of the revised and validated HVAC installation specification (Reference 4.6).

2.3 Ebasco performed engineering walkdowns in accordance with a Field Verification Method (FVM) (Reference 4.1) which identified the as-built transverse support configuration. These configurations were design validated by performing calculations in accordance with the Ebasco design procedures (References 4.2 through 4.5). Design changes were identified for those supports if calculations determined that the design criteria were not satisfied. These design changes are being implemented.

2.4 Ebasco performed new static tests (Reference 4.7) of duct specimens, including tests with axial tension loads applied, which provided data for the determination of the ultimate strength of the duct as constructed at CPSES Unit 1 and Common. These data were used to confirm the allowable stress limits. These allowable stress limits were used for the design validation of the HVAC duct.

2.5 Ebasco performed new static tests (Reference 4.7) of duct specimens, including tests on specimens with openings, which provided data for the determination of the ultimate strength of the duct as constructed at CPSES Unit 1 and Common. These data were used to confirm the allowable stress limits. These allowable stress limits were used for the design validation of the HVAC duct.

2.6 The original fire dampers and HVAC duct sleeves in HVAC duct are being replaced for unrelated reasons. The new fire dampers and sleeves have been procured as Seismic Category I components and are being installed as Seismic Category I components in safety-related HVAC duct.

2.7 Ebasco design procedures (References 4.3 and 4.5) specify the applicable loadings for evaluating HVAC duct supports, including the cantilever portion of the support's base angle. The design validation of base angles was performed in accordance with these design procedures.

2.8 Ebasco performed engineering walkdowns in accordance with Field Verification Methods (FVMs) (References 4.1 and 4.9) which identified HVAC supports with drilled-in concrete expansion anchors which did not meet the perpendicularity requirements of the revised and validated HVAC installation specification (Reference 4.6). The identified HVAC support concrete expansion anchors are being modified to comply with the revised and validated HVAC installation specification.

2.9 Ebasco performed new static tests (Reference 4.7) of duct specimens which provided data for the determination of the ultimate strength of the duct as constructed at CPSES Unit 1 and Common. These data were used to confirm the allowable stress limits. These allowable stress limits were used for the design validation of the HVAC duct.

2.10 Modifications are being implemented to tack weld the counterweights and counterbalance arms in place.

3.0 Corrective Action and Preventive Action

- No additional issues were identified during the review and resolution of these issues.

- This issue was determined to be reportable under the provisions of 10CFR50.55(e). This issue was part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-85-54.

3.1 Corrective Action

Design criteria for HVAC duct and HVAC supports were established and documented in the Design Basis Document (DBD) (Reference 4.8). Design procedures (References 4.2 through 4.5 and 4.10) were developed which incorporate the design criteria. Engineering walkdowns were performed in accordance with Field Verification Methods (FVMs) (References 4.1 and 4.9) to determine the as-built configuration of HVAC duct and HVAC supports. These duct and supports were validated by performing calculations in accordance with design procedures (References 4.2 through 4.5 and 4.10).

Design changes were identified for HVAC duct and HVAC supports if the calculations determined that the design criteria were not satisfied. These design changes are being implemented.

New static tests (Reference 4.7) were performed on HVAC duct specimens which provided data confirming the allowable stress limits of duct as constructed at CPSES Unit 1 and Common. The HVAC installation specification was revised and validated to assure proper installation of HVAC duct and HVAC supports. The revised construction procedures (References 4.11 through 4.13) and revised Quality Control (QC) inspection procedures (References 4.14 and 4.15) were reviewed to assure consistency with the revised and validated HVAC installation specification (Reference 4.6).

3.2 Preventive Action

Design criteria for HVAC duct and HVAC supports were established and documented in the Design Basis Document (DBD) (Reference 4.8). Design procedures (References 4.2 through 4.5 and 4.10) were developed which incorporate the design criteria.

The HVAC installation specification was revised and validated to assure proper installation of HVAC duct and HVAC supports. The revised construction procedures (References 4.11 through 4.13) and revised Quality Control (QC) inspection procedures (References 4.14 and 4.15) were reviewed to assure consistency with the revised and validated HVAC installation specification (Reference 4.6). The original HVAC installation contractor has been replaced and Quality Control (QC) inspections are now being performed by TU Electric Quality Control (QC).

4.0 References

4.1 CPE-EB-FVM-CS-029, "Procedure for Seismic HVAC Duct and Duct Hanger As-Built Verification in Unit 1 and Common Areas", Revision 6.

4.2 Ebasco Document SAG.CP23, "Seismic Design Criteria for Seismic Category I HVAC Ducts and Duct Supports for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 1, June 5, 1987.

4.3 Ebasco Document SAG.CP24, "General Instructions for Seismic Category I HVAC Duct and Duct Support Analysis for Comanche Peak Steam Electric Station Nos. 1 and 2", Revision 4, December 15, 1987.

4.4 Ebasco Document SAG.CP31, "Design Criteria for Seismic Category II HVAC Duct and Duct Supports", Revision 2, October 1, 1987.

4.5 Ebasco Document SAG.CP32, "General Instructions for Seismic Category II HVAC Duct and Duct Support Analysis", Revision 2, December 15, 1987.

4.6 TU Electric Specification 2323-MS-85, "HVAC Ducts, Louvers and Accessories", Revision 6.

4.7 Corporate Consulting Development Company, Ltd., "Test Report for Static Load test of HVAC Duct Work for Comanche Peak Steam Electric Station (CPSES)", CCL Report No. A-749-87, October 23, 1987.

4.8 CPSES Design Basis Document DBD-CS-086, "HVAC Duct and Duct Supports", Revision 1, December 31, 1987.

4.9 CPE-EB-FVM-CS-066, "Procedure for As-Built Verification of Seismic HVAC Air Handling Units, Plenums and Equipment Supports in Unit 1 and Common Areas", Revision 2.

4.10 Ebasco Document SAG.CP30, "Seismic Design Criteria for Air Handling Units, Plenums and Equipment Supports", Revision 0, June 29, 1987.

4.11 TU Electric Construction Department Procedure CHV-101, "HVAC - Detailing, Fabrication, Installation, Rework and Repair", Revision 2.

4.12 TU Electric Construction Department Procedure CHV-106, "Qualitative Walkdown of HVAC Supports and Ducts (Unit 1 and Common Areas)", Revision 4.

4.13 TU Electric Construction Department Procedure ECC 10.99-HV-010, "HVAC Grouting of Base Members with Ceilcote 658-N Epoxy Grout", Revision 1, July 23, 1987.

4.14 TU Electric NEO Quality Assurance Department Procedure NQA-3.09-6.01, "Quality Control Inspection of Safety Related HVAC Systems", Revision 2.

4.15 TU Electric NEO Quality Assurance Department Instruction NQI-3.09-M-006, "Verification/Inspection of Seismic HVAC Systems", Revision 2.

SUBAPPENDIX A19

ENVIRONMENTAL CONDITIONS AND REQUIREMENTS (IRR DAP-E-EIC-503)

1.0 Definition of the Issue

The issue was that inadequate calculations existed for determining temperatures in plant areas.

2.0 Issue Resolution

Ebasco resolved this issue by establishing the design criteria for plant ambient temperatures for applicable plant operating modes (except for the loss of non-safety-related HVAC systems following a loss-of-offsite power). These design criteria are specified in the Design Basis Documents (DBDs) (References 4.2 through 4.15). Ebasco performed new calculations to determine temperatures which demonstrate compliance with the design criteria. These calculations were performed in accordance with Ebasco design control procedures (Reference 4.1). These procedures require that calculations be checked and independently reviewed to assure accuracy.

Ebasco also performed calculations to determine temperatures, in areas outside containment which contain safety-related equipment, resulting from loss of non-safety-related HVAC systems following a loss-of-offsite power. The results of these calculations were transmitted to Impell for use in the equipment qualification portion of the Corrective Action Program (CAP) as described in the Equipment Qualification Project Status Report (PSR) (Reference 4.16). These calculations were performed in accordance with Ebasco design control procedures (Reference 4.1). These procedures require that calculations be checked and independently reviewed to assure accuracy.

3.0 Corrective and Preventive Action

- No additional issues were identified during the review and resolution of this issue
- This issue was determined to be reportable under the provisions of 10CFR50.55(e). Inadequate calculations for determining temperatures except during loss of non-safety-related HVAC systems following a loss-of-offsite power, were part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-85-43 in letter number TXX-4659, dated December 20, 1985 from TU Electric to the NRC. Loss of non-safety-related HVAC systems, outside containment, following a loss-of-offsite power and its impact on environmental qualification of safety-related equipment were part of the conditions reported as Significant Deficiency Analysis Report (SDAR) CP-84-27 in letter number TXX-4409, dated March 6, 1985 from TU Electric to the NRC.

3.1 Corrective action

The design criteria were established for the plant ambient temperatures for applicable plant operating modes (except for the loss of non-safety-related HVAC systems following a loss-of-offsite power). These design criteria are specified in the Design Basis Documents (DBDs) (References 4.2 through 4.15). Ebasco performed new calculations to determine temperatures which demonstrate compliance with the design criteria. These calculations were performed in accordance with Ebasco design control procedures (Reference 4.1). These procedures require that calculations be checked and independently reviewed to assure accuracy.

Ebasco also performed calculations to determine temperatures, in areas outside containment which contain safety-related equipment, resulting from loss of non-safety-related HVAC systems following a loss-of-offsite power. The results of these calculations were transmitted to Impell for use in the equipment qualification portion of the Corrective Action Program (CAP) as described in the Equipment Qualification Project Status Report (PSR) (Reference 4.16). These calculations were performed in accordance with Ebasco design control procedures (Reference 4.1). These procedures require that calculations be checked and independently reviewed for accuracy.

3.2 Preventive Action

The design criteria, which specify the plant ambient temperatures for applicable plant operating modes, are specified in the Design Basis Documents (DBDs) (References 4.2 through 4.15). The Ebasco design control procedures (Reference 4.1) require that calculations be checked and independently reviewed to assure accuracy.

4.0 References

4.1 Ebasco CPSES Manual of Procedures

4.2 CPSES Design Basis Document DBD-ME-300, "Containment Ventilation Systems", Revision 1, December 22, 1987.

4.3 CPSES Design Basis Document DBD-ME-301, "Containment Air Cleanup Systems", Revision 1, December 22, 1987.

4.4 CPSES Design Basis Document DBD-ME-302, "Safeguards Building Ventilation System", Revision 1, December 22, 1987.

4.5 CPSES Design Basis Document DBD-ME-302A, "Diesel Generator Area Ventilation System", Revision 1, December 22, 1987.

4.6 CPSES Design Basis Document DBD-ME-302B, "Electrical Area HVAC System", Revision 3, February 4, 1988.

4.7 CPSES Design Basis Document DBD-ME-302C, "Mainsteam and Feedwater Area Air Conditioning System", Revision 1, December 22, 1987.

4.8 CPSES Design Basis Document DBD-ME-303, "Auxiliary Building Ventilation System", Revision 1, December 22, 1987.

4.9 CPSES Design Basis Document DBD-ME-303-01, "Fuel Handling Building Ventilation System", Revision 1, December 22, 1987.

4.10 CPSES Design Basis Document DBD-ME-304, "Control Room Air Conditioning System", Revision 1, December 22, 1987.

4.11 CPSES Design Basis Document DBD-ME-305, "Uncontrolled Access Area Ventilation System", Revision 1, December 22, 1987.

4.12 CPSES Design Basis Document DBD-ME-309, "Primary Plant Ventilation System," Revision 2, February 12, 1988.

4.13 CPSES Design Basis Document DBD-ME-311, "Safety Chilled Water System", Revision 1, December 22, 1987.

4.14 CPSES Design Basis Document DBD-ME-312, "Service Water Intake Structure Ventilation System", Revision 1, December 22, 1987.

4.15 CPSES Design Basis Document DBD-ME-313, "Uninterruptable Power Supply Area Air Conditioning System", Revision 1, December 22, 1987.

4.16 TU Electric CPSES Unit 1 and Common, Impell Corporation Project Status Report (PSR), "Equipment Qualification", Revision 0.

APPENDIX B

ISSUES IDENTIFIED DURING THE PERFORMANCE OF THE CORRECTIVE ACTION PROGRAM (CAP)

This appendix describes the details of the resolutions of issues determined to be reportable under the provisions of 10EFR50.55(e) that were identified during the performance of the HVAC portion of the Corrective Action Program (CAP). Included in these appendices are HVAC systems and component-related Significant Deficiency Analysis Reports (SDARs) initiated by TU Electric. Specific references to the criteria, procedures and design changes which have resolved the issue are provided.

To report the resolution of the issues identified during performance of the Corrective Action Program (CAP), an individual Subappendix was developed for each issue. Each Subappendix includes: a definition of the issue; issue resolution; and corrective and preventive action.

The preventive action is embodied in the procedures and Design Basis Documents (DBDs) developed and used in the HVAC portion of the Corrective Action Program (CAP). These procedures and Design Basis Documents (DBDs) resolve the HVAC Corrective Action Program (CAP) issues. Implementation of these preventive actions will assure that the design and hardware for CPSES Unit 1 and Common will continue to comply with the licensing commitments throughout the life of the plant as described in Secion 5.4.

Corrective Action Program (CAP) issues contained in Appendix B are listed below:

Issue No.	Issue Title
B1	SDAR CP-87-124, Xomox Valves
B2	SDAR CP-88-08, Class 1E Battery Room Temperature

SUBAPPENDIX B1

SDAR CP-87-124, XOMOX VALVES

1.0 Definition of the Issue

The issue was that for Xomox plug or butterfly valves with Limitorque 90 degree electric motor operators with H-BC gears, the potential may exist for certain components in the drive train within the operator or between the operator and the valve stem to move out of correct engagement. This issue was identified by Xomox Corporation (Reference 4.1).

2.0 Issue Resolution

Ebasco resolved this issue by identifying the specific application where such valves are utilized at CPSES Unit 1 and Common (control of component cooling water flow to the condensers of the Control Room air conditioning units), and contacting the Xomox Corporation. Xomox Corporation has advised (Reference 4.2) that replacement drive parts to resolve this issue are available from them. These replacement parts are being procured from Xomox.

3.0 Corrective and Preventive Action

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

This issue was determined to be reportable under the provisions of 10CFR50.55(e). It was reported as Significant Deficiency Analysis Report (SDAR) CP-87-124 in letter TXX-7141, dated December 30, 1987 from TU Electric to the NRC.

3.1 Corrective Action

Replacement parts for the components identified as potentially defective by Xomox Corporation (Reference 4.1) are being procured. The replacement parts are to be installed subsequent to delivery.

3.2 Preventive Action

The issue deals with a vendor item which was found defective by the vendor. The vendor is addressing the preventive action to prevent recurrence.

4.0 References

4.1 Xomox Corporation Letter, from D.J. Hobson to C. Killough of TU Electric, dated October 16, 1987.

4.2 Xomox Corporation Letter, from D.J. Hobson to C. Killough of TU Electric, dated November 5, 1987.

SUBAPPENDIX B2

SDAR CP-88-08, CLASS 1E BATTERY ROOM TEMPERATURE

1.0 Definition of the Issue

The issue was that the batteries are required to be sized to provide their required output at 70°F. However, the Heating, Ventilation and Air Conditioning (HVAC) system design allowed for a minimum temperature of 40°F during a Loss of Offsite Power, when the non-Class 1E unit heaters will not be operating.

2.0 Issue Resolution

Ebasco resolved this issue by revising the design criteria of the Class 1E battery room Heating Ventilation and Air Conditioning (HVAC) system to provide a minimum room temperature of 70°F under required plant operating conditions. This revised criteria is specified in the Design Basis Document (DBD) (Reference 4.1). Design modifications for compliance with the revised criteria are being implemented.

3.0 Corrective and Preventive Actions

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

This issue was determined to be reportable under the provisions of 10CFR50.55(e). It was reported as Significant Deficiency Analysis Report (SDAR) CP-88-08, in letter number TXX-88067, dated January 13, 1988 from TU Electric to the NRC.

3.1 Corrective Action

The design criteria of the Class 1E battery room Heating, Ventilation and Air Conditiong (HVAC) system was revised by Ebasco to specify a minimum room temperature of 70°F under required plant operating conditions. This revised criteria is specified in the Design Basis Document (DBD) (Reference 4.1). Design modifications for compliance with the revised criteria are being implemented.

3.2 Preventive Action

The design criteria for the ambient temperature requirements in the Class 1E battery rooms have been documented in the Design Basis Document (DBD) (Reference 4.1).

4.0 References

4.1 CPSES Design Basis Document DBD-ME-305, "Uncontrolled Access Area Ventilation System", Revision 1, December 22, 1987.