No. TR-83090-01
Rev. 0

FINAL REPORT

INDEPENDENT ASSESSMENT PROGRAM

FOR

COMANCHE PEAK STEAM ELECTRIC STATION

Prepared For

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October 12, 1984

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1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

At the request of Texas Utilities Services, Inc., Cygna Energy Services developed a program to provide supplementary evidence regarding the overall design quality of the Comanche Peak Steam Electric Station (CPSES). The program was intended, as shown in Exhibit 1.1, to be used in conjunction with recent NRC-sponsored evaluations, especially the Construction Appraisal Team (CAT) inspection and the Special Investigation Team (SIT) review of the Walsh-Doyle allegations. The program was also intended to address the concerns and comments expressed by the NRC in letters to Texas Utilities dated May 4 and July 15, 1983.

To address these concerns, Cygna developed an Independent Assessment Program (IAP) which Texas Utilities issued for comments on June 10, 1983. In a letter dated July 15, the NRC provided three basic comments for consideration: (1) the IAP should include a technical design review, (2) the system selected for the technical design review should have demanding design parameters, and (3) the implementation evaluation of the design control program should consider more than the design change and interface control elements. The present Independent Assessment Program (IAP) was the result of the above evolution.

The scope and methodology of this Independent Assessment Program was transmitted to the NRC by Texas Utilities on September 9, 1983 (H.C. Schmidt letter to D.G. Eisenhut). Subsequent NRC approval of the program was received on September 23, 1983 (D.G. Eisenhut letter to R.J. Gary).

The general approach taken to achieve the program objectives was to evaluate a given project scope along two distinct paths. The first path consisted of an independent evaluation to assess the design control process used on the project for the selected scope. This review was multi-disciplined and covered the design control requirements that would apply to the total plant design

effort. This is referred to as the "horizontal" review. The second path was to evaluate the implementation of the design control process in the design of selected systems or elements within the total plant design. This review evaluated the conformance of the technical design to the design control requirements for the selected systems and/or elements. The design review also evaluated the final design conformance with design criteria and licensing commitments, and tested the validity of the assumptions made and methods utilized in the design process. This is referred to as the "vertical" review.

1.2 SCOPE OF THE WORK

The following criteria were considered in selecting the systems or elements for this scope of work for the vertical review:

- the design should be safety-related with demanding design parameters;
- the design should represent a cross section of disciplines;
- the design process should have several organizational interfaces;
- the design should have characteristics which cannot be performance tested or verified under actual design conditions; and
- the design should include a system turned over to the start-up group, such that the design process would be complete.

Taking the above criteria into consideration, the following two elements of the safety related systems were chosen for the Independent Assessment Program:

- the Residual Heat Removal (RHR) Safety Injection System - Train "B" from the containment sump line penetration to the RHR heat exchanger; and

- the Spent Fuel Pool Cooling System - Train A

The technical implementation review of the RHR System covered the mechanical, electrical, and structural design aspects of representative components, including a review of the design analysis control process. The as-built implementation review of the Spent Fuel Cooling System covered similiar aspects from a final construction viewpoint, and provided added assurance of the adequacy of the design control process.

The time period which the review of each element encompassed is as follows:

• Design Control	1975 to present
• Structural	1977 to present
• Pipe Stress	1977 to present
• Pipe Support	1980 to present
• Electrical Design	1975 to present

Exhibit 1.2 depicts graphically the scope of the technical review. Exhibits 1.3, 1.4, 1.5 and 1.6 indicate the various contractors involved and the scope of their responsibilities for each element investigated.

1.5 RESULTS

The Observation Log (Exhibit 1.9) summarizes the final status of all observations identified during the course of this review. A total of 36 observations were identified. Of these, four were invalid observations and one was identified as a potential finding.

A summary of the valid observations and PFRs, by discipline, is provided below:

Discipline	Valid Observations	PFR's	DPFR's
Walkdown	5	0	0
Design Control	7	0	0
Pipe Stress	9	0	0
Pipe Support	4	0	0
Equipment Qualification	0	0	0
Structural	7	1	0
Electrical	0	0	0
Total	32	1	0

In addition to the observations noted above, a number of technical questions arose during the Comanche Peak Atomic Safety Licensing Board (ASLB) hearings, many of which were outside of the original IAP scope. At this time, several of these issues have not been fully resolved. The technical conclusions presented in the next section are contingent upon the satisfactory resolution of those open items.

1.6 CONCLUSIONS

The Independent Assessment Program for CPSES achieved four important objectives. The Program was able to :

- assess the adequacy of Texas Utilities' design control program;
- assess the adequacy of the design of an important safety related system;
- verify a selected as-built configuration; and
- verify implementation of selected elements of the design control program.

The first objective has been met with the following conclusions:

- Texas Utilities Services, Inc.'s design control activities, as defined in their design control program documentation, satisfy the project commitments made in the CPSES SAR and QAP, and standard practice; and
- The design control activities of Gibbs & Hill satisfy the commitments of contract documents and the CPSES SAR.

The second objective has been met with the following conclusions:

- The review provided added assurance that the design control process has been adequately implemented in the areas of criteria, procedures, interface control, and documentation.

* Selected elements of one safety related system have been adequately designed to perform their intended safety function in accordance with the project commitments, applicable code requirements and industry standards.

The third objective has been met with the following conclusions:

* An as-built walkdown of a completed system provided added assurance that proper controls were in place to ensure construction was completed in accordance with the drawings, specifications and associated change notices.

The fourth objective has been met with the following conclusions:

* Texas Utilities Services, Inc. and Gibbs & Hill have adequately implemented control of design changes, interfaces, and analyses (based on G&H review only) in accordance with the design control commitments as delineated in their respective design program documentation.

This scope of work afforded Cygna an opportunity to examine the CPSES design process on safety-related systems located inside the safeguards building and fuel building. It provided for an assessment of activities related to mechanical (piping, pipe supports, equipment qualification), structural (cable tray supports) and electrical engineering disciplines.

This program assessed the transfer of information between the various design and construction organizations, as well as the accuracy and completeness of various elements of the design process. The scope of our design control and technical reviews supplements the scope of previous reviews of CPSES (see Exhibit 1.1). This Independent Assessment Program provided sufficient

evidence for Cygna to conclude that, within the scope of this review, the overall design activities on CPSES are adequate and the design control program has been properly implemented. Viewed in this context, this Independent Assessment Program also provides the NRC and Texas Utilities Services, Inc. with added assurance as to the adequacy of the CPSES design process and its implementation.

EXHIBIT 1.1

CPSES IMPLEMENTATION
REVIEW MATRIX

Element	CAT	SIT	IAP
Program Requirements (Organization)	*		
Design Input Document Control		*	*
Design Analysis Control		*	X
Drawing Control	X	*	*
Procurement Control	X		*
Internal/External Interface Control		*	X
Design Verification Control		*	*
Document Control	X	*	*
Design Change Control	X	*	X
Corrective Action Control	X	*	*
Records	*	*	*
Internal/External Audits and Surveillances Control	X		*
Design		X	X
As-Built	X	*	X

X = Full Review

* = Not In-depth

EXHIBIT 1.3

RESPONSIBILITY MATRIX
MECHANICAL
(SPENT FUEL POOL COOLING AND RESIDUAL HEAT REMOVAL)

	Texas Utilities	G&H	W	ITT Grinnel	B&R	NPSI
1) Conceptual Design	X[1]	X	X[2]			
2) Design Criteria		X	X[2]			
3) System Design		X	X[2]			
4) Piping Layout		X				
5) Pipe Stress Analysis		X				
6) Input to Pipe Stress						
a) ARS		X				
b) SAM		X				
c) Hydrodynamic Loads		N/A				
d) Support Stiffness		X				
7) Pipe Support Design	X			X[4]		X
8) Pipe Anchor Design	X			X		X
9) Equipment Supports		X				
10) Installation					X	
11) Purchase Specifications		X				
12) Procurement	X					
13) As-Built Drawings						
a) Pipe	X					
b) Pipe Supports	X					

[1] Approval Only

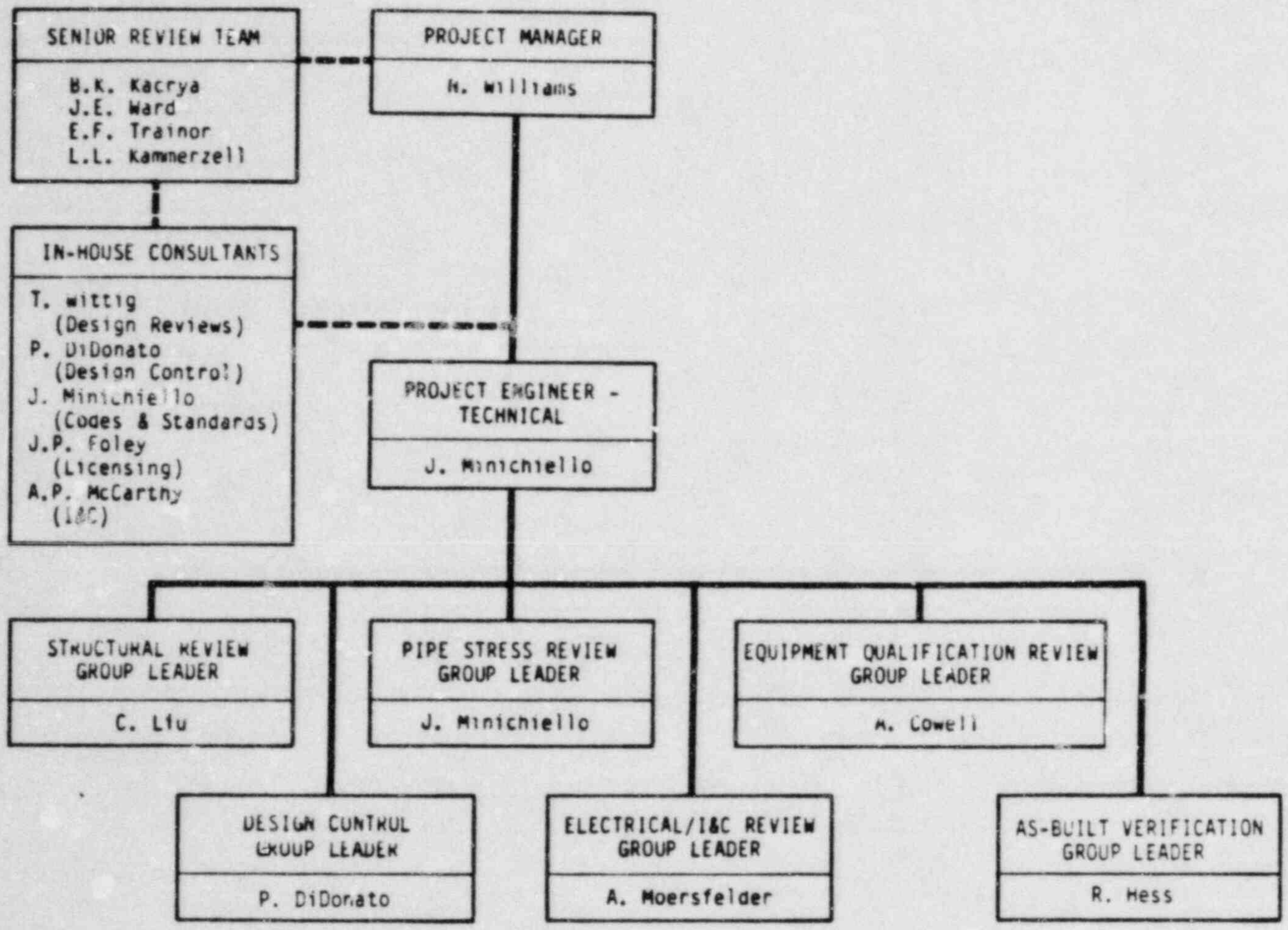
[2] For NSSS components including R.H.R. system

[3] Balance of plant

[4] Responsible for a majority of the supports

EXHIBIT 1.7

PROJECT ORGANIZATION



LEGEND
—— Project Direction
- - - Consultation

EXHIBIT 1.8

REVIEW PROCESS FLOW CHART

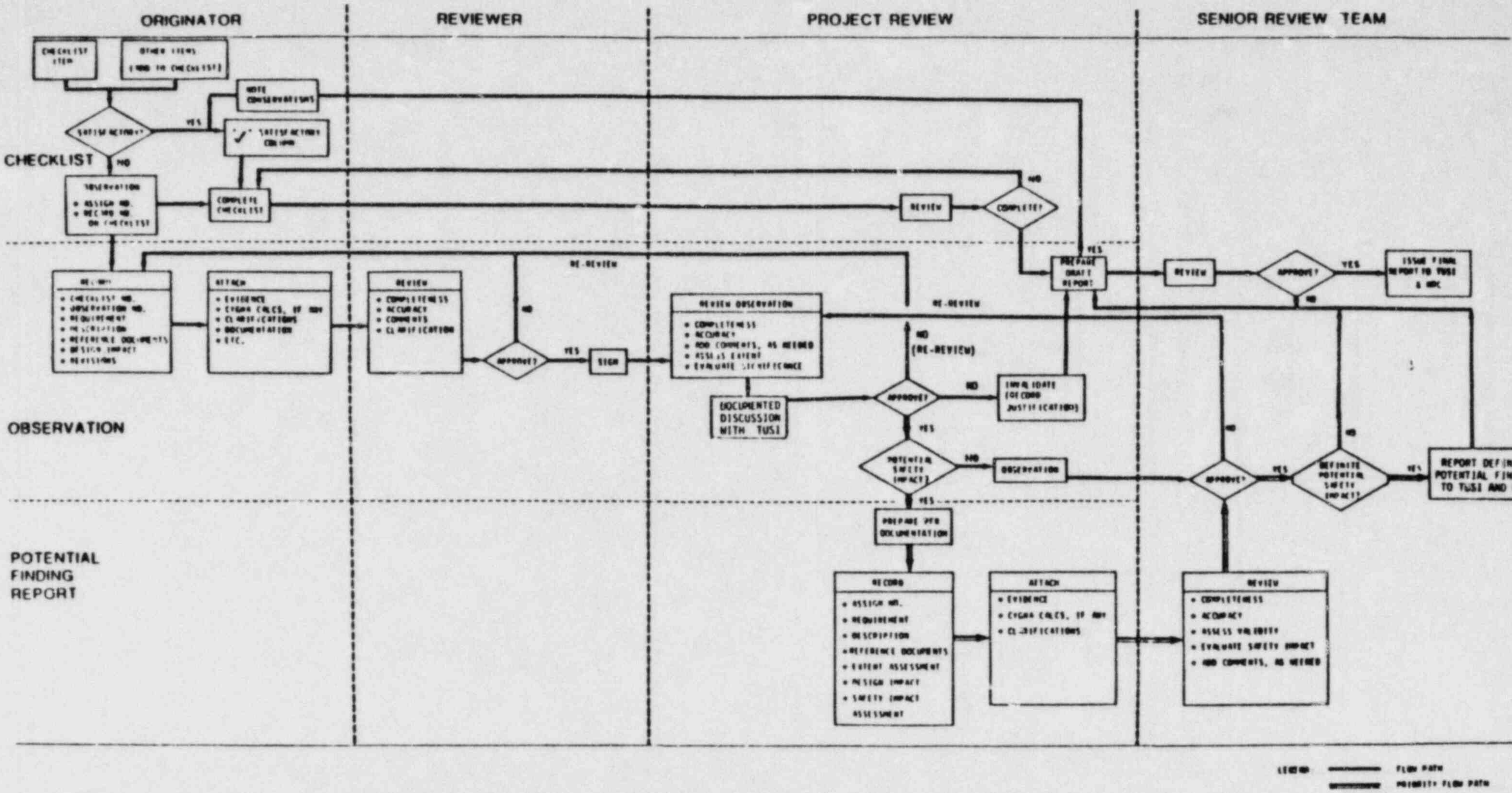


EXHIBIT 1.9

Observation Log

Rev. No. 4 Date 10/10/84

Observation No.	Description	Classification: Valid Y	Valid N	Potential Finding Y	Potential Finding N	Definite Potential Finding Y	Definite Potential Finding N	Closed Y	Closed N	Isolated Y	Isolated N
DC-01-01	The CPSES Document Control Center (DCC) does not maintain an accurate listing of design changes generated against drawings and specifications. This was substantiated upon review of eighteen drawings, seven specifications and approximately 112 associated design changes. These discrepencies are as follows: Affected Document — Design Change Missing from DCC Log Dwg. 2323-S-0800 — DCA-12534 (Rev. 1) Dwg. 2323-E1-0018-01 — DCA-16858 Dwg. 2323-S-0801 — DCA-713 Dwg. 2323-S-0825 — DCA-7850 (Rev. 4)	X			X		X	X			X
DC-01-02	The Design Change Log Books maintained by site file custodians did not include the posting of all design changes. This was substantiated upon review of the Document Control Center list of design changes against affected documents versus the site file custodian Design Change Log Books. AFFECTED DOCUMENT — MISSING DESIGN CHANGE — LOCATION SPEC MS-20B.1 — DCA-14781 — Purchasing SPEC MS-20B.1 — DCA-14026 (Rev. 2) — Purchasing DWG 2323-E1-0018-01 — DCA-9222 (Rev. 1) — Electrical SPEC MS-46A — DCA-11193 (Rev. 2) — Purchasing SPEC MS-46A — DCA-11939 (Rev. 1) — Purchasing	X			X		X	X			X

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Observation Log

Observation No.	Description (Rev. No. 4 Date 10/10/84)	Classification: Valid Y	Valid N	Potential Finding Y	Potential Finding N	Definite Potential Finding Y	Definite Potential Finding N	Closed Y	Closed N	Isolated Y	Isolated N
	SPEC MS-46A DCA-14349 (Rev. 1) Purchasing SPEC MS-46A DCA-16383 (Rev. 1) Purchasing SPEC MS-46A DCA-17620 Purchasing SPEC MS-46A DCA-13037 Purchasing SPEC MS-46A DCA-18073 Purchasing SPEC MS-605 DCA-10413 (Rev. 3) Purchasing SPEC MS-605 DCA-17849 Purchasing SPEC MS-605 DCA-17852 Purchasing										
DC-01-03	An initial review of fourteen drawings disclosed that one (Gibbs & Hill drawing 2323-S-0801) was not stamped "THIS DOCUMENT AFFECTED BY DESIGN CHANGES." A further sample of 20 drawings disclosed that four drawings lacked the required stamp.	X			X		X	X			X
DC-01-04	The Field Design Change and Review Status Log, as maintained by the Design Change Tracking Groups (DCTG) was reviewed for compliance to Procedure CP-EP-4.7 "Control of Engineering/ Design Review of Field Design Changes." The review disclosed: 1. The DCTG status log did not accurately reflect all outstanding design changes listed (e.g. Specification 2323-ES-100, DCA-9695; 2323-S-0800, DE/CD's, DCDDA's, FICR's). 2. The DCTG status log does not accurately reflect the status of design change documents to be incorporated versus design changes not to be incorporated (e.g. DWG. 2323-S-0801, DCA-81 and DCA-92).	X			X		X	X			X

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Observation No.	Description	Valid Y	Valid N	Potential Finding Y	Potential Finding N	Definite Potential Finding Y	Definite Potential Finding N	Closed Y	Closed N	Isolated Y	Isolated N
	3. The DCTG status log contains design changes entered against the incorrect affected document. (DCA-1803 was listed against another specification when it should have been listed against MS-20B.1.)										
	4. The DCTG status log identifies design changes as applicable to certain documents when in fact they have been voided.										
DC-02-01	A review of specifications MS-13, 15, 29A, and 64, and associated revisions and addenda, disclosed that several revisions of specifications MS-13 and MS-15 for safety-related mechanical equipment were apparently issued to the owner prior to performance of design review and/or resolution of design review comments as follows:	X			X		X	X			X

Spec.	Rev.	Date Issued to TUSI	Date Design Reviewed	P.O. Issue	Date Resolution of Design Review Comments
MS-13	0	2/19/75	2/14/75	N/A	2/24/78
MS-13	1		1/1/76	5/27/76	9/11/79
MS-51	ADD 1	10/30/74	12/11/75	N/A	No comments
MS-51	1	9/9/75	12/31/75	N/A	3/19/76
MS-51	2	11/19/75	3/23/76	3/20/75	8/2/78

Observation No.	Description	Valid Y	Valid N	Potential Finding Y	Potential Finding N	Definite Potential Finding Y	Definite Potential Finding N	Closed Y	Closed N	Isolated Y	Isolated N
DC-02-02	Gibbs & Hill Design Specification MS-200 specifies ASME III, 1974 edition, through Summer 1974 Addenda as a design basis. However, the computer code (ADLPIPE Version 2C) used for pipe stress calculations AB-1-69 and AB-1-70 incorporates the requirements of ASME III, 1974 edition, through Winter 1975 Addenda.	X			X		X	X			X

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Observation No.	Description	Classification: Valid Y	Valid N	Potential Finding Y	Potential Finding N	Definite Potential Finding Y	Definite Potential Finding N	Closed Y	Closed N	Isolated Y	Isolated N
DC-02-03	Pipe stress problems AB-1-69 and AB-1-70 were analyzed using the computer program ADLPIPE Version 2C dated 4/77. However, the ADLPIPE version dated 9/72 is specified in the CPSES FSAR.	X			X		X	X			X
PI-00-01	Gibbs and Hill does not specify any weld mismatch (δ) when determining stress intensification factors for butt welds.	X			X		X	X			X
PI-00-02	Gibbs & Hill uses an increase in the upset and emergency condition allowables when considering welded attachment stresses in combination with general piping stresses.	X			X		X	X			X
PI-00-03	Gibbs & Hill has no procedure for checking that an adequate number of modes are considered in the dynamic analysis. All modes up to 33 Hz are included in the analysis.	X			X		X	X			X
PI-01-01	The wall thickness used for the computer analysis piping segments 16"-SI-074-151R-2 and 16"-SI-073-151R-2 was 0.5 inches. The correct value is 0.375 inches.	X			X		X	X		X	
PI-02-01	The response spectra for the containment structure at elevations 805.5' and 860.0' were not included in the analysis for problem 1-70. These are needed to envelope the attachment at penetration MII-5 (elevation 820'-1-9/16"). Cygna did note that the SAM for the containment building <u>were</u> included in the proper analysis.	X			X		X	X		X	
PI-02-02	Support RH-1-064-010-S22R (previous tag number RH-1-062-001-S22R) is modelled 14 inches downstream from its correct, as-built location on piping segment 8"-RH-1-064-601R-2.	X			X		X	X		X	

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Observation No.	Description	Classification: Valid Y	Valid N	Potential Finding Y	Potential Finding N	Definite Potential Finding Y	Definite Potential Finding N	Closed Y	Closed N	Isolated Y	Isolated N
PI-02-03	In the welded attachment analysis for the restraints in Problems 1-70, the analyst used the maximum thermal expansion loads for the equation 11 check, rather than the range of the loads.	X			X		X	X			X
PI-02-04	The reinforcing pad used in the welded attachment analysis for anchor SI-1-037-005-S32A was 10" long rather than the 8" shown in the latest drawing. Cygna did note that the loads used were a conservative set from a previous revision of the piping analysis.		X		X		X	X		X	
PI-02-05	The incorrect pipe schedule (80 instead of 40) was used in calculating the allowable forces and moments for the RHR heat exchanger tubeside nozzles. The correct schedule produced lower allowables.	X			X		X	X			X
PI-03-01	In the finite element analysis for penetration MS-1, 2, 3, 4, the geometry below the lower taper (for ≈2") was modeled incorrectly, due to an error in element generation. The error resulted in an area of the model with triangular holes adjacent to triangular steel.	X			X		X	X		X	
PS-02-01	The embedment lengths shown on the drawing (6-1/2" and 3-1/2") do not match those in the calculation (7-3/4" and 5")	X			X		X	X			X
PS-09-01	The working range (i.e. top up or bottom out) for spring hanger nos. SI-1-079-001-S32S and RH-01-010-002-S22S was not checked to ensure that the travel due to seismic movement was within the working range of the hanger.	X			X		X	X			X

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Observation No.	Description	Valid Y	Valid N	Potential Finding Y	Potential Finding N	Definite Potential Finding Y	Definite Potential Finding N	Closed Y	Closed N	Isolated Y	Isolated N
PS-10-01	The design input data for support RH-1-064-001-S22R contained an error in the X displacement sign (+.395 " vs. -.395"). This error appears on the form transmitted from the pipe stress group to the pipe support group for use in the design.	X			X		X	X		X	
PS-12-01	The allowables for a "PUH" style U-bolt were used in the design calculation. The bill of materials calls out a "PUS" style U-bolt.	X			X		X	X		X	
CTS-00-01	Self-weight excitation due to the weight of the support was not considered in the tray support design.	X			X		X	X			X
CTS-00-02	Gibbs & Hill performed the calculation of total resultants for component loads as follows: a. For anchor bolts, Gibbs & Hill included the dead load in the square root of the sum of the squares (SRSS) combination of component seismic forces. This resultant is 9% less than the actual combination where the dead load effects are added absolutely to the SRSS of the seismic forces. b. Combined component member loads were calculated from various static and dynamic loads (i.e., dead and seismic) using the algebraic summation method for the following cable tray supports:	X			X		X	X			X

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Observation No.	Description	Valid Y	Valid N	Potential Finding Y	Potential Finding N	Definite Potential Finding Y	Definite Potential Finding N	Closed Y	Closed N	Isolated Y	Isolated N
	Standard Details A_i, B_i, C_i, and D_i (where i = 1 to 5, depending on the number of tray levels), details A, B, C, and D of drawing no. 2323-E1-0601-01-S, which are based on Standard Detail D_i, and Standard Details 4, 5 and 7.										
CTS-00-03	In the review of cable tray support calculations, Cygna discovered the following deficiencies in the modeling assumptions for frame analyses: a. Cable tray Standard Details A_i, B_i, C_i and D_i, where i = 1 to 5 depending on the number of tray levels, and Details A, B, C and D on Gibbs & Hill drawing 2323-E1-0601-01-S which are based on Standard Detail D_i, are modeled as plane frames. Two basic configurations are analyzed. The first configuration consists of two vertical members, called hangers, connected by horizontal members, called beams, which support the cable trays. This configuration is typical for Standard Details A_i, B_i and C_i. The second configuration consists of one vertical hanger and one to four beams which are attached to the hanger at one end and a concrete surface at the other. This second case it typical of Standard Detail D_i and the related Details A, B, C and D. All anchorage points were modeled as pinned in the plane of the frame. Both support configurations are modeled with vertical and horizontal cable tray loads at the beam to hanger joints	X			X		X	X			X

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Observation No.	Description	Valid Y	Valid N	Potential Finding Y	Potential Finding N	Definite Potential Finding Y	Definite Potential Finding N	Closed Y	Closed N	Isolated Y	Isolated N
	instead of at the beam tray support points. The total horizontal and vertical load distribution was assumed to be split equally between the beam support points. The above assumptions are deficient for the following reasons: 1. Placing tray loads at the beam-hanger joints does not reflect the actual loading configuration thereby eliminating the effects of local bending and torsion on the beams. 2. For Standard Detail D_i, where loads were placed at the beam ends which were connected to the concrete surface (these points being modeled as simple supports), load effects were totally removed from the structure. b. Hanger ceiling connections consisting of angles anchored to concrete by either one or two bolts were modeled as hinges in the cable tray support frame analysis. Although this assumption is acceptable for the frame analysis, the assumption of a fixed joint is more appropriate for the evaluation of the base angle and anchor bolts.										
CTS-00-04	Cable tray Standard Details A_i, B_i, C_i and D_i, where i = 1 to 5, depending on the number of tray levels, Details A, B, C and D on Gibbs & Hill drawing 2323-El-0601-01-S which are based on Standard Detail D_i, and Standard Details 4, 5 and 7 were modeled as plane frames. Frame analysis and design were based upon a single ratio of height to width, whereas the ratio varies over the range of frames installed. Tray loads were		X		X		X	X			X

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Observation No.	Description	Valid Y	Valid N	Potential Finding Y	Potential Finding N	Definite Potential Finding Y	Definite Potential Finding N	Closed Y	Closed N	Isolated Y	Isolated N
	placed in various directions in an attempt to simulate the worst case combination for the frame members. For Standard Detail D_i and Details A, B, C and D, an analysis of the base plate/angle and the anchor bolts included only loads with the largest acceleration factors. The above analysis procedures are deficient for the following reasons: 1. If generic analyses are being performed for the design of cable tray group supports, care must be taken to ensure that the worst case configuration is evaluated. No basis was found to ensure that the analysis reflected the worst case aspect ratio. 2. The use of loads with the largest acceleration values in the analysis of the base plate/angle and anchor bolt system is unconservative if it precludes the possibility of vertical loads being directed upward, i.e. opposite gravity. The imposition of upward forces on one beam and downward forces on an adjacent beam coupled appropriately with other forces could result in anchor bolts with higher loads than those used in the original calculations.										
CTS-00-05	The anchor bolts, base plate/angle and channel of cantilever support Detail "E" were originally designed as two-way restraints to resist axial loads on the channel and moments about its major axis. In order to use Detail "E" on a cable tray riser, where it must act as a three-way restraint,	X			X		X	X			X

Observation No.	Description	Valid Y	Valid N	Potential Finding Y	Potential Finding N	Definite Potential Finding Y	Definite Potential Finding N	Closed Y	Closed N	Isolated Y	Isolated N
	the channel section was modified to resist moments about its weak axis. The ability of this configuration to function as intended, i.e., to also resist moments about the weak axis, could not be guaranteed since the anchor bolts and the base plate/angle were not evaluated for such a load.										
CTS-00-06	The analysis and design of Details A, B, C and D on Gibbs & Hill drawing 2323-E1-0601-01-S was based upon the analysis and design of Standard Detail D_i, where i = 1 to 5 depending on the number of tray levels. The orientation of the major axis of the C6 x 8.2 section, used as a hanger for both support series, differs by 90 degrees. The major axis for Standard Detail D_i is out of the plane of the frame while for Details A, B, C and D it is in the plane of the frame. As a consequence, Details A, B, C and D are more flexible than Standard Detail D_i. This was not considered in the analysis. In addition the changes in the design of the beam connections to the hanger were not evaluated.	X			X		X	X			X
CTS-00-07	Details A, B, C and D on Gibbs & Hill drawing 2323-E1-0601-01-S utilize base plates with concrete expansion anchor bolts to attach the beam members to vertical concrete surfaces. In the initial base plate analysis, the plate was evaluated as a pinned-pinned beam. The resulting plate stresses exceeded allowables. A second check of plate stresses was made, assuming that the plate acted as a fixed-fixed beam. The calculated stresses were then found to be acceptable. The use of a fixed-fixed assumption is not necessarily representative of the actual situation.	X			X		X	X			X

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Observation No.	Description	Valid Y	Valid N	Potential Finding Y	Potential Finding N	Definite Potential Finding Y	Definite Potential Finding N	Closed Y	Closed N	Isolated Y	Isolated N
CTS-00-08 (PFR-01)	The cumulative effect of the following analysis techniques and/or procedures may have a potential impact on plant safety:	X		X			X		X		X

Observation No.	Description	Checklist No.
CTS-00-01	Neglect of self-weight excitation of Cable Tray Support.	CTS-11, -13, -24, -25, -32, -33, -34, -35, -37, -38, -39
CTS-00-02	Improper load combination by the SRSS method.	All
CTS-00-03	Computer modeling assumptions which resulted in improper load placement and the assumptions that a rigid one- or two-bolt base angle acts as a pinned rather than a fixed connection.	CTS-2, -3, -10, -11 -13, -24, -25, -26, -27, -28, -29, -30, -32, -33, -34, -35, -36, -37, -38, -39
CTS-00-05	Cantilever member with a two-bolt base connection assumed to act as a three-way restraint.	CTS-6, -14, -15, -16, -17, -18, -19 -20, -21, -22
CTS-00-06	Extrapolation of specific details from generic analyses which assume different member orientation	CTS-11, -13,

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Observation No.	Description	Classification									
		Valid		Potential Finding		Definite Potential Finding		Closed		Isolated	
		Y	N	Y	N	Y	N	Y	N	Y	N
	CTS-00-07 Unconservative assumption for base plate behavior. CTS-11, -13										
WD-01-01	The upper locknut on the strut for pipe support SF-X-001-015-F43R is not tightened.	X			X		X	X		X	
WD-02-01	The gap between the clamp on support SF-X-007-014-F43R and the strut on support SF-X-003-003-F43K varies from 1/4" to 7/16".	X			X		X	X		X	
WD-02-02	The following snubbers were installed 180° from the configuration shown on the support drawings: 1) SF-X-003-003-F43K 2) SF-X-003-005-F43K 3) SF-X-003-006-F43K 4) SF-X-005-017-F43K	X			X		X	X			X
WD-03-01	The gap between the pipe and the structural steel for restraint SF-X-033-007-F43R is 0" and 1" in the unrestrained direction. The support drawing indicates a required gap of 1/2" on both sides of the pipe in that direction.		X		X		X	X		X	
WD-07-01	The spent fuel pool cooling pump is single grounded.		X		X		X	X		X	
WD-07-02	Temperature indicator X-TI-4837 was not installed.	X			X		X	X		X	
WD-07-03	Of the six conduits checked, one instance was found where the Cable and Raceway Schedule identified the conduit between Spent	X			X		X	X		X	

Observation Log

Observation No.	Description	Valid Y	Valid N	Potential Finding Y	Potential Finding N	Definite Potential Finding Y	Definite Potential Finding N	Closed Y	Closed N	Isolated Y	Isolated N
	Rev. No. 4 Date 10/10/84										
	Fuel Cooling Panel XLV-06 and T130FCZ33 as C-03015123. The installation and routing drawing identified this as Conduit No. C-13015123.										

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industry standards and licensing commitments. In a similar manner, each technical discipline (mechanical, structural, electrical, walkdown) developed detailed project criteria. These criteria are contained in Appendix E.

3.3 PROCEDURES

The horizontal review was guided by matrices, while the vertical reviews were guided by checklists. These tools identified key elements to be evaluated during the design control review and implementation evaluation, respectively. Any time a reviewer determined that a line item on the matrix or checklist was inadequately addressed, the item was noted on the checklist or matrix, as appropriate. All discrepancies were reviewed by the Project Review team to determine if it should be recorded as an observation. Any observations later determined to a have potential safety impact were recorded as a "Potential Finding Report" (PFR). Matrices, Checklists, Observation Records and PFR's are described in more detail in the following sections.

3.3.1 Matrices

The programmatic reviews involved developing a quality program matrix, which identified the quality requirements committed to with a cross correlation to the Texas Utilities and Gibbs & Hill design control program. The completed matrices are provided in Appendix D. Appropriate portions of the following Texas Utilities design control documents were used to develop the matrix:

- CPSES QA Program
- CPSES Project Quality Engineering Procedures
- CPSES Project Quality Engineering Instruction
- CPSES Site Document Control Procedure

When a discrepancy was noted, it was recorded on the checklist and then reviewed by at least two members of the project team. It was the responsibility of these team members to evaluate (1) the completeness and accuracy of the discrepancy, and (2) the potential design impact.

If the information was both complete and accurate, and if the discrepancy had potential impact on design, an Observation was recorded.

3.3.3 Observation Record

Completed Observation Records are shown in Appendix F. The observation number is a unique number sequentially assigned to each observation within a checklist. The Observation Record contains a description of the discrepancy, the requirements, and an initial assessment of the potential design impact. Each observation record was prepared by the originator of the observation and then reviewed by a qualified person assigned by the Project Manager. Based on this review, an evaluation by the Project Team, consultation with Cygna specialists, and discussions with Texas Utilities technical and quality assurance staff, an Observation Record Review was then prepared. This review record documents an assessment of probable cause and resolution of each observation. This determination was approved by the Project Manager and the observation originator.

3.3.4 Potential Finding Report

Completed Potential Finding Reports (PFRs) are contained in Appendix G. Each PFR was assigned a sequential number starting with 01. On this form, the cognizant reviewer recorded a description of the observation, an assessment as to the extent of the observation plus an evaluation of the design and safety impact. The PFR was then reviewed by the Senior Review team for completeness and accuracy.

- Design verification
- Document control
- Design change control
- Corrective action
- Internal/external audits and surveillance

The matrices and checklists developed ensured that the governing criteria would be met and that any deviations would be noted as observations.

In the technial implementation review, the Cygna teams assessed the adequacy of the design analysis for the following areas:

- Pipe Stress Analysis
  - Check input data (pressure, operating modes, anchor movements, dynamic loads)
  - Verify that the computer model uses the proper geometry, section properties, supports, components
  - Ensure special features are considered (Valve stem frequencies, nozzle load checks, local stress analysis for lugs)
  - Review stress report data (load cases and combinations, valve accelerations, piping displacements)
- Pipe Support Design
  - Review input data (required support stiffness, support type, piping deflections and loads)

- Review design calculations (welds, members, standard components, proper computer modeling, consideration of base plate flexibility)

- Check support drawings (type, location, clearances, size of members, weld data, anchor bolt data)

- Equipment Qualification

  - Review Qualification file (adequate documentation, proper references)

  - Check drawings and load input (dimensions, weights, material properties, pressure, temperature, dynamic loads)

  - Review design calculations (structural integrity, operability, computer modeling)

  - Review test results (conformance with standards, similarity to actual component, natural frequencies, Test Report Spectra)

- Flued Head

  - Review input data (materials, pressure, temperature, piping loads)

  - Review computer model (dimensions, material properties, method)

  - Review stress report (code checks, hand verification of model)

- Structural Design (Cable Tray Supports)

  - Check support spacing

- Review of loads and load combinations (dead, live, seismic)

- Review of stresses and use of allowables (members, welds, anchor bolts, plates)

- Electrical Review (Power and Instrumentation and Controls)

  - Verify that electrical distribution system one-line diagrams comply with basic design considerations of electrical engineering.

  - Review electrical power and control systems overall design against appropriate regulations and standards identified in SAR.

  - Review electrical design criteria for voltage tolerance limits and incorporation into the RHR pump assembly specifications and motor nameplate data.

  - Check cable size for adequate ampacity, voltage drop and short circuit considerations.

  - Check cable voltage rating and insulation rating against electrical design criteria

  - Check cable specification and cable manufacturer's data for incorporation of cable ratings.

  - Review cable schedule and raceway (conduit) design for maintenance of voltage and system separation requirements.

  - Check short-circuit analysis for maximum fault current at the generator bus caused by a fault at RHR-Train B pump.

- Check breaker interrupting rating for compliance with 6900V switchgear specification.

- Check protective relay settings.

- Verify conformance of the Gibbs & Hill control circuit with design input documentation from Westinghouse.

- Verify that design documents and specifications identify Nuclear Safety Related components as appropriate.

- Check interconnection and control cable identification and routing against the cable and raceway schedule and routing design criteria.

- Check electrical isolation between safety and non-safety circuits.

- As-Built Walkdowns

  - Check component locations against drawings

  - Review installation against specifications and vendor data

  - Review identification of cables and raceways

  - Check welding and support orientation

As is evident from the above, the Cygna implementation review teams considered those areas important to plant safety and subjected each to a detailed review.

3.5 PROJECT REVIEW TEAM

Exhibit 3.2 illustrates the role of the Project Team review in the decision process. When a discrepancy or an observation was identified, a Project Team review was performed to verify the accuracy of the concern, its completeness, the design impact, and the extent. Given this information, the potential safety impact could be evaluated.

Once an observation was determined to be the proper course of action it was sometimes necessary as an integral part of the Project Team review to interface with Texas Utilities in order to confirm the accuracy of an observation and to evaluate the design impact. To maintain independence, all such interfaces with Texas Utilities were recorded in the form of conference reports or telephone conversation reports. In addition to reviewing observations, the Project Team also reviewed the completed checklists to verify their completeness and accuracy.

3.6 SENIOR REVIEW TEAM

All valid observations and PFR's were reviewed by the Senior Review Team. A cognizant member of this team, assisted as necessary by Cygna in-house consultants, reviewed each observation for completeness, accuracy, and potential impact on plant safety. Based on their assessment, the Senior Review Team then would do either of the following:

- Approve the Project Team conclusions.
- Direct the Project Team to perform more work, such as clarifying data, redirecting the review, or performing additional assessments within the current work scope.

The Senior Review Team also evaluated the collective safety impact of observations that were individually concluded to have insignificant safety consequences. During the entire review process, those potential findings were identified as having potential safety impact received immediate and first priority attention. Should the Senior Review Team conclude that the observation did have a definite potential impact on plant safety, the finding would be reported immediately to Texas Utilities in accordance with Title 10 of the Code of Federal Regulations, Part 21.

EXHIBIT 3.1

TERMINOLOGY

Term	Definition
Checklist	A listing of key items to be checked during the independent assessment. The checklist provides a guide to the reviewer; it is neither all inclusive nor limiting.
Review Criteria	A compilation of acceptable procedures and standards. The adequacy of the design and design control process is measured against these criteria.
Discrepancy	Identification of an item in apparent nonconformance with review criteria.
Observation	An accurate and complete discrepancy with potential design impact as judged by the Project Team.
Invalid Observation	Any observation which is judged to be inaccurate as a result of further review.
Valid Observation	An accurate and complete observation as judged by the Project and Senior Review Teams, which requires further review to assess design impact.
Potential Finding	A valid observation having a potential impact on plant safety as judged by the Project Review Team.
Vertical Review	An implementation-evaluation of selected design and design control elements.
Horizontal Review	A quality assurance review of the design control program.
Definite Potential Finding	A potential finding verified by the Senior Review Team to have a potential impact on plant safety. This is a reportable finding to Texas Utilities under requirements of 10CFR Part 21.
Isolated	An unsatisfactory condition found to be localized and distinct.
Extensive	An unsatisfactory condition found to be generic or programatic.

4.0 REVIEW RESULTS AND CONCLUSIONS

After preparing the criteria, matrices, and checklists described in the previous sections, the Cygna review team performed the assessment of the defined scope. Appendix C contains a list of the documents reviewed by Cygna.

This section describes the results of each element of the assessment and draws a final conclusion concerning the design activities within the scope of the IAP. Each phase of the assessment is detailed in the following paragraphs. Also included are the descriptions of the observations noted during the review and their resolution. The more detailed observation forms are contained in Appendix F.

In addition, as a result of the Comanche Peak Atomic Safety Licensing Board (ASLB) hearings, questions were raised by Citizens Association for Sound Energy (CASE) on February 22, 1984, after their review of the initial draft issue of this report. It should be noted that in many cases these questions required answers which were well outside the original scope of this Independent Assessment Program. After the hearings conducted from April 24, 1984 through May 3, 1984 several issues still remained open. These issues are discussed in the appropriate technical sections which follow. At this time, these issues have not been fully resolved and remain as open items.

4.1 DESIGN CONTROL PROGRAM

4.1.1 Texas Utilities Service, Inc. (TUSI) Design Control Program

The review of the TUSI design control program resulted in no observations. The design control program, as documented in the CPSES QA Plan, Project Quality Engineering Procedures and Supporting Instructions, Site Document Control Procedures and the Quality Procedures adequately addressed the requirements of ANSI-N45.2.11 draft 2, revision 2, "Quality Assurance Requirements for the Design of Nuclear Power Plants," as

committed to in the CPSES Final Safety Analysis Report. This conclusion is supported by the quality program matrix provided in Appendix D, which identifies the quality requirements and the procedural control references within the TUSI design control program documents.

4.1.2 Gibbs & Hill Design Control Program

The review of the Gibbs & Hill (G&H) documented design control program resulted in no observations. This design control program as documented in the Gibbs & Hill CPSES Project Procedure and Project Guide Manuals adequately addressed the requirements of ANSI N45.2.11 draft 2, revision 2. This conclusion is supported by the quality program matrix as shown in Appendix D, which identifies the committed quality requirements and the procedural control references within the Gibbs & Hill design control program documents.

4.2 IMPLEMENTATION EVALUATION

4.2.1 Design Change Control

4.2.1.1 TUSI

The implementation evaluation of the TUSI Design Change Control Program resulted in four valid observations, identified as DC-01-01 through DC-01-04, and are summarized as follows:

DC-01-01 The CPSES site document control center (DCC) master log of outstanding design changes issued against drawings or specifications is not accurate.

DC-01-02 The CPSES controlled document recipient logs of outstanding design changes issued against drawings or specificiations are not accurate.

DC-01-03 All drawings are not identified with a marking indicating that outstanding design changes have been issued against such.

DC-01-04 The CPSES Design Change Tracking Group design verification tracking system is not accurate.

TUSI was previously aware of these problems documented by observations DC-01-01 through DC-01-03 as a result of other reviews and audits performed at CPSES. In fact, TUSI had initiated plans for a more tightly controlled DCC program which would alleviate the conditions existing in the program prior to the IAP findings. In summary, this program consists of the following actions:

A) Establish document control satellite stations to better control the distribution of design documents including all associated design changes.

B) Develop an accurate computer manual listing of all design drawings, listing all outstanding design changes. This entails TUSI performing a complete review of all design documents, design changes, respective Gibbs & Hill (G&H) design review records, the computer listing of design changes issued against G&H-generated design documents, and the newly developed TUSI Design Change Tracking Group computerized design review status listing.

C) Revise the existing document control center manually operated design change and design document logging and distribution system via the use of the new computerized document control system (see paragraph B above). The new computerized system

is used as the basis for control of all outstanding design changes issued against affected documents. Further, this listing controls the distribution of design changes to the appropriate satellite files and replaces, in part, the satellite file manual logging system.

The above described system, which was developed and partially instituted during the progress of the IAP, was approximately 85% complete as of October 15, 1983. The Cygna follow-up review of a substantial sample determined that each of the three observations, DC-01-01 through DC-01-03, has been resolved. For complete details of these observations, including their resolution, refer to Appendix F.

In the case of observation DC-01-04, Cygna determined that the computerized listing, at the time of observation identification, was in the process of being developed and refined. Furthermore, this listing was being utilized only as a design review tracking mechanism and not as a control document for a complete and accurate listing of design changes issued. Subsequently, the computerized listing was completed (see discussion above) and incorporated into the newly developed document control program. At that time, it became the master listing for design changes issued against affected design documents. For complete details of this observation and its closure refer to Appendix F.

4.2.1.2 Gibbs & Hill

The implementation of the Gibbs & Hill design change control program resulted in one valid observation (DC-02-01). This observation identified instances where design specifications and changes had been issued prior to the performance of design review and/or resolution of design reviewer comments.

Investigation into this area revealed that the same condition had been identified through the TUSI audit program during 1975 and 1976. TUSI and Gibbs & Hill conducted extensive corrective action and follow-up activities throughout the 1976 through 1979 time frame including the institution of additional procedural controls, personnel training, and development of action listings to resolve the audit deficiencies. In addition, after the 1979 time frame, continued monitoring in the form of TUSI and Gibbs & Hill audits and Gibbs & Hill surveillance was performed. In conclusion, TUSI exercised substantial control over the audit deficiencies up through deficiency closure. For specific details refer to the observation contained in Appendix F.

4.2.1.3 Brown & Root

The implementation review of the Brown & Root design change control system revealed that any design changes generated were handled via the CPSES design change and document control program. This review resulted in no observations.

4.2.2 Design Analyses Control

The implementation of the Gibbs & Hill design analyses control program resulted in two valid observations.

These observations can be summarized as follows:

DC-02-02 Pipe stress calculations were based on an analysis using computer program ADLPIPE version 2C whereas the FSAR listed ADLPIPE version 1C as a design basis.

DC-02-03 The pipe stress analysis was performed using a computer program (ADLPIPE) based on the requirements of the ASME Code, Section III, Winter 1975 Addenda whereas the specification requires the use of the ASME Code, Section III, Summer 1974 addenda.

In each of the cases above, the deficiencies were considered minor with no resulting design impact. For complete details, refer to the observations including their resolution in Appendix F.

4.2.3 Interface Control

The interface control activities by Texas Utilities and Gibbs & Hill were found to be effective, with no observations identified. Further evidence of proper interface control was established by the Cygna technical reviews. This was exhibited by the accurate transfer of design data between groups. An example of this was found in Cygna's verification that the pipe stress analysts used the appropriate pressures and temperatures which were generated by a different discipline.

4.3 TECHNICAL REVIEW EVALUATION

Cygna performed its technical reviews along two paths. First, Cygna reviewed the general guidelines provided to each engineer to determine if these were in compliance with licensing commitments. Cygna then reviewed a sample of each calculation to ensure that the guidelines were followed. In cases where the guidelines were unclear or unavailable, Cygna requested additional documentation (for example, see checklist PI-01, note 5). By following this procedure, Cygna could determine both the adequacy of the design, design interfaces and design methods, as well as the depth of training given to each engineer.

As a result of the technical reviews, Cygna identified a total of 29 observations. Of these, Cygna determined that four were invalid upon further review. The remaining observations were divided as follows:

- Pipe Stress - 9
- Pipe Supports - 4
- Equipment Qualification - 0
- Electrical - 0
- Cable Tray Supports - 7
- Walkdown - 5

Each of the above, except for CTS-00-08 in the Cable Tray Supports, was closed out by either reviewing an expanded sample size (to determine if the error was extensive) and/or performing additional calculations (to determine design impact). As a result of the Cygna review in Observation CTS-00-08, Cygna prepared a Potential Finding Report (PFR-1), which is provided in Appendix G and is described in more detail in Section 4.4 of this report.

4.3.1 Pipe Stress Implementation Evaluation

The pipe stress review covered two areas:

- The RHR/Safety Injection piping from the containment sump to the RHR heat exhanger (Gibbs & Hill problems AB-1-69 and AB-1-70), Train B

- The flued head penetration (Gulf & Western)

In reviewing the pipe stress analysis, Cygna focused on both the analytical methods and the implementation of those methods. In the case of Gibbs & Hill, Cygna found the methods were documented in the form of Engineering Guides which the analysts followed with a few exceptions

discussed below. For Gulf and Western, the Gibbs & Hill specification clearly defined the design requirements indicating good control of design interfaces. In both cases, there was adequate reference to the appropriate documents in the calculation packages.

Cygna did have three observations on the methods used by Gibbs & Hill. In two cases, PI-00-01 and PI-00-02, Gibbs & Hill had not accounted for factors which could affect the design: weld mismatch as it affects stress intensification factors and an appropriate stress allowable for welded attachments. In PI-00-01, Cygna determined that Gibbs & Hill does meet the intent of the Code when using later available data for primary stresses. Cygna performed an expanded review in the area of secondary stresses and determined that the Gibbs & Hill standard practice had no design impact. In PI-00-02, Cygna found that Gibbs & Hill does comply with the intent of the ASME Code and that their practice had no impact on design. In PI-00-03, Gibbs & Hill had not considered the possible effect of higher order modes on dynamic analyses. Based on the facts that Gibbs & Hill did meet the appropriate commitments in FSAR Section 3.7B.3.8.1, paragraph 2, and that for the problems which Cygna reviewed, the Gibbs & Hill engineers did exercise proper judgement in reviewing the stress analysis results for these effects, Cygna concluded that further investigation into the potential safety impact of this observation was not warranted. Therefore, each of the three observations was closed, as noted in the resolution in Appendix F.

Review of the two piping problems resulted in six observations concerning implementation of analytical procedures. Of these, one was deemed invalid upon later review. The five remaining observations dealt with:

- Incorrect wall thickness (PI-01-01)
- Omission of response spectra (PI-02-01)
- Different support location from as-built (PI-02-02)

* Improper use of thermal expansion loads (PI-02-03)
* Incorrect allowable nozzle loads (PI-02-05)

Further review showed that all observations could be closed as indicated in their respective resolutions in Appendix F, and that either individually or cumulatively there was insignificant impact on design and safety.

In reviewing the pipe stress analyses, Cygna noted supports formed by welding two trunnions to the pipe and attaching a strut or snubber to the end of each trunnion. Also noted were trapeze supports in which the pipe was attached to the trapeze beams by means of either a pretensioned U-bolt or by welding. Gibbs & Hill has modeled these configurations without considering the possible rotational restraint in such an arrangement. Cygna believes this is an acceptable approach to modeling for pipe stress results. Cygna has noted, however, that the support designers then take the Gibbs & Hill load and divide it evenly between the two struts or snubbers. This does not account for the possible load imbalances due to gaps or piping rotation. It is Cygna's experience that certain organizations within the industry do consider some load imbalance when designing such restraints. The question of an appropriate load split between the components remains as an open item.

As a general overview, Cygna found the Gibbs & Hill methods appropriate and, for the most part, well implemented. The Gibbs & Hill "QA Books", or calculation files, for each problem are easy to follow and contain copies of all needed reference work. In particular, Cygna finds the "Corrective and Future Action" memo at the start of each "QA Book" an excellent method for ensuring that all open items are checked as data becomes available. The depth of the Gibbs & Hill documentation and referencing made the review process proceed smoothly.

For the flued head analysis, Cygna had only one observation, on modeling, which did not affect the design (PI-03-01). Cygna reviewed 15 of the remaining 18 flued head analyses to determine the extent of the error and found it isolated to this one problem. The quality of the Gulf and Western documentation made the review task easier. Cygna would like to compliment Gulf and Western on their inclusion of "hand" checks in the final reports to insure that the finite element model was producing the proper results.

4.3.2 Pipe Support Review

The pipe support review included all supports on the main flow path between the containment sump and heat exchanger, plus the anchors on all branch lines in problems AB-1-69 and AB-1-70. Gibbs & Hill had prepared the pipe support design specification and TUSI, ITT Grinnell, and NPSI had performed the majority of the final large bore pipe support reviews. Only one observation resulted from Cygna's review of the design methodology (PS-09-01). This one observation related to seismic displacements outside the working range of springs. After further review, Cygna determined this observation had no significant impact on plant safety and resolved it as shown in Appendix F.

In reviewing the 31 specific pipe support calculations, Cygna had three observations:

- Improper anchor bolt embedment length shown on the drawing (PS-02-01).
- Incorrect data given to the support group (PS-10-01).
- Incorrect allowable loads (PS-12-01).

After further review, Cygna determined that the last two (PS-10-01 and PS-12-01) were isolated errors. In reviewing PS-02-01, Cygna determined that the overall bolt length shown on the drawing was the determining factor in installation and that the embedment length shown in the calculation was the minimum possible for that overall bolt length. Thus, the difference in embedment lengths has no design impact. Each of the above is further described in Appendix F.

In general, the supports Cygna reviewed were simple in nature, consisting of a clamp or U-bolt, a connecting link (strut, snubber, or spring), and baseplate. Cygna did see cases in which U-bolts were used in place of pipe clamps, but Cygna believed that only minimal pretension or "cinching" was needed to allow the U-bolt to function as a clamp. As such, the pretension would not adversely affect the piping. Torquing requirements, including cinching, were defined in installation specifications which were not part of the IAP review scope. Cinching was not required or defined in any of the design documents reviewed by Cygna. Accordingly, cinching loads were not known and were not considered in the design assessment. TUGCO has recently performed a series of tests and analyses to measure the effect of pretensioning on the pipe and U-bolt. Cygna is reviewing this data and considers this issue as open until that evaluation is completed. Other than not defining the level of preload in the calculations, TUGCO provided calculations which were straightforward in format and sufficient in detail to ensure design adequacy of the pipe supports.

4.3.3 Equipment Qualification Review

To determine acceptability of equiment qualification procedures, Cygna reviewed the RHR Train B pump (TBS-RHAPRH-02) by Westinghouse. The review included the pump, motor and auxiliary equipment. Cygna found no items requiring further review and found all the Westinghouse

documentation in good order. In particular, Cygna reviewed those items noted by the earlier SQRT audit as needing corrections and found that Westinghouse had addressed each appropriately.

4.3.4 Electrical Review

In the electrical area, Cygna reviewed the Gibbs & Hill design of both the Train B RHR pump power distribution circuit and the containment sump isolation valve control circuitry. The review covered both the adequacy of the design documents (compliance with licensing requirements) and the design calculations themselves. In the review Cygna found no items requiring further assessment and, therefore, had no observations in this area.

4.3.5 Cable Tray Support Evaluation

Gibbs & Hill produced the structural calculations and designs for the cable tray supports. Rather than have one specific calculation for each tray support, Gibbs & Hill used standard support details, e.g., a standard three-level support or two-level support. These standards were further separated into one, two or three-way restraint designs. Gibbs & Hill then collected similiar "standard" designs and evaluated them in a single generic calculation. In cases where only one aspect (e.g., base plate) of a design was typical of, for example, ten designs, each of the ten designs would first have a separate calculation for their unique features. Each calculation would then reference the first for the design of the common aspect. These standard designs were shown on their respective drawings and sent to the field. The field assigned the actual supports numbers for each tray support. This review did not include a comparison of the design versus installation configurations.

Cygna reviewed the original design calculations for those supports associated with the RHR Pump power supply cable tray. These 40 supports were based on 8 standard calculations, (15 standard details), and represent 43% of the cable tray supports for the plant. Since Gibbs & Hill had not prepared any procedures for performing or tracking these calculations, but used standard structural design methods and allowables (AISC), Cygna did not perform any reviews in the procedural area.

Gibbs & Hill used both hand calculations and finite element techniques in the analysis of the frames. In the review of the standard calculations, Cygna found seven areas which required further review for design impact. Of these seven observations, three involved the computer analyses and assumptions, two involved assumptions made for hand calculations, and two applied to loads and load comination methods. To resolve the seven observations, both Cygna and Gibbs & Hill performed detailed calculations to determine:

- the validity of the original assumptions
- the effect of conservatisms in the original analysis
- the design impact of changes in support geometry and modeling

As shown in the resolution of these observations in Appendix F, Cygna determined that one observation was invalid and the remaining six observations produced no significant impact on the design or on the safety of the plant. Basically, the conservatisms present in the original design such as tray weight, "g" values, and damping values, outweigh the effects of later design changes. The process of using conservative input loads for initial designs is normal practice.

In reviewing each checklist and observation, Cygna noted that each standard calculation had one or more design deficiencies. Thus, in observation CTS-00-08, Cygna questioned not only each deficiency by itself, but the cumulative effect. As noted in that observation, Gibbs & Hill had redone each entire calculation, combining the Cygna comments with the latest information. These calculations showed that sufficient margin to allowable stress levels existed for the supports within the review scope. There was no clear assurance, however, that sufficient margins existed for all the other cable tray support designs within the plant. Because of this, Cygna has prepared PFR-1, which is presented in Appendix G and discussed further in Section 4.4.

In determining the loads on the tray supports due to seismic excitation, Gibbs & Hill used the mass of the tributary span of the tray multiplied by the peak seismic acceleration. During Cygna's review, the project team discussed the influence of dynamic effects due to the consideration of multi-mode response. The possible increase in tray/support loads due to these effects may be accounted for by use of a static coefficient in lieu of performing a dynamic analysis. At the time of the review, Cygna believed these effects were offset by the use of peak accelerations and the conservatism in not accounting for the damping of the cables. This issue remains open pending further review.

In conclusion, Cygna has found that the cable tray supports within the Cygna scope are adequate. The design and revision process are, however, difficult to follow; Cygna suggests that a set of standard instructions be prepared for design, revision and review of cable tray supports. Such a set should include a set of justified assumptions and would ensure uniformity across the design process.

4.3.6 As-Built Verification

The as-built verification of the Spent Fuel Pool Cooling System was separated into the following, easily definable, categories:

- Electrical, Instrumentation and Controls
- Mechanical - piping supports
- Structural

There were seven walkdown observations consisting of three pertaining to Electrical, and four pertaining to Mechanical. No observations were noted in the Structural walkdown. The validity of these observations and their consequences with respect to impact on plant safety are discussed in the following subsections.

Electrical Walkdown

The basis of the walkdowns was to verify that the field installation is in compliance with the latest revision of the relevant construction documents and drawings. Included in this was a review of separation requirements, grounding components, cable installation and cable terminations.

Separation Requirements:

The field verification of electrical separation requirements was performed by reviewing the separation in the following control panels as well as the electrical raceway installation:

- Spent Fuel Pool Cooling Panel
- BOP Auxiliary Relay Rack 1
- BOP Auxiliary Relay Rack 4

The above panels and raceway were found to be maintained in accordance with separation criteria of the electrical erection specification and requirements described on the cable tray and conduit plan drawings.

Grounding:

The review of the electrical grounding system consisted of verifying that the raceway system and spent fuel pool cooling pump had been grounded in accordance with the requirements of the electrical erection specification and grounding drawings 2323-E1-1703 and 1703-01.

The following observation was made:

- WD-07-01 The Spent Fuel Pool Cooling Pump is single grounded rather than double grounded as required by drawing 2323-E1-1703-01.

This observation has been determined to be invalid since using only a single ground will have no impact on the performance of the pump or plant safety. This observation was therefore closed.

Components:

The components review effort was performed for equipment and instrumentation associated with Spent Fuel Pool Cooling System Train A. The verification consisted of two stages: first, a review of component locations and fluid system interfaces with respect to plant drawings and secondly, a check of the component's type and model.

The following observation was made:

- WD-07-02 Temperature indicator X-TI-4837 had not been installed.

The temperature indicator was scheduled to be installed at a later date in order to avoid damage from ongoing construction in the area. Per the instrument installation checklist for this item, dated 7/22/81, this item has been turned over to B&R and TUGCO. This is in conformance with Brown & Root Procedure No. 35-1195-ICP-4, Rev. 6. It has been determined by discussion with TUSI that this temperature indicator is not a safety related item. This observation was therefore closed.

Cable Installation:

The cable installation review consisted of four items, the most important of which was the routing. The three other review items were cable supporting, spacing and bend radius requirement.

The cable routing review verification was limited in the case of control and instrument cables to assure that the cables enter the proper conduit and that the conduits tie to the correct tray section. Only a limited review was possible due to the fact that identification of cables after they enter the tray system becomes extremely difficult. One reason for this difficulty is that the cables are tagged only at the end point. This, coupled with the large number of cables in the trays, made verification of the total routing impossible without disconnecting and sending a signal through the conductors.

In the case of the 480 Volt Spent Fuel Pool Cooling Pump motor leads, the routing of the (3) 1/C 750 MCM cables was verified up to the location at which they left the Fuel Building.

The review area for the cable riser supports was limited to two locations. These were the conduit riser at the Spent Fuel Pool Cooling pump for the motor supply cable and the tray riser at tray sections T120FBU12 and T120FBU11. This is a 14' vertical drop.

The spacing of power cable in trays was also verified. This was performed for the (3) 1/C 750 MCM power cables associated with the spent fuel pool cooling pump. This circuit was chosen since it was the only one in the sample which required cable spacing. The spacing of the cables was verified throughout the tray runs in the Fuel Building.

The installed bending radius of cables was reviewed in the field. Initially some of the permanently trained cables appeared to have a bend radius less than the normal standard for that size cable. A review of plant files showed correspondence with cable vendors allowing the decrease in minimum bending radius.

The following observation was made:

- WD-07-03 The Cable and Raceway Schedule identified the conduit between Spent Fuel Pool Cooling Panel XLV-06 and T130FCZ33 as C-03015123. The installation and routing drawing identified this as conduit No. C-13015123.

For this particular case the difference in IDs concerned only the unit number. However, in order to provide assurance that there were no further discrepancies of this type which might have an impact on design or plant safety a further review was performed by Cygna. To ensure, with a reasonable degree of certainty, that the above discrepancy was an is[illegible] ca[illegible]om sample of eight safety related conduits in the [illegible]hosen from drawings FSE-234-E1-800 and FSE-234-E1-[illegible]mbers and their termination points were verified

against the identification given in the raceway schedule. Each conduit, and one of its termination points was then located in the field. All identification numbers were verified to be correct. As a result of this further investigation, Cygna is satisfied that the mislabelling of conduit C-13015123 is an isolated case and has no potential impact on design or plant safety. This observation was therefore closed.

Cable Termination.

The cable termination verification consisted of reviewing the cable field termination against the requirement of the connection drawing and cable schedule. The review included 23 cables associated with the spent fuel pool cooling system.

The review confirmed that cables were installed in accordance with the connection drawing. In the cases where field jumpers were required, these were also verified to be in agreement with the connection drawing.

It was further noted that cable E0018815 is listed as being deleted in the Unit 1 cable schedule issue 308. The cable is terminated at the Unit 2 BOP Auxiliary Relay Rack 4 in accordance with connection drawing E2-0158. The termination of the cable at Motor Control Center CPX-EPMCEB-03 was verified.

Mechanical Walkdown (Piping and Supports)

The purpose of the walkdown was to verify the as-built location of pertinent features of the piping system such as valves, branch connections, elbows and supports and to verify the as-built condition of the supports.

Except in the few places where any form of measurement (either accurate or approximate) was not possible, the location of all of the piping elements was verified to be in conformance with the relevant drawings.

There was a total of 91 supports on the selected piping system, 48 of which were fully accessible for inspection. The configuration and general form of all of the remaining 43 supports were found, by visual inspection, to be in agreement with the design drawings. In addition, the accessible dimensions and hardware data for seven of the 43 supports were checked.

The following observations resulted from the Mechanical Walkdown:

- WD-01-01 The upper locknut on the strut for support SF-X-001-015-F43R has not been adequately tightened down.

The problem had previously been reported to the NRC via SDR No. 113. Implementation of the corrective actions, as outlined in SDAR-CP-83-13 dated 6/9/83, will provide assurance that there is no impact on design or plant safety. This observation was therefore closed.

- WD-02-01 The clearance between the strut of pipe support SF-X-003-003-F43K and the pipe clamp of support SF-X-007-014-F43K varies from a minimum of 1/4" to a maximum of 7/16".

It has been confirmed by J. Finneran (TUSI) that the reported clearance is sufficient to avoid any interference due to the calculated pipe movements. This observation was therefore closed.

- WD-02-02 The following snubbers were installed 180° (inverted) from the configuration shown on the support drawings:

  1) SF-X-003-005-F43K
  2) SF-X-003-003-F43K
  3) SF-X-003-006-F43K
  4) SF-X-005-017-F43K

Brown & Root Procedure No. CP-CPM 9.17 dated 5/31/83 addresses this problem and permits such a reversal. This observation was therefore closed.

- WD-03-01 The gaps between the pipe and the support steel for support SF-X-033-007-F43R are 0" and 1" in the unrestrained direction. The support drawing indicates a required gap of 1/2" on both sides of the pipe in that direction.

The discrepancy with the design drawing was uncovered by TUSI during their walkdown activities. Per As-built Reverification Form No. 1267, dated 3/3/83, this matter has been transmitted to design review. This observation was closed based on the "acceptable-as-is" determination of the TUSI design review, indicating the effectiveness of the TUSI as-built program.

Structural Walkdown

The structural walkdown consisted of inspection of the following:

- The floor, walls and ceiling of the Unit 1 Pump Room for spalling, voids, general formwork, etc.

- The location, size, finish and grout of the foundations for:

  a) Pump CPX-SFAPSF-01

  b) Heat Exchanger CPX-SFAHSF-01

  c) Radiation Monitor X-RE-4863

- The location and size of the penetrations for:

  a) Pump suction from the pool

  b) Pump discharge to the pool

- A randomly selected sample of five cable tray supports in Pump Room 1 and the adjacent area.

A thorough inspection of the interior of the Pump Room was not possible since all surfaces have been painted. However, the exterior walls, which had not been painted, exhibited good workmanship. All other items proved to be satisfactory.

4.4 POTENTIAL FINDING REPORTS

During the course of the Independent Assessment Program, Cygna identified a total of 32 valid observations, including one which was considered to be a potential finding. As described in Section 3.0, Methodology, an "Observation" is any nonconformance to the review criteria having potential design impact and a "Potential Finding" is an observation considered to have a significant potential impact on plant safety. After further review, the potential finding, or PFR, was determined to have no definite impact on plant safety and was closed. Consequently, this PFR was not reportable under the guidelines of 10CFR21. In the following paragraph, the resolution of the PFR is discussed. Appendix G contains more detailed documentation for this potential finding.

PFR 01 In reviewing the cable tray support design within the Cygna scope, Cygna noted various technical deficiencies in each design. While each deficiency by itself did not affect the acceptability of these support designs, there was no assurance that the cumulative effect would not have a potential impact on plant safety.

This PFR was closed based on four considerations:

- Gibbs & Hill initiated analyses on the supports within the Cygna scope and incorporated the Cygna comments. An examination of the results showed that the design margins for support components are more than 10%.

- The designs within the Cygna scope of review covered 43% of the supports in the plant.

- In accordance with Gibbs & Hill's design change verification procedures, field changes to supports are reviewed and approved by Gibbs & Hill. Any subsequent changes to that support reference all changes made to it, thus ensuring that the approval considers all changes.

- There is no potential safety impact.

4.5 CONCLUSION

The purpose of this Independent Assessment Program was to provide added assurance that the design process in place for Commanche Peak Steam Electric Station produced an adequate design. Cygna Energy Services has conducted an independent assessment of the design control program and its implementation in the design of selected systems. While Cygna did find certain instances where the process or procedures were apparently not adequate, more detailed review

showed that each had a negligible impact on the plant design. There are, however, three issues which still remain open at this time as a result of the ASLB hearings. These issues are the following:

- Consideration of the redistribution of support loads in "double-trunnion" and trapeze pipe supports. (See Section 4.3.1.)

- Evaluation of the effects of pretensioning or "cinching" U-bolts on both the pipe and the U-bolt. (See Section 4.3.2.)

- The use of a static coefficient of in performing equivalent static analyses for cable tray support design. (See Section 4.3.5.)

Cygna bases its conclusions contingent upon the satisfactory resolution of these issues.

The scope of our design control and technical reviews supplements the scope of previous reviews of CPSES (see Exhibit 1.1). This Independent Assessment Program provided sufficient evidence for Cygna to conclude that, within the scope of this review, the overall design activities on CPSES are adequate and have been properly implemented. Viewed in this context, this Independent Assessment Program also provides the NRC and TUSI with added assurance as to the adequacy of the CPSES design process and its implementation.

APPENDIX A

STATEMENT OF INDEPENDENCE

This statement attests to the fact that Cygna Energy Services and the members of the Independent Assessment Program project team have no vested interest in the outcome of our effort to provide added assurance as to the adequacy of the Comanche Peak Steam Electric Station (CPSES) design process.

Cygna Energy Services has performed no engineering design work or construction services on the Texas Utilities' CPSES project, nor for any other Texas Utilities project. However, from October 4 to October 6, 1982 Cygna conducted a seminar on general probabilistic risk assessment for management and licensing personnel.

No member of the Cygna Project Team nor the Cygna Energy Services corporate management nor the in-house Cygna consultants has ever worked for Texas Utilities nor been associated with any design activities on the CPSES project while employed by any other organization.

No member of the Project Team or any corporate officer or any in-house consultant or any relative thereof owns stock in Texas Utilities.

I believe this satisfies the current NRC requirements regarding the independence of the engineering firm.

10/11/84

Michael N. Shulman — Date
General Manager, Western Region

NOMENCLATURE

ADR -	Audit Deficiency Report (B&R)
ANI -	Authorized Nuclear Inspector (or Inspection)
ARMS -	Automated Records Management System
ASLB -	Atomic Safety Licensing Board
ASME -	American Society of Mechanical Engineers
B&PV	Boiler and Pressure Vessel
B&R -	Brown & Root
BRH -	B&R Hanger Drawing
BRHL -	Hanger Location ISO
BRP -	B&R Piping ISO
CAR -	Corrective Action Report (B&R)
CASE -	Citizens Association for Safe Energy
CMC -	Component Modification Card
CP -	Comanche Peak
CPP -	Comanche Peak Project (Letter or Group)
CPPA -	Comanche Peak Project ARMS
CPPE -	Comanche Peak Project Engineering
CPSES -	Comanche Peak Steam Electric Station
CVC -	Change Verification Checklist
DC -	Design Criteria
DCA -	Design Change Authorization
DCC -	Document Control Center
DC/DDA -	Design Change/Design Deviation Authorization
DCTG -	Design Change Tracking Group
DE/CD or D/E C/D or D/E CDR -	Design/Engineering Change/Deviation Request
DRCL -	Distribution Routing Control List
EESV -	Engineering Evaluation of Separation Variance
FI/CR -	Field Interpretation/Clarification Request
FMHS -	Field Modified Hanger Sketch
FSEG -	Field Structural Engineering Group
FVR -	Field Verification Report
G&H -	Gibbs & Hill
G&H/NY	Gibbs & Hill/New York
HFT -	Hot Functional Testing
Hx -	Heat Exchanger

NOMENCLATURE (Continued)

IAP -	Independent Assessment Program
I&C -	Instrumentation & Control
IEEE -	Institute of Electrical and Electronics Engineers
IEG -	Instrument Engineering Group
ISO	Isometric
MRR -	Material Receiving Report
NCR -	Noncomformance Report
OD -	Outside Diameter
OSD -	Over Short Damaged Report
PC -	Project Coordinator
PDR -	Piping Deviation Record Form (B&R)
PO -	Purchase Order
PPSE -	Comanche Peak Pipe Support Engineer
PSG -	Procurement & Surveillance Group (B&R)
PSDG -	Pipe Support Design Group
PSE -	Pipe Support Engineering
QA -	Quality Assurance
QC -	Quality Control
QE -	Quality Engineering
RHR -	Residual Heat Removal
RIR -	Receiving Inspection Report
RWN -	Room Work Notification
SAM -	Seismic Anchor Movement
SDAR -	Significant Deficiency Action Request
SHF -	Secondary Hot Functional
SI -	Safety Injection
SIF -	Stress Intensification Factor
SSAG -	Site Stress Analysis Group
SWA -	Start-up Work Authorization
SWO -	Stop Work Order (B&R)
TNE -	TUSI Nuclear Engineering
TUGCO -	Texas Utilities Generating Company
TUSI -	Texas Utilities Services, Inc.
TSAB -	Technical Services As-Built Group
TSFC -	Technical Services File Clerk

NOMENCLATURE (Continued)

TSG -	Technical Services Group
TSMD -	Technical Services Mechanical Drafting
WRC -	Welding Research Council