TEXAS UTILITIES GENERATING CO. COMANCHE PEAK STEAM ELECTRIC STATION



SUPPLEMENT A SYSTEMS INTERACTION PROGRAM CORRECTIVE ACTION PLAN

MECHANICAL GENERIC ISSUES REPORT

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EBASCO SERVICES INCORPORATED

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T U ELECTRIC COMANCHE PEAK STEAM ELECTRIC STATION

UNITS 1 AND 2

SYSTEMS INTERACTION PROGRAM GENERIC ISSUES REPORT

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SYSTEMS INTERACTION PROGRAM

GENERIC ISSUES REPORT

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SYSTEMS INTERACTION PROGRAM

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LIST OF GENERIC ISSUES

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4	Missiles
5	Seismic / Nonseismic Interactions
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SYSTEMS INTERACTION PROGRAM

GENERIC ISSUES REPORT

I. INTRODUCTION

T U Electric has retained Ebasco Services Incorporated to develop and implement a program to identify and evaluate systems interactions that may result from pipe breaks, seismic events and missiles. This activity will produce the identification, location and evaluation of all interactions and the specification, installation and maintenance of protective measures necessary for CPSES to satisfactorily comply with FSAR and regulatory requirements.

In addition, the implementation of this program will address the generic issues described in Section III which have arisen from the following causes;

- a) Design changes to the plant's configuration.
- b) Piping reanalyses done by SWEC.
- c) Review of original calculations and methodology.
- d) Discrepancies noted by TERA.

II. BACKGROUND

In 1977 a Damage Study Program was established in Gibbs & Hill's NY office to identify and evaluate the effects of high energy pipe breaks based on as designed conditions. Protective measures in the form of pipe rupture restraints were specified and designed. Activities associated with moderate energy pipe breaks, seismic induced failures and missiles were limited to FSAR preparation and defense and normal design activities.

In 1980 a site group was formed to supplement the NY activities. The site group performed walkdowns for high energy pipe breaks, moderate energy pipe breaks and seismic induced failures. While T U Electric managed the site activities, overall program management remained with Gibbs & Hill. In late 1983 all activities were moved to the site and T U Electric took over program management. In late 1984 Ebasco was retained by T U Electric to assist in the implementation of pipe break evaluations for Unit 2. Ebasco was responsible for the establishment of program methodology and the evaluation of pipe break interactions. Program management, Unit 1 activities and the remainder of Unit 2 activities were by T U Electric.

In mid 1986 Ebasco was directed to take over all Damage Study activities. Efforts were to be focused on using Unit 2 methodology to upgrade the Unit 1 studies. Ebasco was also directed to review and update, where necessary, all Unit 1 work. In late 1986 the above efforts were given the title Systems Interaction Program, a more descriptive name.

III. GENERIC ISSUES

Below is a listing of generic issues formulated as a result of the activities identified in Section I and from Ebasco's participation on the Unit 2 SIP. The nature of each issue has been identified (e.g. program goal, potential deficency, actual deficency or allegation).

Baseline Documents

Program interfaces should be documented through project procedures. (program goal)

Program criteria should be documented in Design Bases Document format. (program goal)

High Energy Pipe Breaks:

Improper determination of pipe whip zones of influence. (potential deficency) (TERA)

Incorrect identification of all safety related targets within jet impingement and pipe whip zones. (potential deficency) (TERA)

Jet cone shapes should be reconsidered based on industry practice advanced through the issuance of ANSI/ANS N58.2. (program goal)

Assess the potential for multiple pipe hinges formation. (potential deficency)

Some of the mass and energy blowdown rates found in the pipe rupture books were calculated using RELAP MOD 3. Errors have been found in some of the versions of RELAP MOD 3 in use at that time. (program goal)

Lack of documentation that the failure modes and effects analysis used verifies shutdown capability and level of protection. (potential deficency) (TERA)

Shutdown evaluations were performed by an engineering task force. The results of these evaluations should be reviewed by the disciplines responsible for the design. (program goal)

Assess changes in pipe break location that may result from SWEC's reanalysis of piping systems. (program goals)

Implementation of "leak before break" technology should be considered. (program goal)

Assess the impact of elimination of arbitrary intermediate breaks. (program goal)

Incorrect jet impingement projected target area calculation methodology. (potential deficency) (TERA)

Calculation methodology is non-conservative and not in accordance with accepted industry practice regarding jet impingement loads. (potential deficency) (TERA)

Jet cone shapes should be reconsidered based on industry practice advanced through the issuance of ANS/ANSI N58.2. (program goal)

Secondary effects of target failures should be addressed. (potential deficency)

Functional damage to large pipes from small whipping pipes should be addressed. (potential deficiency)

Insufficient evaluation of environmental parameters and their consequences. (potential deficency) (TERA)

Assess the impact on environmental calculations of changes in architectural features and new break locations. (potential deficency)

Moderate Energy Pipe Breaks:

Assess the impact of changes to the plant fire protection systems. (potential deficency)

Lack of documentation that the failure modes and effects analysis used verifies shutdown capability and level of protection. (potential deficency)

Shutdown evaluations were performed by an engineering task force. The results of these evaluations should be reviewed by the disciplines responsible for the design. (program goal)

Missiles

Absence of documentation demonstrating that all credible missile sources were identified. (potential deficency) (TERA)

Absence of or incomplete assessment analysis of missiles affecting plant safe shutdown capabilities. (potential deficency) (TERA)

Improper specification of equipment design requirements that preclude missile generation. (potential deficency) (TERA)

Failure to verify as-built conditions to ensure the adequacy of the protection of safety related structures, systems, and components from potential missile hazards. (potential deficency) (TERA)

Seismic / Non Seismic Interactions

Assess the potential for failure of seismic anchored nonseismic component "breaking up". (potential deficency)

Assess the impact of plant modifications. (potential deficency)

Procedures for SIP review of plant modifications and additions made by plant operations groups should be developed. (program goal)

Flooding

Assess the impact of changes to the plant fire protection systems. (potential deficency)

Changes in plant configuration could affect the flooding calculations. (potential deficency)

FSAR

Assess changes in pipe break location that may result from SWEC's reanalysis of piping systems. (program goal)

Implementation of "leak before break" technology should be considered. (program goal)

Jet cone shapes should be reconsidered based on industry practice advanced through the issuance of ANS/ANSI N58.2. (program goal)

Assess the impact of elimination of arbitrary intermediate breaks. (program goal)

Documentation Maintenance

Procedures for notifying SIP of plant modifications should be reviewed and modified where necessary to contain specific criteria for when SIP is to perform Interdisciplinary Review. (program goal)

Methodology for tracking the impact of plant modifications on the SIP should be developed. (program goal)

The SIP should field verify that it's recommendations have been correctly implemented. (program goal)

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IV. REPORT ORGANIZATION AND RESOLUTION PROCESS

The appendices to this report describe the approach used by Ebasco to evaluate and resolve the generic issues identified above. An individual appendix has been developed for each area of the Systems Interaction Program.

Each appendix is divided into individual sections for each activity. The generic issue(s) being addressed are identified and a detailed description of the activity is given.

The generic issues identified in the TERA findings are addressed and are included in the above listing. Individual issues raised by TERA are not addressed in the report. Specific TDDR's have been prepared and responded to address those issues.

This report has been prepared, reviewed and approved by Ebasco and will be revised as future circumstances dictate. Each revision will clearly identify the affected sections and will be reviewed and approved by Ebasco.

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V. ABBREVIATIONS

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ANS	American Nuclear Society
ANSI	American National Standards Institute
CPSES	Comanche Peak Steam Electric Station
DAP	Design Adequacy Program
DBD	Design Basis Document
DCA	Design Change Authorization
DCC	Document Control Center
FSAR	Final Safety Analysis Report
G&H	Gibbs and Hill
HELB	High Energy Line Breaks
LOCA	Loss of Coolant Accident
MELB	Moderate Energy Line Breaks
MS/FW	Main Steam and Feedwater Systems
NRC	Nuclear Regulatory Commission
PBI	Pipe Break Isometrics
PRB	Pipe Rupture Books
SIP	Systems Interaction Program
SLD	Shutdown Logic Diagrams
SRP	NRC Standard Review Plan
SSE	Safe Shutdown Earthquake
S/NS	Seismic / Nonseismic Interactions
SWEC	Stone & Webster Engineering Corp.
TERA	Consulting Firm responsible for Third Party review
TDDR	Technical Design Deficiency Report
WEC	Westinghouse Electric Corp
Z of I	Zone of Influence Sketch

SYSTEMS INTERACTION PROGRAM

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IV. REFERENCES

- 1) 10CFR Part 50, Appendix A General Design Criterion 4 "Environmental and Missile Design Bases".
- 2) 10CFR Part 100 Reactor Site Criteria.
- Regulatory Guide 1.29, Seismic Design Classification
- 4) Regulatory Guide 1.46, Protection Against Pipe Whip Inside Containment.
- 5) Regulatory Guide 1.115, Protection Against Low-Trajectory Turbine Missiles.
- 6) NUREG-0800 US NRC Standard Review Plan Sections 3.5, 3.6
- 7) ANSI/ANS 58.2 1980, Standard Design Basis for Protection of Light Water Nuclear Power Plants Against Effects of Postulated Pipe Rupture.
- IEEE-279-1971, Criteria for Protection Systems for Nuclear Power Generating Stations.
- IEEE-308-1974, Criteria for Class IE Power Systems for Nuclear Power Generating Stations.
- TERA DAP-E-M-501, Evaluation of High Energy Line Breaks.
- 11) TERA DAP-E-M-507, Missiles Hazards
- 12) CPSES Final Safety Analysis Report

SYSTEMS INTERACTION PROGRAM

GENERIC ISSUES REPORT

APPENDIX 1

Baseline Documents

GENERIC ISSUE

Program interfaces should be documented through project procedures.

RESOLUTION APPROACH

General program interfaces are described in the SIP task description and in the Ebasco interface procedure. Details of each interface is described in the relevant project procedure to be prepared by SIP.

Program input interfaces are as follows.

- DCC Project design documents
- SWEC Break locations and piping displacements at pipe whip restraints.
- WEC Break locations and piping displacements at pipe whip restraints.
- G&H Backup files for existing SIP calculations.
- Grinnell Fire protection piping routings.

Program output interfaces are as follows:

- SWEC Loads on essential structures, systems and components. SLD and results of shutdown evaluations. Flood levels.
- WEC Loads on essential systems and components.

- Impell High energy break environments, flood levels, water spray and essential equipment lists by room.
- Ebasco Loads on essential conduits and cable trays.

GENERIC ISSUE

Program criteria should be documented in Design Basis Document format.

RESOLUTION APPROACH

The current program criteria document is Ebasco's "Damage Study Criteria Documents". Criteria from this documents and other relevant project documents will be gathered into individual DBD's for Pipe Breaks, Seismic/Non-seismic Interactions and Missiles.

SYSTEMS INTERACTION PROGRAM

GENERIC ISSUES REPORT

APPENDIX 2

High Energy Line Breaks

GENERIC ISSUE

Improper determination of pipe whip zones of influence.

RESOLUTION APPROACH

Pipe Rupture Books were prepared for those stress problems where pipe rupture restraints were required. This practice will be expanded to all stress problems.

The Pipe Rupture Books will document all structures and components in the path of a whipping pipe capable of influencing the pipe whip movement. For installed pipe whip restraints the design adequacy will be verified. For other structures and components their interaction loads will be transmitted to the appropriate design group during the evaluation phase of HELB studies. Computer models using RELAP and PIPERUP will be prepared where required

For pipe whip with large deflections, known as unrestrained pipe breaks; the pipe whip movement will be documented by references to the applicable program criteria, a suitable calculation or by computer analysis, such as ABAQUS.

GENERIC ISSUE

Incorrect identification of all safety related targets within jet impingement and pipe whip zones.

RESOLUTION APPROACH

For the Unit 2 studies the practice of documenting zones of influence on orthographic sketches was developed. This practice is being extended to the Unit 1 studies. Pipe whip movement and jet shape will be orthographically shown on Zone of Influence Sketches. The sketches will show the nearby significant structures, systems and components affecting the pipe whip movement and jet shape. A FVM will be utilized to verify the completeness of the sketches prior to use in the walkdowns.

GENERIC ISSUE

Jet cone shapes should be reconsidered based on industry practice advanced through the issuance of ANSI/ANS N58.2.

RESOLUTION APPROACH

In prior HELB studies on UNIT 1 a jet cone shape of 10 degree half angle was used. During the preparation of Unit 2 studies the decision was made to use the "exploding" jet cone shape given in ANSI/ANS 58.2. This model more closely reflects recent experimental data While this change reduces the range of a jet, there is a greater near area affected.

GENERIC ISSUE

Assess the potential for multiple pipe hinges formation.

RESOLUTION APPROACH

Ebasco is currently evaluating the potential for the formation of a second hinge.

GENERIC ISSUE

Some of the mass and energy blowdown rates found in the pipe rupture books were calculated using RELAP MOD 3. Errors have been found in the some of the versions of RELAP MOD 3 in use at that time.

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RESOLUTION APPROACH

Ebasco will verify the results obtained from the RELAP MOD 3 models with those prepared using RELAP MOD 5.

GENERIC ISSUE

Lack of documentation that the failure modes and effects analysis used verifies shutdown capability and level of protection.

RESOLUTION APPROACH

For the Unit 2 studies the practice of documenting shutdown analysis using Fault Tree methodology was established. This practice is being extended to Unit 1 studies.

The Shutdown Logic Diagrams are fault tree diagrams that illustrate the shutdown capability of the plant following any one of the five break categories analyzed. The five breaks analyzed will be as follows:

Large Break LOCA (>4") Small Break LOCA (<4") MS/FW Break Inside Containment Other Breaks Inside Containment

Breaks Outside Containment

A mathematical analysis of the SLD will be performed to obtain the component combinations, known as minimal cut sets, required for each break category. The analysis will be performed using FTRAM computer program and/or SETS computer program.

The essential components identified in the SLD will be listed in the Essential Equipment Data Base. For each item it's location and the reference design documents used in preparing the SLD are listed. From the cables list in the Essential Equipment Data Base an Essential Raceway Data Base will be prepared identifying the conduit, cable trays, junction boxes, terminal boxes, and cable in high energy break areas.

GENERIC ISSUE

Shutdown evaluations were performed by an engineering task force. The results of these evaluations should be reviewed by the disciplines responsible for the design.

RESOLUTION APPROACH

The shutdown calculations including the Shutdown Logic Diagrams will be transmitted to the appropriate organization that is responsible for the overall system design. All comments will be resolved and revised diagrams and calculations will be issued when necessary.

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GENERIC ISSUE

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Implementation of "leak before break" technology should be considered.

RESOLUTION APPROACH

A FSAR amendment has been submitted.

GENERIC ISSUE

Assess the impact of elimination of arbitrary intermediate breaks.

RESOLUTION APPROACH

A submittal was made to the NRC to justify the removal of arbitrary intermediate breaks.

GENERIC ISSUE

Incorrect jet impingement projected target area calculation methodology.

Calculation methodology is non-conservative and not in accordance with accepted industry practice regarding jet impingement loads.

RESOLUTION APPROACH

Errors were found in the computer model, PIPSCIN, used to calculate jet loads (SDAR 86-13)..These errors have been reanalyzed and where necessary recalculated using

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JLOAD computer program. JLOAD is a computer program developed by EBASCO specifically developed for CPSES and has been prepared and design verified in accordance with project procedures. The revised loads have been transmitted to the appropriate discipline and the current design has been found to be acceptable A detailed report is scheduled for a March, 1987 submittal to the NRC.

GENERIC ISSUE

Calculation methodology is non-conservative and not in accordance with accepted industry practice regarding jet impingement loads.

Jet cone shapes should be reconsidered based on industry practice advanced through the issuance of ANS/ANSI N58.2. (program goal)

RESOLUTION APPROACH

Ebasco will reevaluate all jet impingement loads using the jet cone shapes found in ANSI/ANS 58.2.

GENERIC ISSUE

Secondary effects of target failures should be addressed.

RESOLUTION APPROACH

Ebasco will assess the need to considered secondary effects. Where it is determined the secondary effects should be considered their results will be so documented.

GENERIC ISSUE

Functional damage to large pipes from small whipping pipes should be addressed.

RESOLUTION APPROACH

Ebasco will transmit the loads of pipe to essential pipe impacts to the appropriate discipline for their analysis of the essential piping systems ability to function. GENERIC ISSUE Assess the potential for multiple pipe hinges formation.

RESOLUTION APPROACH

Ebasco is currently evaluating the potential for the formation of a second hinge.

GENERIC ISSUE

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Insufficient evaluation of environmental parameters and their consequences.

Assess the impact on environmental calculations of changes in architectural features and new break locations.

RESOLUTION APPROACH

Ebasco will review all environmental calculation outside the containment and modify them, where necessary, to reflect any changes in the architectural features of the plant and the revised break locations issued by SWEC. The computer program used is COMPARE. T U ELECTRIC COMANCHE PEAK STEAM ELECTRIC STATION

SYSTEMS INTERACTION PROGRAM

GENERIC ISSUES REPORT

APPENDIX 3

Moderate Energy Line Breaks

GENERIC ISSUE

Assess the impact of changes to the plant fire protection systems.

RESOLUTION APPROACH

As Grinnell revises fire protection piping, SIP will revise moderate energy line break studies.

GENERIC ISSUE

Lack of documentation that the failure modes and effects analysis used verifies shutdown capability and level of protection.

RESOLUTION APPROACH

Shutdown evaluations of MELBs will utilize the same shutdown logic diagram prepared for HELBs outside the containment.

GENERIC ISSUE

Shutdown evaluations were performed by an engineering task force. The results of these evaluations should be reviewed by the disciplines responsible for the design.

RESOLUTION APPROACH

The Shutdown Calculations including the Shutdown Logic Diagrams will be transmitted to the appropriate design organization that is responsible for the overall system design. All comments will be resolved and revised diagrams and calculations will be issued when necessary.

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APPENDIX 4

Missiles

GENERIC ISSUE

Absence of documentation demonstrating that all credible missile sources were identified.

Absence of or incomplete assessment analysis of missiles affecting plant safe shutdown capabilities.

Improper specification of equipment design requirements that preclude missile generation.

Failure to verify as-built conditions to ensure the adequacy of the protection of safety related structures, systems, and components from potential missile hazards.

RESOLUTION APPROACH

Ebasco will establish a program documenting the plant ability to withstand missile hazards. As part of this program Ebasco will review all present documentation available from each source including the site and appropriate engineering/licensing locations. This will assess the material presently available to conform with the requirements of the program (FSAR, NRC, etc.). Upon conclusion of this review the following procedure shall be implemented.

1. Identification of Missile Sources

This effort will entail the review of specifications and other equipment documentation to identify potential missile sources. It will include the characteristics of missiles as to configuration, energy, zone of influence, and type (e.g. valves and valve bonnets, high speed rotating machinery, fan blades and thermal wells). The development of these characteristics

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may include vendor supplied data or that derived from from NUREG documents and engineering analysis.

2. Walkdown

Upon the identification of each type of missile source an inventory shall be conducted by area for actual missile identification and it's potential interaction with safety related targets. This walkdown shall produce complete documentation as to missile (and subsequently source/target interaction) location, zone of influence (where applicable), type of missile, etc. This data shall be recorded on a data sheet similar to those existing for HELB and MELB walkdowns. This information shall be transferred to a database for maintenance and data retrieval purposes.

3. Evaluation

An evaluation of all source/target interactions shall be conducted utilizing the data compiled from the walkdown. The design basis document shall be utilized as the source document for evaluations. The tools by which the evaluations will be performed shall be the shutdown logic diagrams as developed for HELB and MELB analysis and modified accordingly to reflect missile criteria requirements, analytical and/or empirical data and methods to evaluate impact of missiles on target integrity and function, and project controlled documents (diagrams, specification, etc.) where applicable. Each missile source/target interaction shall produce an evaluation and subsequent resolution. Where a resolution requires a physical modification to be implemented, whether to the source or target, appropriate change documents shall be generated. These data shall be recorded in the programs database.

T U ELECTRIC COMANCHE PEAK STEAM ELECTRIC STATION

SYSTEMS INTERACTION PROGRAM

GENERIC ISSUES REPORT

APPENDIX 5

SEISMIC / NON-SEISMIC ANALYSIS

GENERIC ISSUE

Assess the potential for failure of seismic anchored nonseismic component "breaking up".

RESOLUTION APPROACH

Ebasco will assess the potential failure of all nonseismic components to "break up".

GENERIC ISSUE

Selection of nonseismic equipment was based on the walkdown teams understanding of the criteria. Review of plant modifications by SIP was fragmented and should be formalized in project procedures.

RESOLUTION APPROACH

The successful implementation of this program is dependent on the identification of sources, targets and their respective interactions. These components, which are recorded on the interaction data sheets, are described as follows:

1. Sources

Sources consist of all structures systems, and components not Seismic Category I in Seismic Category I structrues. Source identification shall be established by review of applicable project design documents and/or appropriate markings in the field. All sources shall be recorded on the interaction data sheets.

2. Targets

A target consists of all Nuclear Safety Class 1, 2, and 3 piping and equipment and all Class 1E components including cables, conduits, cable trays and electrical and I&C equipment which may be damaged by a source. Target identification shall be established by review of applicable project design documents and/or appropriate markings in the field. All targets shall be recorded on the interaction matrix sheets. -

GENERIC ISSUE

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Procedures for SIP review of plant modifications and additions made by plant operations groups should be developed.

RESOLUTION APPROACH

Meetings with representatives of the operation department have been held and a procedure has been drafted to control the location of permanent and moveable cabinets used by operations. T U ELECTRIC COMANCHE PEAK STEAM ELECTRIC STATION

SYSTEMS INTERACTION PROGRAM

GENERIC ISSUES REPORT

APPENDIX 6

Flooding

GENERIC ISSUE

Assess the impact of changes to the plant fire protection systems.

Resolution Approach

Ebasco will review all flooding calculations and modify them, where necessary, to reflect any changes in the plant fire protection system. This review will consider both inadvertent operation of the fire protection system as well as the affect of seismic failures.

GENERIC ISSUE

Changes in plant configuration could affect the flooding calculations.

Resolution Approach

Ebasco will review all flooding calculations outside the containment and modifying them, where necessary, to reflect any changes in the plant architectural features. T U ELECTRIC COMANCHE PEAK STEAM ELECTRIC STATION

SYSTEMS INTERACTION PROGRAM

GENERIC ISSUES REPORT

APPENDIX 7

FSAR

GENERIC ISSUE

Assess changes in pipe break location that may result from SWEC's reanalysis of piping systems.

RESOLUTION APPROACH

Ebasco will submit FSAR update as necessary.

GENERIC ISSUE

Implementation of "leak before break" technology should be considered.

RESOLUTION APPROACH

A FSAR amendment on "leak before break" technology has been submitted to the NRC.

GENERIC ISSUE

Jet cone shapes should be reconsidered based on industry practice advanced through the issuance of ANS/ANSI N58.2.

RESOLUTION APPROACH

Ebasco will prepare a FSAR update to incorporate the criteria and ANSI/ANS 58.2.

GENERIC ISSUE

Assess the impact of elimination of arbitrary intermediate breaks.

RESOLUTION APPROACH

Ebasco will prepare a FSAR update as necessary once this item has been resolved with the NRC staff. T U ELECTRIC COMANCHE PEAK STEAM ELECTRIC STATION

SYSTEMS INTERACTION PROGRAM

GENERIC ISSUES REPORT

APPENDIX 8

Documentation Maintenance

A. Plant Modifications - Design Review

GENERIC ISSUE

Procedures for notifying SIP of plant modifications should be reviewed and modified where necessary to contain specific criteria for when SIP is to perform Interdisciplinary Review.

RESOLUTION APPROACH

The SIP will assist plant operations in the preparation of procedures covering the location of movable cabinets and similar movable objects used by operations.

B. Modification Tracking

GENERIC ISSUE

Methodology for tracking the impact of plant modifications on the SIP should be developed.

RESOLUTION APPROACH

The data bases described in this report will act as means of tracking SIP documentation. This will facilitate the review of plant modifications by the SIP Group

C. Field Verifications

GENERIC ISSUE

The SIP should field verify that it's recommendations have been correctly implemented.

RESOLUTION APPROACH

Instructions will be incorporated into SIP procedures to instruct the SIP to document field implementation of the fixes it recommended as resolutions to interactions.

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