

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

DOCKETED  
USNRC

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD <sup>'84 OCT 10 A11:20</sup>

In the Matter of

TEXAS UTILITIES GENERATING  
COMPANY, et al.

(Comanche Peak Steam Electric Station  
Station, Units 1 and 2)

OFFICE OF SECRETARY  
DOCKETING & SERVICE  
Docket Nos. 50-445-1  
and 50-446-1

CASE'S FIRST MOTION FOR SUMMARY DISPOSITION  
REGARDING CERTAIN ASPECTS OF THE IMPLEMENTATION  
OF APPLICANTS' DESIGN AND QA/QC FOR DESIGN

in the form of

AFFIDAVIT OF CASE WITNESS JACK DOYLE

Q1. What is the purpose of this Affidavit?

A1. Having stood back and taken a long look at the overall picture of what is going on regarding the Applicants' Motions for Summary Disposition, I perceived the need to file additional information for the Board pointing out and summarizing the following which outlines the failure by Applicants to comply with the provisions of:

10 CFR Part 50, Appendix A, specifically Criteria 1 and 4;

10 CFR Part 50, Appendix B, specifically Introduction, last paragraph, which states, in part:

" . . . Quality assurance includes quality control, which comprises those quality assurance actions related to the physical characteristic of a material, structure, component, or system which provide a means to control the quality of the material, structure, component, or system to predetermined requirements." (Emphasis added.)

. . . not manicuring of a fait accompli;

1 Criterion I;

2 Criterion II, specifically last 17 lines, which state:

3 "The program shall take into account the need for special  
4 controls, processes, test equipment, tools, and skills to  
5 attain the required quality, and the need for verification of  
6 quality by inspection and test. The program shall provide  
7 for indoctrination and training of personnel performing  
8 activities affecting quality as necessary to assure that  
9 suitable proficiency is achieved and maintained. The  
10 applicant shall regularly review the status and adequacy of  
11 the quality assurance program. Management of other  
12 organizations participating in the quality assurance program  
13 shall regularly review the status and adequacy of that part  
14 of the quality assurance program which they are executing."

15 Criterion III;

16 Criterion IV;

17 Criterion V;

18 Criterion VI;

19 Criterion VII;

20 Criterion VIII;

21 Criterion IX;

22 Criterion X;

23 Criterion XI, especially lines 8 through 14, which state:

24 "The test program shall include, as appropriate, proof tests  
25 prior to installation, preoperational tests, and operational  
tests during nuclear power plant . . . operation, of  
structures, systems, and components." (Emphasis added.)

26 Criterion XV;

27 Criterion XVI;

28 Criterion XVII; and

29 Criterion XVIII.

30 Applicants will also be shown to be in non-compliance with:

1 ANSI N45.2.11;

2 ASME Section III;

3 AISC (American Institute of Steel Construction), to which  
4 Applicants are committed in their own Specification  
5 2323-MS-46A, "Nuclear Safety Class Pipe Hangers and  
6 Suports," at pages 3-15 through 3-20, specifically  
7 paragraph 3.3.h.;

8 MSS (Manufacturers' Standardization Society), specifically  
9 MSS SP-58, "Pipe Hangers and Support-Materials and  
10 Design," and MSS SP-69, "Pipe Hangers and Supports-  
11 Selection and Application," to which Applicants are  
12 committed in their own Specification 2323-MS-46A at page  
13 3-20, paragraph g.(1) and (2), respectively;

14 10 CFR 50.34(a) and (b) . . . among others.

15 In short, Applicants' QA/QC program for engineering at Comanche  
16 Peak not only has suffered, but currently is suffering, from a complete  
17 collapse, thus allowing for fundamental engineering errors to be  
18 incorporated into Comanche Peak on such a massive scale that the health  
19 and safety of the public are at risk.

20 Q2. Are the points which you are about to make representative of a large  
21 percentage of the engineering and construction at Comanche Peak?

22 A2. No! The majority of the points and allegations are based only on  
23 several hundred of the more than 40,000 pipe supports which are  
24 installed at Comanche Peak. One must keep in mind that the typical  
25 twin nuclear facility contains about 20 million elemental parts. For

1 example, the Davis Besse nuclear power plant, one unit of only 900 MW  
2 capacity, contained, in part, approximately:

3 12,000 tons of structural steel;

4 50,000 cu. yards of concrete;

5 2 million feet of copper wire;

6 100,000 ft. of instrumentation pipe and tubing;

7 85,000 ft. of pipe over 2-1/2 in. diameter;

8 91,000 ft. of small bore pipe (under 2-1/2 in. diameter;

9 the welding required for the piping was 20,000 girth welds (appx.);

10 there were over 12,000 pipe supports with hundreds of thousands of

11 joint welds;

12 the numbers involved in the electrical, HVAC, and cable trays

13 rival the numbers cited for the piping systems;

14 this plant required over 10 million man-hours of manual labor and

15 over a million hours of non-manual labor.

16 As may be noted, it does not take much to reach 20 million  
17 elements.

18 Now when one is discussing a sample of components which may be  
19 comprised of a few tens of thousands of elements (welds, nuts, bolts,  
20 plates, structural members, hardware, etc.) compared to 20 million  
21 elements, it cannot be called a large sample. But when this small  
22 sample indicates a complete failure to control fundamentals, then it is  
23 indeed fair to state that the safety of the complete facility is at  
24 best indeterminate if not dangerous.

25 Q3. You say your sample was relatively small. Could you explain this?



1 A3. Certainly. In my original deposition, I offered documentation on 52  
2 node points which contained 58 separate supports (X, Y, or Z  
3 independent supports). In addition to these supports, I have since had  
4 the opportunity to examine 10 calculations and drawings from the Cygna  
5 Phases 1 and 2 review. Further in relation to Cygna, I have reviewed  
6 their findings on 22 main steam supports as outlined in Volume 3 of the  
7 Phase 3 segment of the review ("Final Report, Independent Assessment  
8 Program of Comanche Peak Steam Electric Station (Phase 3)," Prepared by  
9 Cygna Energy Services, July 16, 1984). This represents a total of some  
10 90 supports or so which I have examined to some extent (not including  
11 the cursory review of the Phases 1, 2, and 3 Cygna Reports). In  
12 addition to this, I have reviewed several of the Applicants' answers  
13 (Motions for Summary Disposition, etc.) to generic allegations; for  
14 example: (a) analysis on one-way constraints (U-bolts) which act as  
15 two-way constraints; and (b) generic stiffness study; to name two.

16 Q4. Taking these four items one at a time, what did you conclude from your  
17 analysis of the 58 individual supports offered into evidence as CASE  
18 Exhibit 669B (admitted at Tr. 3630)?

19 A4. To start with, the Nuclear Regulatory Commission (NRC) investigation of  
20 the original allegations was remiss in its objectivity, to say the  
21 least (see also discussion in CASE's 8/22/83 Proposed Findings of Fact  
22 and Conclusions of Law (Walsh/Doyle Allegations), pages XXVII - 35  
23 through -39). The SIT Report, which (coupled with the Affidavit of the  
24 Staff's Witness Dr. Chen on open Walsh/Doyle items dated 10/14/83) was  
25 your basic whitewash, arrived at two general conclusions:

1 (a) All of the allegations were without merit with the exception  
2 of a part of one allegation as related to bending of Richmond  
3 insert bolts (A-307 threaded rod); and

4 (b) The Applicants were aware of any points of an allegation  
5 which they could not talk away before Mark Walsh or I  
6 outlined the problem (stability, for example).

7 On point (a), Dr. Chen would not accept his own finite analysis  
8 which showed an 18 per cent distribution of shear loads to the outer  
9 web of the tube steel which induced high stresses in the bolt (see  
10 Staff Witness Dr. Chen at Tr. 6533-6536). Beyond this, Dr. Chen stated  
11 that Applicants also found high bending stresses during their  
12 investigation (see Tr. 6533-6536). Dr. Chen and Staff Witness Mr.  
13 Tapia preferred to accept the test data which was the result of testing  
14 with a flat plate and not a tube (see Mr. Tapia at Tr. 6515). This  
15 procedure precluded the bending moments which would have resulted if  
16 the test represented the actual field condition (the Applicants use of  
17 a flat plate instead of the tube was not in compliance with 10 CFR Part  
18 50, Appendix B, Criterion XI which (a) requires that tests be performed  
19 prior to installation and (b) that testing be representative and follow  
20 a written procedure which incorporates requirements and limitations).  
21 After the completion of the tests, no one could evaluate with any  
22 finality the results as related to normal, upset or emergency  
23 conditions (see NRC Staff Witness Dr. Chen at Tr. 6542-6552).

24 In effect, the NRC Staff and the Applicants have not conceded that  
25 there is any problem with the supports at Comanche Peak and have taken

1 the position that all of the allegations are without merit.

2 The facts are that history and Applicants' activities have proved  
3 beyond doubt that of the original 58 supports mentioned in CASE Exhibit  
4 669B, a large percentage have been subjected to major rework to bring  
5 them up to par as required by the law, the codes, basic fundamentals,  
6 and common sense.

7 In enumerating the supports mentioned above, I am only addressing  
8 those supports which I can document as having been changed, not the  
9 others which I know have been revised but cannot cite why I know.

10 First, by Applicants' own testimony, all unstable supports which  
11 utilized a U-bolt in lieu of clamp were to be cinched up to prevent  
12 clamp rotation; this was also Board Chairman Bloch's understanding (see  
13 Tr. 6646; see also Staff' Dr. Chen at Tr. 6718, where he states that  
14 individually these supports were unstable). Of the items contained in  
15 CASE Exhibit 669B, the following fall into this category:

- 16 (1) MS-1-003-006-S72R (in design, this is similar for MS-1-001-  
17 006-S72R; MS-1-002-006-S72R; and MS-1-004-006-S72R);  
18 (2) MS-1-001-005-S72R (see Cygna Report, Volume III, PS-071);  
19 (3) SI-1-031-704-A32R (2 supports);  
20 (4) CC-1-028-701-A33R.

21 The use of U-bolts in this manner is a unique design feature, and  
22 is not in compliance with 10 CFR 50.34 (a)(8). In many cases, as may  
23 be noted in MSS SP-58 and SP-69, the procedures used at Comanche Peak  
24 are not an industry practice.

25 The Applicants also confirmed that the box beams would be

1 corrected to prevent instability (see Chairman Bloch, Tr. 6646, and Dr.  
2 Chen, Tr. 6718). The following box beams required modification:

- 3 (1) CC-1-028-034-S33R (see below for change required for W6x12  
4 beam base attachment);
- 5 (2) CC-1-028-039-S33R (see below for change required for W6x12  
6 beam base attachment);
- 7 (3) CC-1-020-001-A33K;
- 8 (4) CC-1-159-010-S43R;
- 9 (5) CT-1-008-007-S22K;
- 10 (6) CT-1-008-008-S22K.

11 The above eleven supports were part of the generic (to Comanche  
12 Peak) stability problem alleged in my August 1982 deposition  
13 (Deposition/Testimony of CASE Witness Jack Doyle, CASE Exhibit 669 and  
14 669A, admitted at Tr. 3630).

15 As relates to the instability problem, Applicants stated that they  
16 had been aware of this since March 1981 (see Applicants' Witness Mr.  
17 Finneran, Tr. 4889/16-20, Tr. 4890/1-4, and Tr. 4895; see also NRC SIT  
18 Report, Staff Exhibit 207, Page 4(h)). In reference to the awareness  
19 by Applicants of a problem with stability, they offer three memos as  
20 proof of this fact (see Affidavit of John C. Finneran, Jr. Regarding  
21 Stability of Pipe Supports and Piping Systems at pages 10 and 11, and  
22 Attachments thereto, attached to Applicants' Motion for Summary  
23 Disposition Regarding Stability of Pipe Supports):

24 The first by Gus Abele (ITT onsite lead engineer), dated 5/22/81  
25 (Attachment A-1 to Finneran Affidavit, page 2) states:



1 "Supports that utilize single or double trapeze assemblies (i.e.  
2 struts or snubbers) and a pipe attachment consisting of a steel  
3 box frame to restraint vertical and side loads. Technical  
4 Services require concrete guidelines and evaluation techniques to  
5 determine the stability of using box frames as pipe attachments  
6 due to the physical tendency of the box frame to rotate the pipe.  
7 Especially for vertical restraints. The governing variables are  
8 numerous: pipe size, movement, existing clearance between pipe  
9 and frame, single vs. double trapeze, struts installed on skew,  
10 location of adjacent supports, vertical vs. horizontal restraints,  
11 and a special but common case of single or double struts and  
12 snubbers from beneath pipe. Samples are enclosed. (Mark No.'s  
13 CC-1-159-010-S43R1, CC-1-028-039-533R). Technical Services will  
14 hold all supports using box structures as pipe attachments until  
15 written procedure or approval from Providence is received."

16 The samples referenced in the third from last sentence in the  
17 memo were not attached to Applicants' Attachment A-1.

18 The second memo, by Gus Abele (Attachment A-2 to Finneran  
19 Affidavit), dated 10/12/81, #RI-9, picks up most of the same wording as  
20 was used in Attachment A-1, and states: "(see attachments)" (emphasis  
21 added). However, only one page was attached to Attachment A-2.

22 The third memo, dated 4/2/82 (Attachment A-3 to Finneran  
23 Affidavit) was an answer to the previous request for information, and  
24 was authored by Ron Wisniewski (ITT Grinnell home office) to Gus Abele.  
25 This document not only does not concur with the conclusions of Gus  
Abele but suggests the problem be discussed with Mr. Ed Eramian. This  
document was, as far as I am aware, the last discussion on the subject  
of instability at Comanche Peak until I revived the problem in about  
March of 1982. (It should be noted that CASE requested "any answer  
that was made, any backup notes, any handwritten notes having anything  
to do with this particular matter in answer to attachment A3, and any  
subsequent information that went back and forth regarding this matter."

1 See transcript of 8/6/84 Applicants/Staff/CASE telephone conference  
2 call, at Tr. 56 (see also discussion at Tr. 49, line 24, through Tr.  
3 83, line 23; especially Tr. 51 through 65.) Applicants refused to  
4 provide this information (Tr. 56-60, and Tr. 86, line 14, through 87,  
5 line 12). But it is my understanding from CASE President Juanita Ellis  
6 that on 8/22/84, the Board Chairman ordered that Applicants provide the  
7 information requested. However, when she inquired on 9/28/84,  
8 Applicants' counsel William Horin advised that there are no additional  
9 documents; Mrs. Ellis asked that he confirm this in writing.

10 For that matter, as recently as the September 1982 hearings,  
11 Applicants' witness Mr. Finneran was stating that the subject of  
12 instability was still being studied at Comanche Peak and was an  
13 indeterminate subject (Tr. 5268/10-13).

14 In relation to the use of U-bolts (much less cinched-up U-bolts),  
15 and still on the subject of instability, the Applicants' procedures are  
16 in violation of standard industry practice for a garbage processing  
17 plant, much less for a nuclear plant, and therefore are in violation of  
18 10 CFR Part 50, Appendix A, Criterion 1, as regards the adequacy  
19 section for nonconformance with standard practice.

20 The chain of codes and laws is as follows:

- 21 (1) In accordance with the provisions of ASME Section III,  
22 NA-3250 (PROVISION OF DESIGN SPECIFICATIONS), Applicants  
23 prepared a technical specification for nuclear safety-  
24 related equipment;
- 25 (2) The title of the document generated in compliance with

1 ASME Section III, NA-3250, is NUCLEAR SAFETY CLASS PIPE  
2 HANGERS AND SUPPORTS, SPECIFICATION 2323-MS-46A;

- 3 (3) ASME Section III, NA-3320(b) regarding Manufacturer's  
4 responsibilities, is directed to ASME NA-3340; and NA-  
5 3340, RESPONSIBILITY FOR COMPLIANCE WITH THIS SECTION,  
6 states:

7 "The Manufacturer who completes or substantially  
8 completes any component, appurtenance, core support  
9 structure, or component support required to be in  
10 compliance with this Section has the responsibility  
11 for the structural integrity using the Design  
12 Specifications as a basis of design . . . "

- 13 (4) In the Design Specification (technical specification)  
14 2323-MS-46A, page 3-15, Section 3.3, CODES AND  
15 STANDARDS, the following is included:

16 "Design, fabrication, materials, certification,  
17 code stamping, and testing requirements included in  
18 this specification shall be in accordance with the  
19 edition and addenda of the following codes,  
20 legislation, regulations, and standards, in effect  
21 on July 28, 1975, unless otherwise specified below  
22 or authorized by the owner."

23 On page 3-20 of the same document, the following are  
24 listed as codes with which Applicants shall comply:

25 "g. Manufacturers' Standardization Society (MSS)

"(1) MSS SP-58, Pipe Hangers and Support-Materials and  
Design

"(2) MSS SP-69, Pipe Hangers and Supports-Selection  
and Application"

- (5) At the Foreword of MSS SP-69, the following is quoted:

"The requirements of this standard were developed  
by a cooperative effort of representatives of pipe

1 hanger manufacturers. They are based on the best  
2 practice current at this time and on proven results  
3 of the research and experience of this industry."

- 4 (6) At SP-69, Section 6, Selection of Hangers and Supports  
5 for Pipe Movement:

6 6.2. The last sentence states: "For piping  
7 supported from below, bases, brackets, or  
8 structural cross members should be used."

9 6.3. The last sentence states: "Where there is  
10 horizontal movement . . . For piping supported from  
11 below, slides, rollers, or roller carriages should  
12 be used."

- 13 (7) Table 1, page 3, of SP-69 does not recommend the use of  
14 U-bolts (type 24 is the designation for U-bolt in this  
15 material) for insulated lines classified as Hot A-1. And  
16 Hot A-1 is defined under 2.1 (Hot Systems) as being 120  
17 degrees F. to 450 degrees F. For Hot A-2 line, type 24  
18 supports are not recommended whether the line is  
19 insulated or not.

- 20 (8) SP-69 states at 12.2, "Riser clamps (Type 42) shall have  
21 a positive means of engagement between the pipe and the  
22 clamp." (By inference, this would include type 24  
23 clamps, which are U-bolts.)

- 24 (9) The practices used in the design and construction at  
25 Comanche Peak proceed under a false premise; that is,  
one constructs the facility, then justifies the  
construction as opposed to justifying the procedure and  
then constructing.

- (10) Comanche Peak practices evade the provisions of 10 CFR  
50, Appendix A, Criterion 1;

- (11) Also, Comanche Peak practices evade the provisions of 10  
CFR 50.55a(a)(1), which states:

"Structures, systems, and components shall be  
designed, fabricated, erected, constructed, tested,  
and inspected to quality standards commensurate  
with the importance of the safety function to be  
performed." (Emphasis added.)



1 (12) Comanche Peak practices evade the provisions of 10 CFR  
2 50.34(a), which states that the minimum information to  
3 be included in the Applicants' Preliminary Safety  
4 Analysis Report (PSAR) was to have included:

5 "(2) A summary description and discussion of the  
6 facility, with special attention to design and  
7 operating characteristics, unusual or novel  
8 design features, . . . principal safety  
9 considerations." (Emphases added.)

10 "(8) An identification of those structures,  
11 systems, or components . . . which require research  
12 and development to confirm the adequacy of their  
13 design; and identification and description of the  
14 research and development program which will be  
15 conducted to resolve any safety questions  
16 associated with such structures, systems or  
17 components; and a schedule of the research and  
18 development program showing that such safety  
19 questions will be resolved at or before the latest  
20 date stated in the application for completion of  
21 construction of the facility." (Emphases added.)

22 "(9) The technical qualifications of the applicant  
23 to engage in the proposed activities in accordance  
24 with the regulations in this chapter." (Emphasis  
25 added.)

10 CFR 50.34 (b) discusses the Final Safety Analysis  
Report (FSAR) (Applicants' Exhibit 3), which is supposed  
to include "information that describes the facility,  
presents the design bases and the limits on its  
operation, and presents a safety analysis of the  
structures, systems, and components and of the facility  
as a whole . . . " and shall include information  
updating that which was presented at the time of the  
construction permit's issuance.

1           While on the subject of instability, it appears that during the  
2 May 1983 hearings, the testimony of the NRC Staff was either blind or  
3 somewhat less than candid. As an afterthought, the Applicants, by  
4 their silence in the matter outlined below, must also be suspect.

5           Dr. Chen, on the matter of instability, stated that he looked at  
6 the exhibits and identified about 30 supports which were identified as  
7 "suffering from this disease" (of instability), that he looked at some  
8 piping systems to see if any of those supports were all grouped  
9 together, and that he didn't see any cases of that in the piping stress  
10 analysis which he looked at (Tr. 6718-6719). Mr. Walsh asked Dr. Chen  
11 whether there might be three or four unstable supports which were  
12 adjacent to each other (Tr. 6722-6727). After some discussion, Dr.  
13 Chen stated "I believe I saw one piping run where the supports had  
14 about three intervening supports" and that was the closest he found  
15 them (Tr. 6727-6728). Dr. Chen elaborated on this and stated that the  
16 piping was not in the same direction in both locations, and therefore  
17 the instability would not have been additive (Tr. 6728).

18           At that point, we had no documentation to prove otherwise, except  
19 that I had seen the problem on four steam lines in Unit 1: MS-1-001;  
20 MS-1-002; MS-1-003; and MS-1-004; and it may also exist on MS-2-001,  
21 etc., for Unit 2. The statements made by Dr. Chen were therefore  
22 allowed to stand.

23           However, the fact is that the main steam lines have five unstable  
24 supports in a row, and in fact, the sixth support is unstable since it  
25 is double-pin-ended (clamp and strut) but all of the other supports

1 cannot assist in giving the strut on the sixth support stability. But  
2 neglecting the sixth support, there are still five unstable supports  
3 in a row at the critical main steam isolation valve and pressure relief  
4 valves. These five supports are as follows, as documented in the  
5 referenced portion of the Cygna Report, Phase 3, Volume 3:

6 MS-1-001-002-S72R -- instability not fixed (PS-068)

7 MS-1-001-003-S72R -- instability repaired (PS-069)

8 MS-1-001-004-S72R -- instability repaired (PS-070)

9 MS-1-001-005-S72R -- instability repaired (PS-071)

10 MS-1-001-006-S72R -- initial instability repaired (PS-072)

11 Beyond this, Applicants keep on insisting that there were less  
12 than two dozen unstable supports (and they are still reluctant to admit  
13 that there are any unstable supports -- see 8/6/84 Applicants/Staff/  
14 CASE telephone conference call at: Tr. 50, lines 3-4, 7, 13; Tr. 51,  
15 line 7; Tr. 52, lines 11-12; Tr. 53, lines 5-6; Tr. 60, line 21; Tr.  
16 61, lines 21-22; Tr. 62, lines 1, 22-25; Tr. 63, lines 12-13; Tr. 65,  
17 lines 23-24; and Tr. 78, line 2). However, Applicants' position falls  
18 apart since, with only the supports that I have seen and not including  
19 Unit 2, I have listed 11 from my deposition, 20 from the Cygna Report  
20 minus 2 duplicates for the main steam, plus 1 from the Phase 1 Cygna  
21 Report (CASE Exhibit 928, formerly Exhibit 891, bound in following Tr.  
22 9825) -- all of which equals an absolute minimum of 30 supports known  
23 to have been repaired to correct stability problems.

24 Another area of proof that the initial allegations contained in  
25 CASE Exhibit 669 (Deposition/Testimony of CASE Witness Jack Doyle,

1 admitted into evidence at Tr. 3630) were accurate, involves the repair  
2 to supports to bring them into compliance with the fundamentals of  
3 engineering and therefore the laws and the codes. Of these supports  
4 known to contain major rework and re-engineering, the following are  
5 examples:

- 6 (1) 2323-S1-0538-07 (see CASE Exhibit 669B, items 9Q-9S) -- major  
7 member added, changed to truss support (see CASE Witness  
8 Doyle at Tr. 6227);
- 9 (2) CC-1-028-034-S33R and CC-1-028-039-S33R -- 6" wide flange  
10 member; web failed; needed redesign (see 12/13/83 Affidavit  
11 of NRC Staff Witness Dr. Rajan, attached to NRC Staff's  
12 12/13/83 Motion to Reopen Record to Admit the Affidavit of  
13 Dr. Jai Raj N. Rajan);
- 14 (3) CC-2-007-025-A43R -- support changed to eliminate two-way  
15 load (see Applicants' 5/23/84 Motion for Summary Disposition  
16 on U-Bolts Acting As Two-Way Constraints, Table 3, Problem  
17 AB-1-62E, Second page 2);
- 18 (4) CC-1-107-008-E23R -- major change (see 10/14/83 Affidavit of  
19 W. Paul Chen on Open Items Relating to Walsh/Doyle Concerns,  
20 page 26);
- 21 (5) CC-1-116-038-F43R -- 1/4 inch wall of 8-inch tube failed;  
22 rebuilt (see Applicants' Witness Finneran at Tr. 4793/4-8,  
23 also CASE's 8/23/83 Proposed Findings of Fact and Conclusions  
24 of Law (Walsh/Doyle Allegations) at pages XIII - 3 through -  
25 6);



- 1 (6) CS-1-239-007-A42R -- changed by CMC 58004 (see SIT Report,  
2 NRC Staff Exhibit 207, page 42);
- 3 (7) CC-2-008-709-A43K -- the SIT uncovered a numerical error in  
4 Applicants' preliminary calculations which resulted in  
5 underestimation of bending stress and could result in an  
6 overstress condition; Applicants indicated their subsequent  
7 review identified an overstress condition which would be  
8 rectified (SIT Report, pages 41-42).

9 The above only includes those structural changes of which I have  
10 personal knowledge. The Applicants and SIT argue that the problems are  
11 the result of "somewhat knowledgeable" engineers, but this would be a  
12 violation of the skill provision of 10 CFR Part 50, Appendix B,  
13 Criterion II. Beyond this, the NRC Staff and the Applicants were well  
14 aware of the lack of skill of the Comanche Peak staff when in 1981 they  
15 had to commence a redesign of massive proportions, particularly at  
16 elevations 790 and 810, because the supports as designed would not fit  
17 in the areas assigned (see NRC Staff Witness Taylor at Tr. 6666).  
18 Further, the somewhat knowledgeable problem was no secret; everyone  
19 knows about it (see: for the NRC Staff: Taylor at Tr. 6403-6405 and  
20 6665; Tapia at Tr. 6669; and for the Applicants: Finneran at Tr. 4955-  
21 4965; Reedy at Tr. 7164; and Vega at Tr. 7166).

22 A second major excuse used by Applicants and NRC Staff was that  
23 every allegation that couldn't be buried was claimed to have been known  
24 earlier by the Applicants, but with no documentation to back up such a  
25 statement. Finally, the NRC stated otherwise in several stipulations

1 regarding who first noted the problems (CASE Exhibit 848, admitted at  
2 Tr. 8352). As just one example: At items 52 and 49, it was basically  
3 stipulated that Applicants did not recognize the problem or attempt to  
4 deal with it prior to my bringing it up, and that they had no mechanism  
5 in place to keep the problem from recurring again and again.

6 Of the original supports contained in my August 1982 allegations,  
7 eighteen have been revised (and more than likely many more have also).  
8 This represents 31% of the sample. One could add the two supports at  
9 CASE Exhibit 669B, items 2D and 2E, CT-1-137-701-S22R and CT-1-137-702-  
10 S22R, which were changed shortly before the hearings and were therefore  
11 never an issue. In reference to items 2D and 2E, I complained that  
12 there were inadequate induced forces into the run pipe and were in  
13 violation of Appendix XI (see CASE Exhibit 669, pages 83/19-22, 84/10-  
14 24, 85/18-24, 101/16-25, 314/13-314/22). If items 2D and 2E are  
15 included as part of the original problems which resulted in changes,  
16 the number of problem supports that I correctly identified is 20 out of  
17 58 or 35 per cent. (See CASE Exhibits 669, 669A, and 669B, Doyle  
18 Deposition/Testimony and Attachments, accepted into evidence at Tr.  
19 3630.)

20 Applicants have another loophole for problems which prove  
21 embarrassing and that is to claim that since the particular support has  
22 not been final vendor certified any allegation carries no weight. The  
23 only time a problem can be laid at the doorstep of Applicants is when  
24 the problem can be shown to exist after the nine iterative steps which  
25 lead to final vendor certification (see SIT Report, NRC Staff Exhibit

1 207, pages 14-16). Not only do Applicants stand by this postulate, but  
2 the concept is contagious. The NRC Staff keeps inserting this caviat  
3 for each problem which cannot be brushed aside by claiming that "it's  
4 not vendor certified" (see 12/13/83 Affidavit of NRC Staff Witness Dr.  
5 Rajan, attached to NRC Staff's 12/13/83 Motion to Reopen Record to  
6 Admit the Affidavit of Dr. Jai Raj N. Rajan, page 2; see also, SIT  
7 Report, page 41, lines 10 and 15, for example).

8 The above caviat "not vendor certified" cannot stand the test of  
9 logic, since using the caviat is itself an admission of non-compliance  
10 with 10 CFR Part 50, Appendix B, Criterion VII, as relates to the  
11 provision for adequacy of the document prior to release for use. And  
12 one must keep in mind that these supports were fabricated, erected,  
13 inspected, turned over to the utility, and many were in place long  
14 before hydro testing.

15 I believe that this original segment of the allegations standing  
16 alone (without the material which follows) is sufficient to prove two  
17 points: (1) The Applicants at best have suffered a massive breakdown  
18 in their QA/QC program, if such a program ever existed for the  
19 engineering discipline; (2) The NRC Staff has failed in their mission  
20 to protect the health and safety of the public and has in effect become  
21 dependent on the Applicants to justify the Staff's position as the  
22 industry regulator.

23 Beyond this, it is apparent that the Applicants have reversed the  
24 role of engineering from that of justifying structures to be used in  
25 construction to justifying structures which have been designed by

1 somewhat knowledgeable engineers. The NRC Staff has been only too  
2 eager to concur in the acceptance of this unique but dangerous  
3 deviation from standard engineering fundamentals and sequence.

4 Q5. Does this conclude your statement of status as relates to the original  
5 allegations?

6 A5. No! There are major areas of problems generic to Comanche Peak which  
7 still must be addressed. For example:

- 8 (1) Richmond bolts of A307 steel in bending;
- 9 (2) Oversize holes for non-friction joints;
- 10 (3) Coupling and prying (Mx and Mz moments) Richmond/tube steel  
11 structures;
- 12 (4) Actual vs. generic stiffness;
- 13 (5) Coupling of moments for double axial restraints;
- 14 (6) U-bolts which are actually two-way restraints but designed as  
15 one-way restraints;
- 16 (7) Cinching and thermal problems with U-bolts;
- 17 (8) Thermal problems with box frames with zero (0) clearance;
- 18 (9) Thermal locking at anchors;
- 19 (10) Problems with moment restraints and upper lateral restraint.

20 This is only to mention a part of a larger list of problems. Some  
21 of these will be discussed below.

22 One must keep in mind that when 35 per cent of the allegations are  
23 proven correct, it is not necessary to prove that every allegation is  
24 legally accurate in order to show that a nuclear power plant is plagued  
25 with problems which collectively indicate it is a dangerous structure.



1 Q6. What points do you wish to make in reference to the Phase 1 portion of  
2 the review by Cygna Energy Services?

3 A6. First I must restate my position on the credibility of Cygna as an  
4 independent reviewer. No person or organization can be effectively  
5 independent in a review process if they are allowed to evaluate their  
6 own findings in a process which is paid for by the reviewed  
7 organization -- that is, not if they ever intend to perform another  
8 review under the same circumstances for another similar organization.  
9 One is only employed by private corporations as long as one satisfies  
10 their requirements, stated or unstated.

11 In the case of Cygna Energy Services, for Phase 1 of their review,  
12 the diligence of their gathering of raw data was somewhat less than  
13 desired, as was pointed out in the February 1984 hearings and discussed  
14 in the material which appears below.

15 Among the basic problems which eluded Cygna, one of the more  
16 critical problems involves the use of incorrect formulas for analysis.  
17 The fact that supports may later be correctly analyzed and fall within  
18 design limits is of no value as an argument for tolerating such  
19 incompetence, since the fact that it occurred and passed through as  
20 many as 10 checks (the original check plus 9 levels for vendor  
21 certification) proves that incompetence was rampant. As a result of  
22 this observation, no engineered element of Comanche Peak can be  
23 considered safe until each element is rechecked by truly independent  
24 assessors.

25 Among the items not included in the review by Cygna, but which

1 were found by me, brought out under cross-examination or delivered by  
2 Board Order, the following are offered:

3 1. Stresses and Deflections at Local Areas:

4 In reference to the Applicants' ability to catch any errors in  
5 engineering during the vendor certification program, examination of the  
6 results of reviewing only 9 calculations during the evaluation of the  
7 Cygna Phases 1 and 2 material will indicate the fallacy of that  
8 thought.

9 For example, for calculation No. SI-1-079-001-S42S (CASE Exhibit  
10 930), the calculation of a W4x13 which is less than 2" long is  
11 accomplished by flexibility analysis while in reality, with this beam  
12 flexibility analysis is impossible. In addition, in using flexibility  
13 analysis, the stress in the W4 is shown to be 1166 psi and for shear,  
14 3,000 psi. The major stress is induced by the flange bending induced  
15 by the bracket and is in excess of 18,000 psi. This fact was conceded  
16 and in fact determined by Cygna when it was pointed out to them.

17 The same impossible analytical process is also used for the 6"  
18 long TS 8x8 (see support No. RH-1-024-011-S22A, CASE Exhibit 936), and  
19 the 3-inch long, 6-inch diameter anchor (see support No. SI-1-030-003-  
20 S32A, CASE Exhibit 937).

21 On calculation RH-1-064-011-S22R (CASE Exhibit 934), on sheet 4 of  
22 4 for the welding calculation, only one component of torsion is  
23 included; beyond this, the bending stress about the y axis was ignored.  
24 On this same calculation, the bending stress inducing moments into the  
25 anchor bolts was neglected (see sheet 3 of 4).

1 For calculation RH-1-064-010-S22R (CASE Exhibit 931), sheet 4 of 8  
2 indicates the strut angle to be 4.99 degrees, thus qualifying as less  
3 than 5 degrees; however, a correct calculation would have shown that,  
4 according to the analysis for the C to C dimension of 45.8125 with an  
5 4" offset, the correct angle is 5.01 degrees.

6 For support No. SI-1-325-002-S32R (CASE Exhibit 928), the clip  
7 angle (item 15) which was installed to assure stability, fails. While  
8 Cygna failed to mention this initially, when compelled to supply an  
9 answer, they finally stated that they were aware of this problem. /1/

10 From the above, the value of the Vendor Certified Drawing (VCD)  
11 program appears to offer little hope of correcting any problem and may  
12 in fact be introducing new problems.

13 This is to list only partially the items involved in this problem.

14 In reference to item 1 above, the calculations were not "correctly  
15 translated" as required by 10 CFR Part 50, Appendix B, Criterion III,  
16 first paragraph.

17 The previous (item 1) shows that of 9 vendor certified equations  
18 which I reviewed, 6 were incorrectly done and one item completely  
19 failed.

20 In addition to these six items, the course of cross-examination of  
21 Cygna in reference to generic problems offers additional evidence that  
22 the postulate that items may be written off by engineering judgement is  
23 not only fundamentally wrong, it is dangerous.

24 /1/ CASE Exhibits 927, 928, 930, 931, 934, and 936 have previously been  
25 supplied to the Board and all parties. Please advise if we need to  
send copies.

1           2.   Double Axial Restraints (snubbers or struts):

- 2           (1)   Either of the two supports (snubbers or struts), when input as a  
3               moment restraining system, will experience substantially higher  
4               loads than are evident when the node point is input into the pipe  
5               stress model as a single unit acting along the centerline of pipe  
6               with the total load later divided equally to the two supports.  
7               This is a recognized problem in industries associated with piping  
8               systems; see, for example, ANSI B31.1, paragraph 121.3.1 (a) and  
9               (b). The facts on this item are that after two years of resting  
10              secure in the knowledge that the Applicants were convinced of the  
11              problems in this procedure and had instituted corrective measures,  
12              we learned that their knowledge only extended to several systems,  
13              and other systems were still being accepted which were not being  
14              introduced into the computer as two-way restraints (force and  
15              moment).
- 16          (2)   When pressed on this issue, Cygna performed analyses which  
17               revealed that for the supports analyzed, the following was noted:  
18               (a)   When input as a single entity, the load on either snubber of  
19                      the system analyzed was 1328 lbs., but when both snubbers  
20                      were input into the computer excentric to the centerlline of  
21                      pipe, the division of loading was no longer 50/50.  
22               (b)   The most loaded snubber had a load of 3933 lbs., almost three  
23                      times the previous condition. This would also have an effect  
24                      on the base plate and anchor bolts. (See Tr. 12,851.)  
25               (c)   The facts involved in noncompliance in this case are as



1 follows:

2 (i) Since the configuration of the support is such that a de  
3 facto moment restraint exists, the manufacturer is  
4 required by the ASME code to ensure the integrity of the  
5 support. (See ASME Section III, NA-3340.)

6 (ii) Beyond this, the provisions of 10 CFR Part 50, Appendix  
7 A, Criterion 1, require that procedures not be  
8 restricted by the letter of the code nor the fact that  
9 direct prohibitions do not exist within the code.

10 In reference to item 2, Cygna witness Ms. Nancy Williams, under  
11 cross-examination, stated that Cygna did find that there was rotation  
12 (Tr. 12769). She further stated: ". . . yes, you will get a  
13 rotational restraint there, and you will probably come up with a  
14 slightly different distribution of loads on the struts or snubbers"  
15 (Tr. 12773). And Ms. Williams attempted to justify the engineering  
16 judgement used to assume that there is no significant effect due to  
17 neglecting the restraint of rotation by referring to the fact that the  
18 "pipe stresses go down" and one must balance the two (Tr. 12774).

19 But Ms. Williams is misleading the Board, since the stress levels  
20 in the pipe and the loads on the struts (or stresses) are not equatable  
21 but actually are totally independent. For example, if a procedure were  
22 used that overloaded building columns but reduced the loading on beams  
23 and girders, the building could still collapse due to that overload.  
24 So the balancing of loading consideration is without merit.

25 Ms. Williams admitted that the restraint effect was taken into

1 account on some systems at Comanche Peak (she believed), "perhaps due to  
2 the importance of that system or a particular configuration associated  
3 with given systems, purely at the judgment of the analyst" (Tr.  
4 12,775). Ms. Williams stated that if two axial snubbers were modelled  
5 as such (that is, two restraint points), then anchor bolts could be  
6 underdesigned (Tr. 13,040). But most important, Ms. Williams confirmed  
7 that Applicants modelled two snubbers as if they were one snubber  
8 acting on the centerline of pipe (Tr. 12,770).

9 It can only be stated that in reference to item 2 above, the  
10 procedure used does not comply with the "correctly translated"  
11 provision of 10 CFR Part 50, Appendix B, Criterion III, first  
12 paragraph. Nor is this procedure in compliance with 10 CFR Part 50,  
13 Appendix A, Criterion 1, in reference to adequacy, since the procedure  
14 does not comply with the provisions of ANSI B31.1 121.3.1(c), the code  
15 for non-nuclear pressure piping which states in part:

16 "In addition to the provisions of (b) above clamps to support  
17 vertical lines should be designed to support the total load on  
18 either arm in the event the load shifts due to pipe and/or hanger  
19 movement."

20 3. Failure to include masses on the run pipe as a result of  
21 supporting suspended elements of the pipe supports:

- 22 (1) Box frames, U-bolt structural clamping devices, and other hardware  
23 supported by the pipe must be included in as dead weight in the  
24 pipe stress analysis.  
25 (2) The SIT found that an assessment of this contribution to the  
piping loads is made on a case-by-case basis . . . if the

1 contribution is considered significant. (And the SIT considers  
2 several hundred lb. loads suspended off the pipe not to be  
3 significant.) (See SIT Report, NRC Staff Exhibit 207, page 35.)

- 4 (3) After Cygna Energy Services was challenged on this point, a finite  
5 pipe stress analysis was executed with the following results (see  
6 Tr. 12,571): The difference in the seismic load on the support  
7 with the largest increase due to including masses supported by the  
8 pipe was 24 per cent, plus other load increases of indeterminate  
9 magnitude. And this is for a system of 16 supports with a total  
10 mass for all supports of only 750 lbs., a maximum single support  
11 suspended load of 120 lbs. and an average load per support point  
12 of less than 50 lbs.

- 13 (4) The facts are that the failure to include masses on the run pipe  
14 as a result of supporting suspended elements of the pipe supports  
15 represents a gross concern for the design of Comanche Peak and is  
16 in violation of the codes and laws to which Applicants are  
17 committed.

18 In reference to item 3 above, the chain of codes and laws is  
19 as follows:

- 20 (a) In accordance with the provisions of ASME Section III,  
21 NA-3250 (PROVISION OF DESIGN SPECIFICATIONS), Applicants  
22 prepared a technical specification for nuclear safety-  
23 related equipment;
- 24 (b) The title of the document generated in compliance with  
25 ASME Section III, NA-3250, is NUCLEAR SAFETY CLASS PIPE

1 HANGERS AND SUPPORTS, SPECIFICATION 2323-MS-46A;

2 (c) ASME Section III, NA-3320(b) regarding Manufacturer's  
3 responsibilities, is directed to ASME NA-3340; and NA-  
4 3340, RESPONSIBILITY FOR COMPLIANCE WITH THIS SECTION,  
5 states:

6 "The Manufacturer who completes or substantially  
7 completes any component, appurtenance, core support  
8 structure, or component support required to be in  
9 compliance with this Section has the responsibility for  
10 the structural integrity using the Design Specifications  
11 as a basis of design . . ."

12 (5) In the Design Specification (technical specification) 2323-  
13 MS-46A, page 3-15, Section 3.3, CODES AND STANDARDS, the following  
14 is included:

15 "Design, fabrication, materials, certification, code  
16 stamping, and testing requirements included in this  
17 specification shall be in accordance with the edition and  
18 addenda of the following codes, legislation, regulations, and  
19 standards, in effect on July 28, 1975, unless otherwise  
20 specified below or authorized by the owner."

21 On page 3-20 of the same document, the following are listed as  
22 codes with which Applicants shall comply:

23 "g. Manufacturers' Standardization Society (MSS)

24 "(1) MSS SP-58, Pipe Hangers and Support-Materials and Design

25 "(2) MSS SP-69, Pipe Hangers and Supports-Selection and  
Application"

(6) At the Foreword of MSS SP-69, the following is quoted:

"The requirements of this standard were developed by a  
cooperative effort of representatives of pipe hanger  
manufacturers. They are based on the best practice current  
at this time and on proven results of the research and  
experience of this industry."



1 (7) SP-69 3.4 for load calculations "where required by specifications,  
2 calculations shall give consideration to the following: . . .  
3 weights of pipe, valves, fittings, insulating materials, suspended  
4 hanger components, and normal fluid contents." (Emphasis added.)

5 Because this suspended material reacts on the pipe, it must  
6 be included in the pipe stress analysis, particularly in our case  
7 since the dynamic out-of-plane loads up and down stream can be  
8 significant.

9  
10 4. Cinched-Up U-Bolts:

11 The extent of the problem may be noted from the following:

- 12 (a) In almost two years of attempts, the NRC Staff and the  
13 Applicants have failed to show that cinching is no problem.  
14 (b) Cygna Energy Services, hired as a consultant by the  
15 Applicants for an independent assessment program, was  
16 challenged on their uncontesting acceptance of this method of  
17 clamping. They spent over two months in analyzing the  
18 problem using the most sophisticated and accurate means  
19 currently available.

20 The results were that the stresses in the U-bolt and the  
21 pipe under 5 foot pounds of torque exceeded the allowables of  
22 the materials and with higher torques would exceed the yield  
23 of the materials (at 80 foot lbs., in fact, in one analysis  
24 the pipe stress was 80,000 lbs. per square inch) (see Tr.  
25 12,331 through 12,335). (If this were compared to the actual

1 allowable of 37,500 psi for pipe based on Sh plus Sa, the  
2 pipe stress far exceeds the allowables.)

3 Cygna's Dr. Bjorkman stated that the methods used in the  
4 modelling were not precise; therefore, the loads indicated  
5 were somewhat conservative (however, the model did not  
6 contain the mechanical loads). Dr. Bjorkman referred to this  
7 analysis as a scoping study and stated that an exact solution  
8 would require extensive effort (Tr. 12,337).

9 In reference to Item 4 above, several points must be made. Cygna  
10 Energy Services, which was responsible for the review of systems at  
11 Comanche Peak; either deceived the Board or totally lacked knowledge of  
12 several important factors relative to pertinent code sections which,  
13 while not adhered to at Comanche Peak, are required for even the most  
14 insignificant facility. See Tr. 12,369, where Ms. Williams states that  
15 they never considered MSS SP-69, and Tr. 12,371-12,372, where Ms.  
16 Williams states that she does not know about the MSS organization.

17 Beyond this, while Applicants, NRC Staff, and Applicants' agents  
18 continually refer to industry practice as the caviat for not performing  
19 analysis or accepting procedures on the basis of judgement, Ms.  
20 Williams admitted that the industry practice being referred to was the  
21 nuclear industry (see Tr. 12,367). Further, Ms. Williams relied on an  
22 office survey to determine industry practice (see Tr. 12,954).

23 In reference to the problem involved with cinched-up U-bolts, Ms.  
24 Williams stated that Cygna had been considering torque for some time,  
25 that they were trying to address all of Mr. Doyle's questions, and

1 realized that the undertaking was far larger than could be answered in  
2 that time period . . . (Tr. 12,406/8-12).

3 On this subject, after lengthy research, Cygna's Dr. Bjorkman  
4 stated that further study was required (Tr. 13,002).

5 Finally both Ms. Williams and Dr. Bjorkman admitted that they had  
6 never seen the cinched-up U-bolt or box frame concept at other nuclear  
7 plants (see Ms. Williams at Tr. 13,027, and Dr. Bjorkman at Tr.  
8 13,028).

9 Relative to the non-compliance of the above, the chain of codes  
10 and laws is as follows:

- 11 (a) In accordance with the provisions of ASME Section III, NA-  
12 3250, PROVISIONS OF DESIGN SPECIFICATIONS, Applicants  
13 prepared a technical specification for nuclear safety-related  
14 equipment;
- 15 (b) The title of the document generated in compliance with ASME  
16 Section III, NA-3250, is NUCLEAR SAFETY CLASS PIPE HANGERS  
17 AND SUPPORTS, SPECIFICATION 2323-MS-46A;
- 18 (c) ASME Section III, NA-3320(b) regarding Manufacturer's  
19 responsibilities, is directed to ASME NA-3340; and NA-3340,  
20 RESPONSIBILITY FOR COMPLIANCE WITH THIS SECTION, states:  
21 "The Manufacturer who completes or substantially  
22 completes any component, appurtenance, core support  
23 structure, or component support required to be in  
24 compliance with this Section has the responsibility for  
25 the structural integrity using the Design Specifications  
as a basis of design . . ."
- (d) In the Design Specification (technical specification) 2323-  
MS-46A, page 3-15, Section 3.3, CODES AND STANDARDS, the

1 following is included:

2 "Design, fabrication, materials, certification, code  
3 stamping, and testing requirements included in this  
4 specification shall be in accordance with the edition  
5 and addenda of the following codes, legislation,  
6 regulations, and standards, in effect on July 28, 1975,  
7 unless otherwise specified below or authorized by the  
8 owner."

9 On page 3-20 of the same document, the following are listed  
10 as codes with which Applicants shall comply:

11 "g. Manufacturers' Standardization Society (MSS)

12 "(1) MSS SP-58, Pipe Hangers and Support-Materials  
13 and Design

14 "(2) MSS SP-69, Pipe Hangers and Supports-Selection and  
15 Application"

16 (e) At the Foreword of MSS SP-69, the following is quoted:

17 "The requirements of this standard were developed by a  
18 cooperative effort of representatives of pipe hanger  
19 manufacturers. They are based on the best practice  
20 current at this time and on proven results of the  
21 research and experience of this industry."

22 (f) Table 1, page 3, of SP-69 does not recommend the use of U-  
23 bolts (type 24 is the designation for U-bolt in this  
24 material) for insulated lines classified as Hot A-1. And  
25 Hot A-1 is defined under 2.1 Hot Systems as being 120 degrees  
F. to 450 degrees f. For Hot A-2 line, type 24 supports are  
not recommended whether the line is insulated or not.

(g) SP-69 states at 12.2, "Riser clamps (type 42) shall have a  
position means of engagement between the pipe and the clamp."  
(By inference, this would include type 24 clamps, which are  
U-bolts.)



- 1 (h) The practices used in the design and construction at Comanche  
2 Peak nuclear plant proceed under a false premise; that is,  
3 one constructs the facility, then justifies the construction  
4 as opposed to justifying the procedure and then constructing.
- 5 (i) Comanche Peak practices evade the provisions of 10 CFR Part  
6 50, Appendix A, Criterion 1;
- 7 (j) Also, Comanche Peak practices evade the provisions of 10 CFR  
8 50.55(a)(a) regarding design to standards commensurate with  
9 the safety function.
- 10 (k) Comanche Peak practices evade the provisions of 10 CFR  
11 50.34(a)(8) on the requirement to prepare a plan for research  
12 and development for unique designs in the PSAR.

13  
14 The next item for consideration is in reference to:

15 5. Box Frames:

16 Box frames utilized as quasi-clamping devices present several  
17 unique problems:

- 18 (1) Stresses in the box frame and most particularly the welding in the  
19 box frame are indeterminate.
- 20 (2) Stresses in the pipe due to the constraint of the thermal growth  
21 of the pipe caused by the box frame are indeterminate.
- 22 (3) We again have the problem of no positive means of engagement  
23 between the pipe and the box frame.
- 24 (4) The use of box frame deviates from the provisions of SP-69 in that  
25 this is not a rigid support in the direction of loading, whether

1 from below or regardless of direction in a seismic event.

2 (5) The effects of thermal constraint on the box frame are as follows:

3 (a) After attempting to justify the use of this unique support  
4 concept, the NRC Staff and the Applicants have failed to  
5 produce evidence of its adequacy. And in fact, the Staff and  
6 the Applicants through their agent admitted that this box-  
7 frame type arrangement and the U-bolts arrangement (double  
8 pin-ended supports) are unstable. (See: Judge Bloch at Tr.  
9 6696; Staff's Dr. Chen, at Tr. 6697, 6698, 6721, and 6727.)

10 Cygna Energy Services, when challenged on accepting this  
11 design concept (see CASE Exhibit 928, expanded and renumbered  
12 version of CASE Exhibit 891, bound in at Tr. 9825), spent  
13 several months in analysis by the finite element method. The  
14 results of their analysis showed that the stresses in the box  
15 frame (welds not analyzed) were, and this does not include  
16 internal pressure or moments of the pipe, at about 70 per  
17 cent of the material allowable which was assumed to be 3 Sm  
18 (not the Sh plus Sa that we would have assumed for the pipe  
19 as required by technical specifications and the code).

20 Cygna's Dr. Bjorkman stated at Tr. 12,669, "I said it  
21 would need further consideration." Also, when asked if this  
22 problem should have been looked at by Applicants, he stated,  
23 "Yes." At Tr. 12,724, Dr. Bjorkman stated that the stress in  
24 the box frame was over yield by 1500 psi, but he said he was  
25 using A36 allowables and the actual allowable for A500 is

1 6,000 psi, better than A36; (however, the strain hardened  
2 area on a 16 inch long steel member subjected to 100 inches  
3 of welding has undoubtedly been annealed back to the A36  
4 condition). Dr. Bjorkman stated that the constraint forces  
5 induced in the sides of the box frame are about 70 to 75  
6 kips (Tr. 12,714). He stated that while the analysis for the  
7 box frame is nearly accurate, the analysis for the U-bolt  
8 cinched-up on the pipe requires much more work and fine  
9 tuning (Tr. 12,882).

10 The facts are that the problems with box frames represent a gross  
11 concern for the design of Comanche Peak and are in violation of the  
12 codes and laws to which Applicants are committed.

13 In reference to item 5 above, Dr. Bjorkman admitted that  
14 engineering judgement to dismiss calculations for box frames was  
15 inadequate (see Tr. 12,666 through 12,669). Beyond this, Dr. Bjorkman  
16 stated that this problem should be looked at by Applicants, including  
17 adding in the effects of pressure and pipe bending (see Tr. 12,669).

18 Ms. Williams confirmed that Applicants never looked into this  
19 stress problem (see Tr. 12,666), nor were the effects of such problem  
20 added to the normal calculated loads for this support (see Tr. 12,666).

21 This problem indicates a non-conformance with 10 CFR Part 50,  
22 Appendix A, Criterion 1, particularly as relates to the generally  
23 accepted code section. Additionally, the procedure is not in  
24 compliance with 10 CFR 50.34 (a)(8) relative to unique designs. Also,  
25 the support fails to consider the industry practice as outlined in MSS

1 SP-69 at 12.2 (depending on thermal expansion is not a positive means  
2 of engagement).

3 Q7. What conclusions do you draw from this phase of the Cygna review?

4 A7. Of the 9 support calculations reviewed, the following is apparent: 6  
5 of the 9 calculations, or 67%, were truncated and/or incorrectly done  
6 and one of the supports had to be reworked since a structural failure  
7 was apparent (see clip angle to hold U-bolt, CASE Exhibit 928; see also  
8 Ms. Williams where she agrees that the clip angle fails, see Tr.  
9 12,699-12,706). Finally all of the above points were established by  
10 me, not Cygna.

11 Q8. What are your points to be made relative to Phase 3 of the review by  
12 Cygna Energy Services?

13 A8. Before proceeding, I would like to establish some ground work. First,  
14 as far as the contents of the calculations review by Cygna, I have  
15 never seen them. I therefore am proceeding on the basis of the raw  
16 material provided by Cygna in Volume 3 of the Phase 3 report starting  
17 with PS-067 through PS-088. I am not referring to Volume 1 of the  
18 report, because the conclusions are not based on whether the design of  
19 the plant was properly done but rather now that the plant is complete,  
20 does Cygna think it is O.K. I am not concerned with the fact that the  
21 money is safe because the thief didn't get it; I am interested in  
22 whether or not the thief was innocent because the money is safe.

23 The following analysis of the raw data from Volume 3 of Phase 3  
24 for the main steam system will point out the real depth of failure as  
25 relates to the Applicants' 9-level final vendor certification program



1 (the minor findings are not included in this assessment but only those  
2 findings which caused Cygna to have to produce a calculation to qualify  
3 the support -- or equivalent). I didn't include errors relative to  
4 local omissions, although I don't agree with Cygna Note 3 because the  
5 AISC requires a local check at all levels of moment connections (see  
6 AISC 4-88 through 4-99). The fact that another code does not mandate  
7 this is irrelevant as a consequence of 10 CFR Part 50, Appendix A,  
8 Criterion 1.

9 All of the following are from Volume 3 of the Phase 3 Cygna  
10 Report:

11 PS-069, Item 2, pages 1 and 2 of 10:

12 "Items 16 to 23 (stability part of the structure) are not  
13 designed. Acceptability of this support is entirely based on  
14 the review of the design of the structural components not  
related to the stability part of the structure. (See  
Observation PS-02).

15 "The methodology used to check the weld between items 8 and 9  
16 is incorrect. However, the weld is acceptable (composite  
section). See Cygna calculation 84042, 4-F, Set B3, Rev. 0.  
17 See Observation PS-07."

18 PS-070, Item 2, page 1 of 9, and  
PS-070, Item 22, page 8 of 9:

19 Item 2: "There are no design calculations for the bumper  
20 portion of this restraint (see Observation PS-02)."

21 Item 22: "Weld of T.S. to Item 5 is not considered in  
22 calculations, weld stresses acceptable per Cygna Calculation  
(File 4-F, 84042, Calculation Set B2, Rev. 0)."

23 PS-071, Item 13, page 6 of 10. It should be noted that this  
24 problem could be critical if the error were reversed and a column  
25 load were shown as tension:

"Analysis SA-4298: Signs for loads were changed twice while  
taking the loads from STRUDL to input into base plate

1 analysis. As a result, compression became tension on the  
2 baseplate. The approach is conservative.

3 "Base plate model does not show any node points or grid  
4 points, bolt locations, etc. (Ref. SA-4299.)"

5 The use of the word "approach" above indicates intent; this  
6 was an error, not an approach.

7 PS-071, Item 21, pages 8 and 9 of 10:

8 "On vendor certification cover sheet 1, Rev. 1 a note stating  
9 that 'warping of Items 3 and 7 as indicated in CMC 59142 not  
10 considered or approved'. There is no indication in the  
11 calculation that the warping problem has been resolved. Also  
12 on sheet 1 of drawing, Rev. 4, note 3 states that Items 3 and  
13 7 may not warp. Per TUGCO's response, this matter was  
14 addressed by the site task force (see response in 6/8/84  
15 letter, Question #42) and engineers were directed to increase  
16 the section properties 5% (see Attachment K to that  
17 letter). Support member is acceptable per Cygna Calculation  
18 Set A9 (Binder 4F, 84042) with 5% modification. Per TUGCO  
19 response dated 6/22/84, all 12 affected supports have been or  
20 will be reviewed to ensure that the 5% is accounted for."

21 It should be noted that this is not a legitimate procedure.  
22 The residual stress caused by the warping must be calculated and  
23 then added to other stresses.

24 PS-072, Item 2, page 1 of 9, and  
25 PS-072, Item 22, page 9 of 9:

Item 2: "Reaction forces at support points were not  
distributed correctly for both the base analyses. See  
comments under Item 13."

It should be noted that this is still in violation of Gibbs &  
Hill procedures in Specification 2323-MS-46A and results in lower  
stresses in the members.

Item 22: "The weld between Items 22 and 23 was not checked.  
However, the weld is adequate based on Cygna Calculation Set  
B7 (84042, 4-F)."

1 PS-073, Item 1, page 1 of 9,  
2 PS-073, Item 15, page 6 of 9, and  
3 PS-073, Item 22, page 8 of 9:

4 "STRU DL model does not match as-built support drawings with  
5 respect to:

- 6 1. Member Lengths;
- 7 2. Load Application Point.

8 However, Cygna agrees that the discrepancies are acceptable  
9 per TUGCO's response (46a) dated June 8, 1984.

10 "Sheets 10 through 14 of Rev. 4 calculation are missing.  
11 Sheet 9 references these pages. These are modification  
12 sketches."

13 It should be noted that the June 18, 1984 (item 46(a)),  
14 letter justifies a problem; it does not alter the fact that the  
15 problem was missed by the complex vendor review system.

16 Item 15: "Frame is attached to existing whip restraint  
17 structural members. Design has not addressed connection of  
18 support members to 1" Plate or 1" Plate connection to pipe  
19 whip restraint members. Cygna agrees that the connections to  
20 the pipe whip restraint members are acceptable per TUGCO's  
21 June 8, 1984"

22 Same comments apply as for Item 1 preceding.

23 Item 22: "Many member joints and the connection to whip  
24 restraint beams are not evaluated in the design. See comment  
25 under Item 15.

"No check of base plate weld adequacy, as shown in Section K-  
K. Weld stresses are acceptable per Cygna calculation B6  
Binder 4/F.

"Connections between TS 6 x 8 x 3/8 not designed (Items 39  
and 40). Weld stresses are acceptable per Cygna calculation  
B6 Binder 4/F."

22 PS-074, Item 2, page 1 of 9:

23 "Punching shear was not checked; however, it meets the  
24 requirements per Cygna review.

25 "Weld between material Items 13 and 18 was checked without  
considering the additional eccentric moment due to the

1 location of weld center of gravity for assymmetric weld  
2 pattern (Sheet 17 of 19). However, the stress is still  
3 acceptable per Cygna's calculation, set A6 (84,042, 4-F).  
4 See Observation PS-05."

5 PS-075, Item 2, page 1 of 9,  
6 PS-075, Item 8, page 3 of 9,  
7 PS-075, Item 11, page 5 of 9,  
8 PS-075, Item 21, page 8 of 9, and  
9 PS-075, Item 22, page 8 of 9:

10 Item 2: "Stresses in pad are not computed and are the  
11 responsibility of NPSI (Secaucus). See Note 2 for more  
12 information.

13 "The component forces due to swing angle were not considered  
14 in the design, but are acceptable since effect is small."

15 Item 8: "Snubber design calculation was not provided.  
16 However, it meets the requirements based on the Cygna review  
17 Calculation Set No. A4."

18 Item 11: "The bolt interaction was based on the allowable  
19 for 13-1/8" minimum embedment, but the as-built drawing  
20 shows that the embedment length was only 13". However, the  
21 interaction is still less than 1 if the allowable load for  
22 13" embedment length is used in the calculation (per Cygna  
23 review Calculation Set No. B1). The 1/8" difference is  
24 minor."

25 Items 21 and 22: "Web crippling and buckling of members  
where concentrated load is applied are not checked. However,  
all the members are within allowable."

"The welds of the composite beam section are not checked  
between Material Items 21, 25 and 26. However, they are  
acceptable per Cygna Calculation Set No. B1."

20 PS-076, Item 8, page 3 of 9, and  
21 PS-076, Item 13, page 6 of 9:

22 Item 8: "The snubber setting and other catalog items were  
23 not checked in the design calculation. However, they are all  
24 acceptable based on Cygna calculation."

25 Item 13: "Minimum spacing violations exist (i.e. less than  
10") but since interaction value is very low (0.26), the  
anchor bolts are still acceptable by inspection."



1           It should be noted, however, that the fact remains that the  
2 procedure was not followed and the final vendor review missed it.

3 PS-077, Item 24, pages 8 of 9 and 9 of 9:

4           "Buckling is not checked. Cygna checked total normal stress  
5 against allowable stress. Ratio of faulted stress to normal  
allowable is small (24%). Therefore this is acceptable."

6           It should be noted that, while the comment of Cygna may be  
7 true (although I am not agreeing with Cygna), they had to perform  
8 a scoping analysis which Applicants failed to provide, and this  
9 was not found by the final vendor review. The ratio before  
10 Cygna's scoping was indeterminate and could have been serious.

11 PS-078, Item 1, pages 1 of 10 and 2 of 10,

12 PS-078, Item 2, page 2 of 10:

13           Item 1: "Input data calculations for STRUDL model shown on  
14 sheet 1 to 8 Design Input calculation (dated 6/21/83) not  
checked. Moment of inertia and section modulus for members 5  
and 6 and 8 to 11 were not calculated correctly.

15           "Members 5 & 6

16           "Iy should be 359.95, but 681.51 used in STRUDL input Sy  
should be 71.99, but 136.3 was used in design.

17           "Members 8 to 11

18           "Iy should be 642.73, but 1213.1 was used in design. Sy  
should be 107.12, but 2.7.18 (sic) was used in design.

19           "Reanalyses of the frame was required in order to obtain the  
20 correct forces & moment for designs. Per TUGCO's calculation  
dated June 8, 1984, the frame is re-analyzed with beam (Item  
21 22) boxed with 3/4" plates. The modified support is  
acceptable (Reference Cygna communications report, dated May  
22 24, 1984, Question 41). See Observation PS-01."

23           Item 2: "The STRUDL analysis assumed fixed ends at nodes 4,  
24 8, 14 & 17. This should be evaluated since those joints can  
not take high moments and forces. No detail calculation was  
provided in the design for those joints.  
25 Per TUGCO's calculation, dated June 8, 1984, the frame was  
modified. In the re-analysis Nodes 4, 8, 14 & 17 are modeled

1 as pinned connections. Cygna's review shows the support is  
2 acceptable."

3 It should be noted that this is not precise; a release based  
4 on stiffness would be the correct approach, not complete release.

5 PS-079, Item 2, page 1 of 9:

6 "No calculations were performed for snubber and weld  
7 connection designs. However, they are acceptable per Cygna  
Calculation Set No. A4 (File 4-F, 84042)."

8 PS-081, Item 1, page 1 of 9,  
9 PS-081, Item 2, pages 1 and 2 of 9,  
10 PS-081, Item 9, page 4 of 9,  
11 PS-081, Item 11, page 5 of 9,  
12 PS-081, Item 13, page 6 of 9, and  
13 PS-081, Item 23, page 9 of 9:

14 Item 1: "Applied forces used in SA-4284 were referenced to  
15 joints 2 & 6 which did not match the corresponding location  
16 of Item 20 in the STRUDL frame analysis model. There was no  
17 corresponding Node No. assigned to the locations where the  
18 member forces were supposed to be used in SA-4284. Per  
19 TUGCO's June 8, 1984 response (Reference Question 44), nodes  
20 2 and 6 are from a model for a similar support. The  
21 locations match closely to those of the actual connection.  
22 Cygna's review of that support (MS-1-004-002-S72R) shows this  
23 to be an acceptable comparison."

24 It should be noted, however, that Cygna could not review the  
25 support without assistance.

Item 2: "No calculation provided to evaluate member stresses  
and weld capacities. Cygna's review of the similar support  
shows them to be acceptable."

It should be noted that the same assistance as above was  
required, since the calculation did not refer to similar support  
but calculated PS-081. The reviewers for certification missed  
this problem.

Item 9: "No calculation provided for strut design. However,  
it is acceptable (see Cygna Calculation Set. No. A4, Binder  
4-F)."

1 Item 11: "The applied forces used to qualify base plate  
2 shown on Drawing Section B-B were different from those shown  
3 in the STRUDL output. (They are verified per TUGCO's June 8,  
4 1984 response, Attachment L.) Bolt locations assumed in the  
5 analysis were different from the actual bolt locations shown  
6 on the drawing. However, the discrepancies are not  
7 significant and bolt and plate stresses are very low."

8 It should be noted that since the qualification for this  
9 support is based on another support calculation, the material  
10 contained in the calculations for this support are fictitious and  
11 yet there was no comment by the final review process. Beyond  
12 this, even with the assistance of TUGCO, Cygna had to perform at  
13 least two calculations.

14 Item 13: "Applied loads used to qualify Thru-Bolt did not  
15 match the STRUDL frame output. Also, analysis SA-3662, Rev.  
16 1 does not show the same values as used in sheet 4 of 8 the  
17 analysis SA-4282 calculation. Note: These comments are  
18 clarified per TUGCO's response (item 44) and Cygna's review  
19 of the original calculation at Grinnell's office in  
20 Providence, RI, which confirms the acceptability of these  
21 components."

22 Same comments apply here as for all of the above.

23 Item 23: "No cover plate provided at tube end moment joint  
24 (Material Item 18). It is acceptable per Cygna Calculation  
25 set C2, Binder 4-F. See also Note 3."

PS-082, Item 2, page 1 of 9,  
PS-082, Item 2A, page 2 of 9, and  
PS-082, Item 10, page 5 of 9:

Item 2: "Incorrect section modulus used for combined section  
(Items 8 and 9). Values of section modulus cannot be added  
algebraically to get total section modulus (Sheet 3 of 9).  
However, stress results are conservative, therefore  
acceptable."

Item 2A: "No design calculations were provided for the loads  
or stresses on the members added for stability (see  
Observation PS-02). This review covers only the remaining  
members."

Item 10: "Incorrect allowable used but OK; final design load is within ITT Grinnell LCD allowable."

PS-083, Item 1, page 1 of 9,  
PS-083, Item 2, page 2 of 10,  
PS-083, Item 10, page 5 of 10,  
PS-083, Item 13, page 7 of 10,  
PS-083, Item 22, page 9 of 10, and  
PS-083, Item 23, page 10 of 10:

Item 1: "Moment load on base plate is transferred into compression/tension loads by taking incorrect dimensions of rear bracket. (See comment under Item 13.)"

"Incorrect moment of inertia for combined section of Items 30 & 31. However, it is acceptable since stresses are low."

"Rear bracket dimensions used in design are taken from ITT LCD-211, Rev. 16. See Note 11."

"Improper dimension from center-line of plate to gusset plate (C - 13-1/8") in Section A-A."

Item 2: "The approach to check the weld between Items 30 & 31 was incorrect. Stresses acceptable per Cygna Calculation C4, Binder 4F. See Observation PS-07."

Item 10: "SA-4122, referenced in calculation for U-bolt design, shows the failure of the bolt. However, the bolt is qualified based on the ITT Grinnell IOC from Frank Birch to Roland Serino dated 12/15/82. This is further justified by the results of the ITT test program."

Item 13: "Larger dimensions were taken for rear bracket while converting moment load on base plate into tension/compression forces at the four corners of welded attachment. Therefore, actual loads are slightly different from the calculated ones. Discrepancy is not significant in terms of anchor bolt loads and stresses in base plate."

Item 22: "Incorrect section properties calculated for weld (Items 31 & rear brackets and base plates). Weld is designed based on larger dimensions of the rear bracket which do not physically fit within TS 1/2" x 12" x 8". However, the connections are acceptable with the smaller dimensions. (Per Grinnell LCD, Rev. 16 for Figure 211.)"

Item 23: "Special analysis SA-4123 shows that the pad used between U-bolt and pipe fails due to bearing stress."



1 However, the pad is qualified based on a rapid letter from R.  
2 B. Reslau to Nick Patsalides which does not show back-up  
3 calculation. It is acceptable per TUGCO calculation in their  
4 June 8, 1984 letter, Item 43."

5 PS-085, Item 2, page 1 of 9, and  
6 PS-085, Item 11, pages 4 and 5 of 9:

7 Item 2: "In STRUDL model, member 18 (Item 34) has member  
8 forces released at joint 17. Releases should have been at  
9 joint 20. However, since this is mainly an axial force  
10 member, there is no significant impact on the design. The  
11 stress is low."

12 Item 11: "For analysis of the base plates (Items 31, 32, 44,  
13 45), the NPSI Base Plate Program requires loads to be input  
14 at 5 load points. Generally these points are the center and  
15 corners of the attachment. No calculations were made to show  
16 how these tensile or compressive loads input for these base  
17 plates were derived. Also note that on plates 31 & 32 the  
18 sides of the welded attachments are not parallel to sides of  
19 the base plate, which is the assumption for this method.  
20 However, they are acceptable based on the calculations shown  
21 in TUGCO response dated June 8, 1984. Also, see Cygna  
22 Calculation Set No. C3 for additional justification."

23 PS-086, Item 3, page 1 of 9, and  
24 PS-086, Item 11, page 5 of 9:

25 Item 3: "The load used in the calculation was 20194 lbs.  
The load reported in the analysis AB-1-02, Rev. 1 was 20305  
lbs., a difference of 111 lbs. This difference is negligible  
because the support allows a 10% deviation in loads.  
See Observation PI-00-06."

In reference to the final vendor certification review, see  
Tr. 7153, where Applicants' Witness Mr. Vega states that Step 7 of  
the iteration compares loads and modifies them if required.

Item 11: "The base plate and anchor bolt were considered  
adequate by engineering judgments without any calculation.  
However, the anchor bolts and plate are acceptable based on  
the Cygna calculation set."

PS-087, Item 1, page 1 of 10,  
PS-087, Item 2, page 2 of 10,  
PS-087, Item 6, page 4 of 10,

1 PS-087, Item 17, page 8 of 10,  
2 PS-087, Item 18, page 8 of 10,  
3 PS-087, Item 19, page 9 of 10, and  
4 PS-087, Item 22, page 9 of 10:

5 Item 1: "In gang support CH-1-030-004-C76R, which connects  
6 to this support, loads were incorrect in load case 1 (Y load  
7 at node 6). Load Case 2 has correct loads (except friction)  
8 and STRUDL results show little change for this support  
9 between Load Case 1 and 2; therefore, the load cases used are  
10 adequate for design of this support.

11 "Wrong angle section used in gang support bracing in STRUDL  
12 analysis - minimal effect on this support.

13 "Latest load  $F_y = -34676$  lb. from piping analysis, design  
14 used  $-34027$  lb., which is a change only 2%. This does not  
15 impact design.  
16 See Observation PI-00-06.

17 "Thermal displacement in Z-dir. (normal Min.) is  $-0.203$ "  
18 instead of  $0.0$ " as noted in the load summary sheet. No  
19 impact on design.

20 "On support drawing sheet 1 of 3 plan view at el.  $899' 9\frac{1}{2}"$   
21 shows structural tubes located at higher elevation  $903' 7"$ .  
22 Minor drafting inconsistency."

23 Item 2: "Tube end prying action on Richmond inserts is not  
24 considered. See Note 6 for further details."

25 Note 6 is contained in Cygna Volume 2, Appendix J, pages 3  
and 4 of 9, and states:

#### 26 "6. Tubesteel Prying on Richmond Inserts

27 "In the designs which employ tubesteel/Richmond insert  
28 combinations, Cygna noted that the engineer released the  
29 rotation about the Y and Z axes (see sketch) in the STRUDL  
30 model for the frame. While release of the Y rotation is  
31 appropriate since the bolt is free within the tube, release  
32 of the Z rotation assumes that the tube will not bear against  
33 the washer at point 'A' and create a load due to prying on  
34 the bolt. TUGCO has provided justification for this and  
35 other analytical assumptions such as: the bolt does not  
carry any load in bending and the effect of bolt hole offset  
on bolt load. Details of the justification may be found in  
the TUGCO letter dated 5/8/84 and in the 'Affidavit of John

1 C. Finneran, Jr., Robert C. Iotti and R. Peter Deubler  
2 Regarding Design of Richmond Inserts and their Application to  
3 Support Designs.' In the letter to Cygna, TUGCO shows that  
4 prying due to rotation about the Z axis is not present when  
5 only vertical loads exist. When torsional moments (Mx)  
6 exist, the study done by TUGCO shows that even with small  
7 amounts of torsion (1000 in-lb vs 40000 lb tension load), the  
8 effect of prying is due to torsion, with no contribution from  
9 moments about the Z axis. For large torsional loads (4000  
10 in-lb vs. 2000 lb tension), the same effect holds true.  
11 Cygna then reviewed all tubesteel/Richmond insert joints  
12 within their scope and determined that the configuration  
13 analyzed by TUGCO (4 x 4 x 3/8 TS with 20" bolt spacing) is  
14 representative of the most flexible configurations and,  
15 therefore, most conservative. As a result, Cygna finds the  
16 method used by TUGCO to model these connections is  
17 acceptable." (A drawing then follows.)

18 In my opinion, the contents of Note 6 appear to be a desperate  
19 attempt of one looking for a way out of a dilemma. But in any event,  
20 the final review team missed the problem.

21 Item 6: "Swing angle of rod is not checked - OK per Cygna  
22 calculation. Refer to Binder 84042/4-F call calculation set  
23 C1."

24 Item 17: "Weight of the spring is not considered in STRUDL  
25 analysis. (Approximately 5%)"

It should be noted that if one can't increase the allowable  
by 5%, one cannot do the reverse (reduce by neglect -- the dead  
load).

Item 18: "Additional dead load has been added; however, no  
frequency analysis was performed - an approximate inertial  
load was applied, though no explanation or justification is  
provided. See Note 7."

Item 19: "Friction load is not considered on a related gang  
support CH-1-030-004-C76R. See Observation PS-08."

Item 22: "Additional moments due to the eccentricity in 3  
sided welded connection between Items 31 and 45 are not  
considered, but acceptable since the stresses in the weld are  
low. See Observation PS-05."

1        PS-088, Item 2, page 1 of 9,  
2        PS-088, Item 8, page 3 of 9, and  
3        PS-088, Item 12, page 5 of 9:

4                Item 2: "Stress in pad was not checked, in this Revision but  
5                will be reviewed by NPSI (Secaucus). See Note 2."

6                Item 8: "Snubber setting was not checked. However, it is  
7                acceptable as per Cygna Calculation C6."

8                Item 12: "Prying action of tubes due to bending is not  
9                considered. See Note 6."

10        Q9: Does that conclude your comments on Phase 3 of the Cygna Report?

11        A9: Yes, except to summarize the material presented in the last two  
12        answers. But first a point must be made relative to the QA/QC program  
13        and its recent history.

14                On numerous occasions, we have heard the Applicants and NRC Staff  
15        deny the validity of allegations based on the argument that the support  
16        being questioned was not final vendor certified and therefore not open  
17        to critique.

18                On an equal number of occasions we have heard the Applicants and  
19        NRC Staff state with equal persuasiveness that the errors would all be  
20        caught in the final vendor review.

21                Beyond this, in testimony we listened to Applicants' Witnesses  
22        Messrs. Finneran, Vega, Krishnan, and others extol the virtues of a  
23        review system based on 9 levels of checking that was so tight that even  
24        time couldn't slip by (see Tr. 7140-7200, especially 7189 and 7192).

25                But now the time has come to silence these oracles of levity  
      because their flawless system is based on the dreams of "somewhat  
      knowledgeable" or incompetent individuals.



1 For starters, as was shown in my earlier answer, for the nine  
2 supports I reviewed for Phase 1 of the Cygna Report, which were all  
3 vendor certified, one had a fatal structural failure and required  
4 modifications, three were analyzed by procedures which are not  
5 applicable to the structures in question and one other contained  
6 incomplete analysis; the final support contained a deceptive equation  
7 to avoid the provisions of the code. In other words, 2/3 of this  
8 sample were not in accordance with 10 CFR Part 50, Appendix B,  
9 Criterion III requirements of:

10 "Measures shall be established to assure that applicable  
11 regulatory requirements and the design basis . . . for those  
12 structures, systems, and components to which this appendix applies  
13 are correctly translated into specifications, drawings,  
14 procedures, and instructions. . . " etc.

15 As for the problems discussed in my previous answer on the 22 main  
16 steam supports reviewed as Phase 3 of the Cygna Report, I offer the  
17 following summary. Of the 22 supports reviewed by Cygna, which are  
18 all Class 2 supports, 18 contained gross errors, a portion of which  
19 include:

- 20 1 Support required major modification to meet the code  
21 requirements due to calculational errors used to obtain the  
22 section properties for 2 members (see Phase 3 Cygna Report,  
23 Volume 3, PS-078).
- 24 2 other supports had errors in the calculations for the section  
25 properties (see PS-082 and PS-083).
- 26 4 supports had calculational errors in the weld analysis (see  
27 PS-069, PS-074, PS-083, and PS-087).

1 4 supports have calculations missing for structural members  
2 (see PS-069, PS-070, PS-073, and PS-082).  
3 1 support has a calculation for section property of a weld  
4 which is incorrect (see PS-083).  
5 2 supports have no base plate A/B calculations (see PS-073 and  
6 PS-087).  
7 5 supports have missing weld calculations (see PS-070, PS-072,  
8 PS-073, PS-075, and PS-079).  
9 1 support has severe warping problem while note on drawing  
10 prohibits warping (see PS-071).  
11 1 support failed to include friction loads (see PS-087).  
12 2 supports had calculations which used the wrong loads (see PS-  
13 073 and PS-086).  
14 1 support incorrectly used the NPSI base plate computer program  
15 (see PS-085).  
16 1 STRUDL model assumed to apply to a suport did not -- for  
17 answers to calculation problems another support calculation  
18 had to be consulted (see PS-081).  
19 1 support required check for buckling but calculation not done  
20 (see PS-077).  
21 1 support required check for crippling at concentrated loads  
22 but this was not done (see PS-075).  
23 4 supports did not have calculations for the snubbers (see PS-  
24 075, PS-076, PS-079, and PS-087).  
25 1 support calculation used the wrong allowables (see PS-082).

- 1 support had no calculation for the struts (see PS-081).
- 1 support had 2 calculations which indicated a component failure which were written off by memos, not calculations (see PS-083).
- 2 supports had no calculation for pads at trunnion to pipe interface (see PS-075 and PS-087).

While these 36 calculational errors are not the total number of errors found in these 22 supports, it is indicative of the extent of the QA/QC breakdown.

Summing up for the last two answers, a total of 9 calculations and drawings from Cygna Report Phase 1 and 22 supports reviewed in Volume 3 of Phase 3 have been discussed. These supports were final vendor certified, and the total is 31.

Of the 31 supports in question, 24 have gross errors which escaped detection through 9 levels of review prior to final vendor certification. This represents a 77.5 per cent error rate, which is fatal for any discipline and a health and safety concern of monumental proportions.

Q10. Do you have any idea of how many of these 31 supports have been modified as a result of the Walsh/Doyle allegations?

A10. As a matter of fact, I have a good guess as a result of reviewing the drawings in CASE Exhibit 669B (Attachment to Doyle Deposition/ Testimony, admitted at Tr. 3630) with the drawings in Cygna Report Phase 3, Volume 3.

I found that the following supports have been modified:

1 MS-1-001-006-C72K -- as a result of section property

2 MS-1-001-003-S72R -- stability

3 MS-1-001-004-S72R -- stability

4 MS-1-001-005-S72R -- stability

5 MS-1-001-006-S72R -- stability

6 MS-1-002-001-S72R -- stability

7 MS-1-002-003-S72R -- stability

8 MS-1-002-004-S72R -- stability

9 MS-1-002-005-S72R -- stability

10 Of the 89 supports reviewed in the three previous answers,  
11 therefore, a total of 30 have been rebuilt to prevent their collapse,  
12 and this represents 34 per cent of the sample -- obviously a fatal  
13 level of failure and a threat to the public health and safety.

14 Q11. Do you have any further statements in reference to the Cygna Reort?

15 All. I have in this regard only one general statement on the notes in Volume  
16 1 of the Phase 3 Report, and in this I will only address Note 16  
17 because the points would be similar for all of the excuses offered by  
18 the Applicants.

19 The box frame was analyzed by Cygna's Dr. Bjorkman for the May  
20 1984 hearings, and he found the procedures which he used to be close to  
21 reality. For that matter, the fine tuning required pertained to minor  
22 points which may be noted in what Dr. Bjorkman said (Tr. 12882/5-8):

23 "So in this particular problem, I don't think the level of  
24 refinement is great. It's to incorporate additional loads in the  
problem, the right allowables, check welds, et cetera."

25 The highly sophisticated finite element procedure used by Dr.



1 Bjorkman indicated overstress conditions (see Dr. Bjorkman at Tr.  
2 12,710-12,712). The Applicants have decided to discard the more accu-  
3 rate finite approach in favor of hand calculations with overlapping  
4 assumptions. Having chosen this process, Applicants proceed to manipu-  
5 late the numbers to show a favorable answer. One of the manipulations  
6 used by Applicants in calculation SI-1-325-002-S32R (see Attachment A  
7 to Affidavit on Local Displacements; especially pages 1 and 2) is to  
8 average on a straight line assumption which is inaccurate in Appli-  
9 cants' favor. Having assumed an incorrect average temperature for the  
10 box frame, Applicants assume (again incorrectly) that the average at  
11 that point is constant around a square so that the average temperature  
12 at the corners of the square frame are the same as the average at a  
13 point on the tube opposite the contact point with the pipe.

14 By their gyrations, Applicants reduced the loads found by finite  
15 methods to 1/2 of their values and thereby manage to make the support  
16 appear to be what might be termed "somewhat acceptable". But looking  
17 at equation 11, page 8, the stress level is about .9; therefore, any  
18 increase would fail the pipe. At this point, I won't become involved  
19 with the erroneous use of the equation shown on pages 5 and 6, because  
20 the principal error involves the average temperature manipulations,  
21 shown above, which cannot be manipulated on a computer.

22 Obviously, the pipe is in serious trouble and so is the somewhat  
23 knowledgeable individual who tried to justify this problem with Mickey  
24 Mouse gyrations which result in several serious errors in fundamentals  
25 for these equations.

1 Applicants and their agents, when confronted with a critique of  
2 the construction resulting from designs by somewhat knowledgeable  
3 engineers, rather than offering the documentation which led to the  
4 construction, persist in coming up with all types of methodologies to  
5 justify a fait accompli.

6 What is occurring at Comanche Peak undoubtedly will have an  
7 adverse impact on the health and safety of the public.

8 Q12. What do you have to say on the material submitted by Applicants as  
9 Motions for Summary Disposition?

10 A12. While I could say enough to stock a library, I won't. However, I  
11 believe I must make at least a few points in order to keep the  
12 Applicants and NRC Staff from getting the false impression that they  
13 are slipping their trash past me. This might give them the idea that  
14 I am, like they are, "somewhat knowledgeable."

15 When examining any material supplied by Applicants and NRC Staff,  
16 one factor to keep in mind is that the material being supplied is not  
17 offered as evidence to do something, but is rather a frantic effort to  
18 salvage a 5 billion dollar public menace. Secondly, as has been shown  
19 conclusively, the Applicants' ability to produce accurate calculations  
20 is not only questionable, it has been proven to be impossible -- even  
21 with 9 levels of review plus the original check.

22 A factor not generally considered in these hearings is the intent  
23 of the law as relates to engineering for these facilities. By devisive  
24 tactics, Applicants would have the Board believe that accuracy is  
25 without privilege as long as some Mickey Mouse manipulation of numbers

1 would ultimately indicate that a structure would not fall on the floor  
2 the first day of operation. Beyond this, Applicants' philosophy is  
3 that if the first calculations prove fatal, it is acceptable to try new  
4 assumptions and machinations until, by whatever Machiavelian postulates  
5 are successful, the problem goes away. This is best noted in three  
6 incidences:

- 7 (1) The flip flop of equations and assumptions for the upper  
8 lateral restraint (see CASE Witness Doyle, Tr. 6018-6032; NRC  
9 Staff Witness Chen, Tr. 6051; and Applicants' Motion for  
10 Summary Disposition Regarding Upper Lateral Restraint Beam).
- 11 (2) When finite element analysis proved that serious problems  
12 existed for the pipe and structure in the box beam  
13 arrangement (see Tr. 12,710-12,712, where Cygna's Dr.  
14 Bjorkman discusses the problems), Applicants reverted to hand  
15 calculation which could be easier manipulated (see Attachment  
16 A to Applicants' Motion for Summary Disposition relative to  
17 box frames with zero inch gaps).
- 18 (3) Finite element analysis of cinched-up U-bolts indicated fatal  
19 problems with this approach to clamping. While Cygna's Dr.  
20 Bjorkman did not accept the results of this analysis, he  
21 suggested that refinements to the model were required (see  
22 Tr. 12,882). The Applicants again chose to displace the  
23 highly sophisticated and extremely accurate finite element  
24 procedure with hand calculations which could be more easily  
25 manicured (see Applicants' Motion for Summary Disposition of

1 CASE's Allegations Regarding Cinching Down of U-Bolts; see  
2 also calculation No. CC-1-028-007-S33R in Applicants' Memo to  
3 Cygna Energy Services dated June 18, 1984).

4 The fact is that regardless of whether or not the support or  
5 procedure will ultimately prove acceptable, the installation and  
6 acceptance of indeterminate structures in nuclear power plants is a  
7 crime under the law.

8 This fact is reflected in the federal laws as codified in the Code  
9 of Federal Regulations. See, for example, 10 CFR Part 50, Appendix B,  
10 Criterion III, as quoted on page 49 herein. In addition to the law,  
11 certain codes and standards to which Applicants are committed are  
12 required by law; see 29 CFR 1910, the William Steiger Action 1970; see  
13 also 10 CFR Part 50, Appendix A, Criterion 1, which states, in part:

14 "Where generally accepted codes and standards are used, they shall  
15 be identified and evaluated to determine their applicability,  
16 adequacy, and sufficiency and shall be supplemented or modified as  
necessary to assure a quality product in keeping with the required  
safety function."

17 Among the codes which are applicable to Comanche Peak is ANSI  
18 N45.2.11, Applicants' Exhibit 148, which states at page 12, item 3.1:

19 "The design input requirements shall be specified on a timely  
20 basis and to a level of detail necessary to permit the design  
21 activity to be carried out in a correct manner." (Emphasis  
added.)

22 The design activity can be carried out in a correct manner only if  
23 the design criteria is established in advance of the design, not when  
24 the criteria is established after construction.

25 Further, N45.2.11 states, in part, at page 25, item 6.3.1:



1 "Design reviews are critical reviews to provide assurance that  
2 design documents such as drawings, calculations, analysis or  
3 specifications are correct and satisfactory." (Emphases added.)

4 The above includes only a portion of the codes which mandate  
5 accuracy and correctness. From the material which follows, it will  
6 become clear that at Comanche Peak accuracy is an unknown quantity that  
7 is replaced by the simpler unwritten Comanche Peak code: "Defend the  
8 bottom line utilizing the doctrine of plausible deniability."

9 The Applicants, to defend the support systems which have been  
10 installed at Comanche Peak, are not offering documentation which  
11 preceded the fabrication, installation, and inspection, but are  
12 offering an iterative series of numerical and verbal manipulations.  
13 The Applicants hope that the Board will accept as proper their original  
14 position of allowing "somewhat knowledgeable" engineers to attempt to  
15 produce the required calculations qualifying these pipe supports. In  
16 short, the Applicants are attempting to hide the trees with a forest.

17 Applicants' attempts to deceive the Licensing Board are summarized  
18 as follows:

19 1. Cinched-Up U-Bolts:

20 The first of these attempts to deceive may be found in Applicants'  
21 Motion for Summary Disposition of CASE's Allegations Regarding Cinching  
22 Down of U-Bolts, but more precisely in the June 18, 1984 memo to Cygna  
23 Energy Services.

24 As an example, with reference to the June 18, 1984, memo to Cygna,  
25 in attempting to account for thermal expansion of pipe constrained by  
U-bolts, page 8 of 9 and 9 of 9 of the calculation, CC-1-028-007-S33R,

1 Applicants only show what they want and how they want, usually falling  
2 short of a realistic analysis.

3 If we assume that Applicants' end premise is accurate, in that  
4 pipe deflections (due to expansion) result in forces in the U-bolt  
5 relative to the formula  $P = \Delta k$ , then the process must also be  
6 capable of working in reverse for this force (obtained by Applicants as  
7 331 lbs.) or in fact the force due to pretorquing which is given by  
8 Applicants as 2908 lbs. Therefore, the equivalent deflection of the  
9 pipe due to the total U-bolt load would be 3240 divided by 331 times  
10 approximately  $1/64''$  = the total diametrical constraint, or  
11 approximately  $3/16''$ . As is obvious, the postulate does not work.

12 I believe that all of the pencilwhipping in the world cannot  
13 eliminate the fact that Applicants undertook this method of approaching  
14 pipe supports without any knowledge of the consequences, which is  
15 evident from the fact (as noted above) that at this time they still  
16 don't know the consequences of cinching and thermal constraint.

17 The facts are that cinched-up U-bolts represent a gross concern  
18 for the design of Comanche Peak and are in violation of the codes and  
19 laws to which Applicants are committed.

20 When Applicants attempt to answer one area of concern, they fail  
21 to notice that their answer almost invariably indicates the result of  
22 pencilwhipping. For example, in an effort to show there is no problem  
23 associated with constraint of thermal growth offered by cinched-up U-  
24 bolts, the Applicants' own procedure proves that a severe problem  
25 exists for cinching, and that is the status of this approach is still

1 indeterminate. But one thing is certain -- the stress levels in the U-  
2 bolt and run pipe are far higher than originally believed by  
3 Applicants, who (along with the NRC Staff) assumed that the additional  
4 loads due to cinching and thermal constraint were negligible (see  
5 Applicants' Dr. Chang, Applicants' Exhibit 142F, page 5, Question and  
6 Answer No. 15, where he states that the temperature of the pipe and the  
7 U-bolt are the same). Perhaps Dr. Chang was trying to avoid the  
8 provisions of ASME Section III, Subsection NF-3272.1 (CASE Exhibit 710,  
9 admitted into evidence), which would require analysis of the effects of  
10 ". . . thrusts, moments and other loads imposed."

11 In the SIT Report (NRC Staff Exhibit 207) at page 33, the report  
12 states, in part:

13 "Alternately, since the maximum temperature differential between  
14 the U-bolt and pipe in uninsulated is expected to be less than 50  
15 degrees Fahrenheit, calculations performed by the Special  
16 Inspection Team indicated that the associated secondary stresses  
17 and loads re negligible relative to ASME Code allowables."

18 Dr. Chen, testifying for the NRC Staff, stated (Tr. 6742/13-24):

19 MR. WALSH: "Have the stresses, due to the pretensioning of the  
20 bolts, been added to the normal expansion of the pipe?"

21 JUDGE BLOCH: "First, is that addressed in the SIT report?"

22 WITNESS CHEN: "As for the load combination -- the addition of  
23 stresses that Mr. Walsh has just identified, no. But I believe  
24 that an assessment was made of the stresses resulting from  
25 preloading we were made, and was written off on the  
basis of engineering judgment and usual industry practice."

26 The NRC Staff again states that the effects of thermal constraint  
27 are negligible on U-bolts and pipes, but this time the statement is in  
28 reference to insulated lines. See SIT Report, page 32, where it

1 states, in part:

2 "In the case of insulated piping (e.g., main steam, feedwater, and  
3 residual heat removal piping), the temperature difference between  
4 the U-bolt and the pipe will be negligible because the U-bolt is  
in thermal contact with the pipe and the insulation is installed  
over both the U-bolt and the pipe."

5 I could go on, but why kill a dead horse.

6 As may be noted from the above, the Applicants and the NRC Staff  
7 argued vociferously and adamantly that neither cinching of U-bolts nor  
8 thermal constraint had any significant effect on the U-bolt or the  
9 pipe.

10 However, as the Cygna finite element program pointed out, the  
11 stresses exceeded 3 times the allowable. Beyond this, the deceptive  
12 mathematical manipulations by Applicants still resulted in stresses  
13 which were more than merely significant.

14 Obviously from the above, it is quite clear that neither the  
15 Applicants nor the NRC Staff had or now has the foggiest notion of the  
16 stress levels present in the pipe or the cinched-up U-bolt.

17 I could go into box frames at this point, but the points and  
18 arguments as well as the legal requirements would be approximately the  
19 same as those which are outlined above for the cinched-up U-bolts.

20 2. Two-Way U-Bolts Acting As One-Way Restraints:

21 The second attempt to deceive which I will address has to do with  
22 two-way U-bolts acting as one-way restraints. Information regarding  
23 this concern was contained in CASE Exhibit 669B (Attachment to Doyle  
24 Deposition/Testimony), items 3D, 3E, 3F, and 3G.

25 The fact is that Comanche Peak has failed to consider two-way



1 loading, which is not in compliance with the technical specification or  
2 the manufacturer's specification for interacting loads.

3 The effects of constraint on a node not considered in the pipe  
4 stress introduce a nonconservatism in the output of loads used in the  
5 design of all supports in the system.

6 Applicants' view of this problem is that:

- 7 (1) Analysis was not required out-of-plane since these installed  
8 supports were only in the preliminary phase of construction  
9 and justification would come later. (See pages 3 to 4 of  
10 Applicants' Motion for Summary Disposition of CASE's  
11 Allegations Regarding U-Bolts Acting As Two-Way Restraints.)  
12 (2) Applicants, in line with their premise that all construction  
13 at Comanche Peak is preliminary and finding that their  
14 initial premise was incorrect, removed a number of these  
15 supports and replaced them with new supports. (See page 5,  
16 paragraph 2, of Applicants' Motion for Summary Disposition of  
17 CASE's Allegations Regarding U-Bolts Acting As Two-Way  
18 Restraints.)

19 Of the 8 U-bolts initially analyzed in Applicants'  
20 Motion for Summary Disposition, all 8 failed to act as  
21 assumed.

- 22 (3) Applicants commissioned further tests to determine the  
23 effects of two-way loads on U-bolts. These tests, which are  
24 ipso facto, are irrelevant to qualify erroneous decision  
25 which were made and resulted in unqualified construction.

1           Beyond this, the term "failure" is not used by me as meaning  
2           collapse, break, etc.; it is rather a generic term used in  
3           the industry indicating a failure to meet criteria to which  
4           Applicants are committed.

5           (4) In the affidavit by Messrs. Finneran and Iotti at page 3 (of  
6           Applicants' Motion for Summary Disposition), they state  
7           without qualification that the clearance for U-bolts to pipe  
8           is 1/16". But I must mention that if the pipe is 4" or less,  
9           the clearance is only 1/32" and these clearances are always  
10          assuming precision construction with no tolerances. The  
11          affidavit at page 6 by Messrs. Finneran and Iotti states that  
12          of the 70 supports of this type (U-bolts), most of them are  
13          on lines 6" and under.

14          (5) The affidavit of Messrs. Finneran and Iotti, at page 8,  
15          states that a rerun of the problems with U-bolts input as  
16          two-way constraints produced no appreciable change in loads;  
17          however, if one studies the tables that resulted from these  
18          reruns, the problems become obvious, as discussed in the  
19          following:

- 20          .     Table 3 (Attachment to Finneran/Iotti Affidavit),  
21                problem AB-1-62E, second page, support No. CC-1-007-025-  
22                A43R, shows that the load increased 29%.
- 23          .     Page 4 of this Table, for Support No. CC-1-007-039-A43R,  
24                shows that the load increased 31%.
- 25          .     Page 5 of Table 3, for support CC-1-007-704-A43R, shows

1                   that the load increased 28%.

- 2                   . Table 4, problem AB-2-63B, at page 3, support No. CC-2-  
3                   126-010-F43R, shows the load increased 26%.  
4                   . CC-2-126-007-F43R, shows a load increase of 61% (2200  
5                   lb. increase).  
6                   . Page 3, CC-2-126-005-F43R, shows a load increase of 21%  
7                   plus a lateral load not existing before of 952 lbs.  
8                   . Support CC-2-126-006-F43R, shows a load increase of 25%  
9                   plus a 318 lb. lateral load not existing before.  
10                  . CC-2-126-011-F43R shows a load increase of 11% plus a 61  
11                  lb. lateral load not existing before.  
12                  . On page 4 of Table 4, support CC-2-164-407-A63K, shows a  
13                  load increase of 27%.

14                  The supports with increases selected above only included  
15                  those with loads that increased 20% or more or where the  
16                  increase was 10% and lateral loads were indicated that had  
17                  not existed previously. As may be noted, nine supports  
18                  suffered significant increase, and additionally, at least one  
19                  support absolutely failed (quite possibly three, since  
20                  heavy-duty U-bolts are generally not used when a PUS type U-  
21                  bolt would only be loaded to approximately 1/3 of its  
22                  capacity for the old loads issued 1/17/83).

23                  It should be noted that these significant increases and  
24                  the failure and potential failures were not mentioned in  
25                  Applicants' affidavits. For that matter, Dr. Iotti and John

1 Finneran time after time in their affidavit assure us we were  
2 not even approaching an area of problem.

3 These supports may have been replaced under the guise of  
4 conservatism, as may be found in Applicants' 5/23/84 Motion  
5 for Summary Disposition, at page 5, second paragraph, where  
6 it states:

7 "Despite Gibbs & Hill's re-evaluation which established  
8 that the system as-built would have been acceptable,  
9 Applicants decided to replace all U-bolts on rigid  
10 frames initially considered as one-way restraints where  
11 piping thermal movements were computed to be equal to,  
12 or exceed, 1/16" in the original analysis."

13 However, in the three supports which either fail or may  
14 fail as indicated above (CC-2-126-011-F43R, CC-2-126-005-  
15 F43R, CC-2-126-006-F43R), the maximum thermal movement  
16 according to Table 1 was only .008. My assumption for the  
17 above is based on the fact that not only are this failure and  
18 these potential failures not mentioned in the text, but in  
19 Table 4, page 3, where these supports are listed and  
20 asterisked, no mention of per cent change is indicated.

21 In reality, the reason for replacing these U-bolts was  
22 that the U-bolt was not qualified to accept a 952 lb. lateral  
23 load for normal upset for support CC-2-126-005-F43R, a 318  
24 lb. lateral load combined with the normal load for support  
25 CC-2-126-006-F43R, and a 61 lb. lateral load for normal upset  
for support CC-2-126-011-F43R (I am assuming that the  
change resulted since this was a light-weight U-bolt -- in



1 any event, there is no doubt that one support absolutely  
2 failed to meet the criterion, CC-2-126-005-F43R), even  
3 assuming that this was a heavy-duty U-bolt for this 12" line.  
4 See CASE Exhibit 669B, items 13-0, 13Q, and 13R.

5 Also, from Table 2, Problem AB-1-65, the following  
6 supports did not react in the manner assumed. CC-X-013-012-  
7 A43R picked up a lateral load of 232 lbs. at normal upset  
8 load conditions. CC-X-023-014-A43R picked up a 71 lb.  
9 lateral load, which did not exist previously. CC-X-023-015-  
10 A43R picked up an 88 lb. lateral load. These lateral loads  
11 represent a significant ratio of the lateral capacity of the  
12 U-bolt.

13 In addition, another support, CC-X-023-011-A43R,  
14 indicates that an additional load of 2300 lbs. was picked up  
15 in the Fx direction which did not exist in the previous  
16 analysis.

17 In no case are the effects of friction on these U-bolts  
18 mentioned in the analysis by Applicants, which would increase  
19 the effects of interaction. Therefore, even this analysis is  
20 non-conservative.

- 21 (6) This is yet another example of where the Applicants' attempt  
22 to prove a point invariably results in opposite conclusions.  
23 For example, in the cases above, Applicants actually prove  
24 that when node point restraints are properly input, 13% of  
25 the supports analyzed are, at best, non-conservatively

1                   designed.

2                   Again, Applicants and NRC Staff have gone to school at the expense  
3 of, and under the tutorage of, CASE witnesses.

4                   The attitude of the Applicants will illuminate the purpose for 10  
5 CFR Part 50, Appendix B, Criterion XVI, which states, in part:

6                   "Measures shall be established to assure that conditions adverse  
7 to quality, such as failures, malfunctions, deficiencies,  
8 deviations, defective material and equipment, and nonconformances  
9 are promptly identified and corrected. In the case of significant  
conditions adverse to quality, the measures shall assure that the  
cause of the condition is determined and corrective action taken  
to preclude repetition."

10                  See also 10 CFR 50.55(e)(ii), which states, in part:

11                  ". . . the holder of the permit shall notify the Commission of  
12 each deficiency found in design and construction, which, were it  
13 to have remained uncorrected, could have affected adversely the  
14 safety of operations of the nuclear power plant at any time  
throughout the expected lifetime of the plant, and which  
represents: . . .

15                  "(ii) A significant deficiency in final design as approved and  
16 released for construction such that the design does not conform to  
the criteria and bases stated in the safety analysis report or  
construction permit. . . "

17                  See also CASE's 8/22/83 Proposed Findings of Fact and Conclusions  
18 of Law (Walsh/Doyle Allegations), Section XXIX. Reportability of Non-  
19 Conforming Conditions.

20                  Also, ANSI N45.2 (CASE Exhibit 687, admitted at Tr. 6414), to  
21 which Applicants are committed, states that adverse items must be  
22 promptly identified and corrected as soon as practical.

23                  The Applicants' inability to conform with the above laws may be  
24 noted from the following: At Question and Answer 16 in Applicants'  
25 Exhibit 142 (Applicants' Prefiled Testimony for September 1982

1 hearings), page 5, Mr. Finneran, Applicants' Pipe Support Engineer for  
2 the Pipe Support Engineering (PSE) Group, stated "the true constraining  
3 nature of the U-bolts is accounted for in the 'as built' piping  
4 analysis and subsequent support review program. Modifications are  
5 being made where this review indicates they are warranted." (But this  
6 means that corrective action cannot occur until after construction of  
7 the system.) Mr. Finneran's failure to comply with the requirements of  
8 the law and codes is understandable. At Tr. 5004/9-12, Mr. Finneran  
9 conceded that he is not an expert in the codes.

10 The NRC Staff, on this matter, plays a game of semantics by  
11 stating that none of the Walsh/Doyle allegations represented a  
12 significant deficiency (see NRC Staff Witnesses Tapia, Taylor, Burwell,  
13 Chen, and Rajan at Tr. 6682-6685). However, when 35 per cent of the  
14 original supports cited in my original testimony (September 1982) had  
15 to be rebuilt, the deficiency was significant.

16 On the matter of U-bolts designed as one-way constraints when  
17 actually operating as two-way constraints, the NRC Staff has the  
18 following to say on the subject (see SIT Report, Staff Exhibit 207,  
19 page 30, fifth full paragraph):

20 "Furthermore, in the subsequent discussions with the Applicant,  
21 seismic displacement data at selected one-way U-bolt restraints  
22 were presented to the Special Inspection Team. These data  
23 indicated that these displacements were less than about 1/32 inch.  
24 Loads associated with these displacements are also negligible."

25 The NRC Staff continued (SIT Report, bottom of page 30 continued  
top of page 31):

"(1) Piping stresses due to restraint of up to 1/16 inch of this

1 type of thermal expansion movement are negligible for all  
2 pipe sizes.

3 "(2) Lateral loads on the U-bolts due to thermal expansion  
4 movements of this type of up to 1/16 inch are negligible for  
all pipe sizes when the relative flexibilities of the pipe  
and U-bolts are considered."

5 Here again we have Applicants and the NRC Staff qualifying  
6 supports based on engineering judgement when in reality they had no  
7 concept of the structural system behavior or the load paths. History  
8 has proven that a problem in fact existed and that this concept of  
9 supporting pipes for one-way loads is in violation of the codes, the  
10 laws and sound engineering fundamentals.

11 Because of the mass of facts contained in this affidavit, I will  
12 only present one more document by the Applicants to prove their case.  
13 But again, this report by Applicants did not precede the construction  
14 but was generated to justify the construction. This last example has  
15 to do with:

### 16 3. Generic vs. Actual Stiffnesses in Piping Analysis

17 The Applicants' Generic Stiffness Study which was performed for  
18 two as-built systems considered the effects of inputting the actual  
19 stiffness of the supports on the loads at the node points. (See  
20 Applicants' Motion for Summary Disposition Regarding Use of Generic  
21 Stiffnesses Instead of Actual Stiffnesses in Piping Analysis; see  
22 also Affidavit of W. Paul Chen on Open Items Relating to Walsh/Doyle  
23 Concerns filed 10/14/83; and Attachment (Applicants' 8/17/83 Additional  
24 Pipe Support Generic Stiffness Study).

25 The Applicants' analysis of the actual stiffness was not complete,



1 since it failed to consider the effects of the anchor bolt, base plate,  
2 and in some cases the U-bolts. Cygna's Dr. Bjorkman, in his testimony  
3 during the April 1984 hearings stated (Tr. 12,865/16-21) that according  
4 to actual tests:

5 ". . . for their particular test and their particular  
6 configuration, a particular value of L that they chose. The  
7 baseplate contributed no more than half to the total displacement.  
In other words, it was approximately 50 percent or less to the  
total."

8 Further, the Applicants failed to include such eccentricities as  
9 are indicated on drawing No. CC-2-011-001-A73R, CC-2-011-003-A73R, and  
10 CC-2-011-005-A73R -- this support also has about a 12 degree kick  
11 angle. These supports are unstable structures which depend on the  
12 torsional stiffness of the pipe to establish the ultimate stiffness of  
13 the support.

14 One fact that does come through loud and clear in the analysis  
15 (even though it is incomplete) by the Applicants is that the generic  
16 stiffness factors were not represented in the installed supports, and  
17 in fact, for the 6" line, the actual stiffness varied from 3.6 times  
18 the generic value to 1/70 of the generic value, and for that case 75%  
19 of the loads increased and were therefore nonconservative. The maximum  
20 increase for one support was 200%; 20% of the supports exhibited load  
21 changes greater than 25%. And it must be mentioned one more time,  
22 these stiffness values did not include the effects of U-bolts, base  
23 plates, anchor bolts, gaps, etc. The greatest load increase in terms  
24 of actual load was one support, the load of which went from 824 lbs. to  
25 1371 lbs. At one anchor, force and one moment also increased more than

1 25%. At the other anchor, all moments and two forces increased, and it  
2 must be recalled that this was for a system with only one support at  
3 1/70 of the generic stiffness, and as shown above, the possibilities  
4 for many systems with one or more soft support (1/70) exists. See W.  
5 Paul Chen Affidavit on Open Items Relating to Walsh/Doyle Concerns  
6 (under cover letter of 10/14/83), page 24, and Attachment (Applicants'  
7 8/17/83 Additional Pipe Support Generic Stiffness Study).

8 Recalculation of support loads was also done for support No. CC-1-  
9 107-008-E23R, which was a support that had a generic stiffness of 1/360  
10 of the generic stiffness. The load increase in this particular support  
11 was over 600% and resulted in a redesign of the support by CMC 94130,  
12 July 29, 1983 (see 10/14/83 Chen Affidavit, pages 25 and 26; see also  
13 drawing, CASE Exhibit 669B, Attachment to Deposition/Testimony of Jack  
14 Doyle, item 11TT).

15 The fact that the effects of U-bolts, struts, etc., influenced the  
16 dynamics of systems, while apparently not a concern of the Applicants or  
17 NRC Region IV, is an express concern of the Nuclear Regulatory  
18 Commission. See the Board's 12/28/83 Memorandum and Order (Quality  
19 Assurance for Design) at page 38, quoting Board Notification 82-105A,  
20 IV, pages 4 and 5, which states:

21 "The dynamic interaction between the pipe and pipe clamp is a  
22 complex design problem. From a design standpoint, there are many  
23 uncertainties that could affect the actual system response such as  
24 consideration of total support system flexibility, mechanical non-  
25 linearities, construction and installation tolerances, and  
uncertainties in the dynamic loading itself. It is beyond the  
scope of this report to discuss the clamp-to-piping responses to  
these various factors. However, the report will focus on those  
local dynamic effects on the piping that can be attributed

1 primarily to the clamp attachment that, in general, are not  
2 explicitly evaluated by piping designers."

3 Therefore, the seismic analysis is rendered nonconservative due to  
4 the fact (as shown above) that the generic stiffness values are not  
5 representative of the supports as used at Comanche Peak.

6 The facts are that the use of generic stiffnesses represents a  
7 gross concern for the design of Comanche Peak and is in violation of  
8 the codes and laws to which Applicants are committed. On this item,  
9 while the NRC Staff attempts to derate the results of the generic  
10 stiffness analysis, it must also be pointed out that it was the NRC  
11 Staff who requested the study in order to justify the use of generic  
12 deflection in design. For this they are to be congratulated.

13 The Applicants, on the other hand, engaged in a stiffness vs.  
14 frequency word game (see Applicants' Witness Vivirito, Tr. 7070/20-  
15 7071/10). In reading this section of the testimony, much verbiage is  
16 devoted to comparing stiffness with frequency but no words are spoken  
17 which indicate the effects of the actual stiffness on loads -- which  
18 was the real issue. Applicants' diversionary tactics indicate clearly  
19 an unwillingness to be candid with the Board.

20 Applicants' diversions continued with the statement by Mr.  
21 Vivirito at Tr. 7067/7-11:

22 ". . . We have performed the study and it is a similar study to  
23 what everyone has performed, and they came to the same conclusion,  
24 and so are we: that support stiffness variations have very little  
25 effect on the dynamic response."

24 The Applicants have admitted that they employed "somewhat  
25 knowledgeable" engineers. In my opinion, this is a gross exaggeration

1 of the Applicants' engineering qualifications. I say this because if  
2 Applicants' engineers have any knowledge, they have failed to display  
3 any tendency to exhibit such quality.

4 Q13. Do you have any further comments on the Comanche Peak QA/QC program?

5 A13. What QA/QC program? At Tr. 7192, Applicants' Witness Finneran stated  
6 that for the 9-level final vendor review program, only their most  
7 qualified personnel would participate. And yet with the oversight of  
8 Mr. Vega and the most qualified engineers on site, 77-1/2% of the main  
9 steam support calculations contained gross engineering errors, with  
10 most of the calculations containing a multiplicity of errors. In fact,  
11 one support of the total of 22 main steam supports had such a gross  
12 error that it failed and had to be rebuilt.

13 Of the three major nuclear accidents that threatened the public  
14 health and safety, all were initiated by minor incidents:

- 15 (1) Fermi 1 accident, caused by failure of a zirconium deflector  
16 which wasn't really required in the first place.  
17 (2) Brown's Ferry accident, caused by non-fireproof materials  
18 ignited by a worker's candle.  
19 (3) Three Mile Island accident, caused by failure of a 3/4 inch  
20 air valve.

21 In view of the facts as stated above and the facts that:

- 22 (1) At least 6 of 9 of the calculations that I reviewed from  
23 Phase 1 of the Cygna review had gross errors in the final  
24 vendor certified calculations which were not noted by Cygna.  
25 And again, 1 of the 9 supports structurally failed and



1 required redesign.

2 (2) Of the 89 supports (31 with calculations), 31 had to be  
3 modified to prevent collapse.

4 When I proved that a fatal error existed in the upper lateral  
5 restraint, NRC Staff Witness Dr. Chen stated at Tr. 6058 that he did  
6 not consider one error in four calculations "to be that significant."  
7 I wonder if Dr. Chen considers a multiplicity of errors in each of 18  
8 out of 22 supports to also be insignificant.

9 I say again -- what QA/QC program?

10 Q14. Did you select the main steam system to discuss because there are more  
11 problems with it than with other systems?

12 A14. No. In a cursory review of the component cooling system (see Volumes 2  
13 and 3 of the Phase 3 Cygna Report, PS-001 to PS-066), I found that 70  
14 per cent of the calculations contained gross engineering errors. I  
15 also found that two (PS-017 and PS-026) of the supports would have  
16 structural failures (same as the failure in CASE Exhibit 928, Support  
17 No. SI-1-325-002-S32R). While this number is slightly less than found  
18 in the main steam system, it is still very significant.

19 I chose the main steam because it was a more critical system and  
20 was smaller (22 supports vs. 66 supports) and therefore easier to  
21 detail in this affidavit.

22 Beyond that, I didn't second-guess Cygna on generic calculational  
23 procedures which they wrote off (cinching, instability, double axial  
24 restraints, etc.) since these issues are being handled in CASE's  
25 Answers to Applicants' Motions for Summary Disposition. The only

1 errors I cite here are those cited by Cygna in the Phases 1, 2, and 3  
2 Cygna Reports.

3 Q15. Are there any problems which are of an interface nature on which you  
4 would like to comment?

5 A15. Yes. In Volume 1 of the Phase 3 Cygna Report (Section 1, page 4) under  
6 PI-00-06, the observation is noted that in numerous instances (18  
7 supports) for the main steam inside containment, the support loads used  
8 in design did not match the values obtained by examining the computer  
9 output. In one case (Support No. MS-1-004-005-C72K), the snubber is  
10 overloaded by using the method of analysis historically used by Gibbs &  
11 Hill.

12 I have two statements to make on this point. First, the gravity  
13 of the erroneous use of loads is not reflected in the pipe support  
14 review, and second, this is not in keeping with the intent of the final  
15 vendor certification program as stated by Applicants' Witness Vega at  
16 Tr. 7153 where he states that step 7 of the iteration compares loads  
17 and modifies them if required.

18 In all, at least four supports are known to have required rework  
19 and one required reanalysis after the final design review for vendor  
20 certification was completed. This is in addition to the 31 which were  
21 redesigned as a result of the original Walsh/Doyle allegations. I must  
22 note that this does not include the U-bolts which were replaced during  
23 the reanalysis for U-bolts used as one-way supports but acting as two-  
24 way constraints.

25 Q16. Could you briefly summarize the main points contained in your

1 affidavit?

2 A16. I'll try. In this affidavit, I have attempted to bring together the  
3 waft and weave which covers more than two years of hearings to present  
4 a tapestry of Applicants' (generally with the approval of the NRC  
5 Staff) incompetence, evasion, and practices which are dangerous to the  
6 health and safety of the public.

7 This affidavit covers four major phases that have occurred during  
8 these hearings:

- 9 (1) The filing of my deposition/testimony, September 1982.  
10 (2) Phases 1 and 2 of the independent design review by Cygna  
11 Energy Services.  
12 (3) Phase 3 of the independent design review by Cygna Energy  
13 Services.  
14 (4) Applicants' filings of Motions for Summary Disposition.

15 The items shown above, taken individually or collectively, draw a  
16 clear portrait of massive incorporation of errors in pipe supports  
17 critical to the safety of Comanche Peak and, as a result, are directly  
18 related to the health and safety of the public.

19 As a result of the condition of the engineering calculations for  
20 the pipe supports after the final review certification, anyone but the  
21 "somewhat knowledgeable" must recognize that the status of engineering  
22 at Comanche Peak at the time of the filing of the original allegations  
23 was nothing less than a disaster.

24 The conclusions which I have drawn, based on documented evidence  
25 (primarily supplied by Applicants, the NRC Staff, or Cygna Energy

1 Services) can be generally summarized as follows:

- 2 1. The iterative design program which exists at Comanche Peak  
3 consists of a design and check program followed by a nine-  
4 level review program.
- 5 2. The allegations originally stated by me (and supported by  
6 documentation) contained 52 node points involving 58 supports  
7 and related to the status of Comanche Peak to the last day of  
8 my employment.
- 9 3. Applicants' attempts to show that no problem exists relative  
10 to CPSES generic concerns raised by Mark Walsh and me (the  
11 Walsh/Doyle allegations) actually prove the Applicants had no  
12 knowledge of the level of problem prior to construction.
- 13 4. Applicants' final vendor certified review program was  
14 developed to insure that the contents of the design and  
15 analysis would be error-free.
- 16 5. Phases 1 and 2 of the review by Cygna Energy Services failed  
17 to note at least 6 major engineering fundamental errors which  
18 existed on 9 of the pipe support calculations reviewed by  
19 CASE.
- 20 6. Cygna Energy Services failed to note that one support of the  
21 9 mentioned above suffered a structural failure on the  
22 modification incorporated to insure stability.
- 23 7. In the Phase 3 review by Cygna Energy Services (main steam  
24 supports), 77.5 per cent of the main steam support  
25 calculations contained gross calculational errors.



- 1           8. In the Phase 3 review by Cygna Energy Services, one support  
2           had such gross calculational errors that the support failed  
3           and was redesigned.
- 4           9. When 77.5 per cent of the calculations for one area and 67  
5           per cent of the calculations in another have gross errors,  
6           the accuracy of the remaining plant systems is suspect.
- 7           10. When 31 per cent of the original supports alleged to have  
8           serious faults are rebuilt and 6-1/2 per cent of the 31  
9           reviewed (by Cygna and later by CASE) had to be rebuilt, the  
10          safety of the plant is indeterminate.
- 11          11. There is no doubt that the independent review process is  
12          neither independent nor reliable.
- 13          12. The NRC Staff has failed in its assigned mission to insure  
14          the health and safety of the public.
- 15          13. The QA/QC program at Comanche Peak has not only failed, it is  
16          non-existent.
- 17          14. Evasion of the truth by Applicants and their agents and the  
18          NRC Staff has been rampant in the hearings before the Atomic  
19          Safety and Licensing Board.
- 20          15. The review of three systems at Comanche Peak (residual heat  
21          removal, main steam, and component cooling), all of which  
22          were final vendor certified, resulted in a calculation error  
23          rate of  $6 + 18 + 46$  divided by  $9 + 66 + 22 = 72$  per cent.  
24          (An error in this case could be one error or a multiplicity  
25          of errors, because only the support was counted as an error

1                   regardless of the number of errors.)

2           16. The U-bolt cross-bar/clamp analogy used at Comanche Peak is  
3           not standard industry practice.

4           17. Practices followed by engineering at Comanche Peak are in  
5           non-compliance with the law.

6           18. The preceding analysis of the Cygna review proves beyond  
7           doubt that there are major problems involving calculational  
8           errors, including the fact that no less than four supports  
9           required modification due to errors in the final vendor  
10          certified calculation . . . identified by either Cygna or (in  
11          the event Cygna missed it) by CASE. Had CASE had access to  
12          all of the calculations for Phase 2 of the Cygna Report, it  
13          is more than likely that we would have found more errors and  
14          possibly more support failures, as was the case when we  
15          reviewed the nine supports from Phase 1.

16          From the preceding, the Comanche Peak facility can only be  
17          considered indeterminate at best and dangerous as a definite  
18          possibility. The fact that at a minimum 72 to 78 per cent of the  
19          calculations which I reviewed contained gross errors -- even after some  
20          ten levels of checking by Applicants, and that at a minimum four of  
21          these supports required rework to prevent failure, shows that  
22          regardless of how many erroneous calculations can later be shown to be  
23          within allowables, at least some of the about 90 calculations (or  
24          neglect to do calculations) proved fatal to complying with the intent  
25          of the codes.

1           The safety of this plant is therefore in doubt unless a 100 per  
2           cent reinspection -- by parties not dependent on the nuclear industry  
3           for their livelihood -- identifies the massive errors which have been  
4           incorporated, with oversights and proper corrective measures as  
5           required to bring the plant up to the level of confidence required to  
6           insure the public health and safety.

The preceding CASE's Motion for Summary Disposition was prepared under my personal direction, CASE Witness Jack Doyle. I can be contacted through CASE President, Mrs. Juanita Ellis, 1426 S. Polk, Dallas, Texas 75224, 214/946-9446.

My qualifications and background are already a part of the record in these proceedings. (See CASE Exhibit 842, Revision to Resume of Jack Doyle, accepted into evidence at Tr. 7042; see also Board's 12/28/83 Memorandum and Order (Quality Assurance for Design), pages 14-16.)

I have read the statements herein, and they are true and correct to the best of my knowledge and belief.

Jack Doyle  
(Signed) Jack Doyle  
Date: Oct 1 1984

STATE OF Massachusetts  
COUNTY OF Plymouth

On this, the 1st day of October, 1984, personally appeared Jack Doyle, known to me to be the person whose name is subscribed to the foregoing instrument, and acknowledged to me that he executed the same for the purposes therein expressed.

Subscribed and sworn before me on the 1st day of October, 1984.

Thomas A. Pato  
Notary Public in and for the  
State of Massachusetts

My Commission Expires: \_\_\_\_\_



UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	}}	
	}}	
TEXAS UTILITIES ELECTRIC	}}	Docket Nos. 50-445-1
COMPANY, <u>et al.</u>	}}	and 50-446-1
(Comanche Peak Steam Electric	}}	
Station, Units 1 and 2)	}}	

CERTIFICATE OF SERVICE

By my signature below, I hereby certify that true and correct copies of  
CASE's Motion and Offer of Proof; and CASE's First Motion for Summary Disposition  
Regarding Certain Aspects of the Implementation of Applicants' Design and  
QA/QC for Design

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have been sent to the names listed below this 6th day of October, 1984,  
by: Express Mail where indicated by \* and First Class Mail elsewhere.

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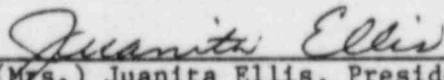
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