UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of TEXAS UTILITIES GENERATING COMPANY, et al. (Comanche Peak Steam Electric Station Station, Units 1 and 2)	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 Summar 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;

Criterion I;

Criterion II, specifically last 17 lines, which state:

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

Criterion III;

Criterion IV;

Criterion V;

Criterion VI;

Criterion VII;

Criterion VIII;

Criterion IX;

Criterion X;

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

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

Criterion XV;

Criterion XVI;

Criterion XVII; and

Criterion XVIII.

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

ANSI N45.2.11;

ASME Section III;

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

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

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

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

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

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

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

12,000 tons of structural steel;

50,000 cu. yards of concrete;

2 million feet of copper wire;

100,000 ft. of instrumentation pipe and tubing;

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

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

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

there were over 12,000 pipe supports with hundreds of thousands of joint welds;

the numbers involved in the electrical, HVAC, and cable trays rival the numbers cited for the piping systems;

this plant required over 10 million man-hours of manual labor and over a million hours of non-manual labor.

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

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

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

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

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

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

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

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

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

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

the position that all of the allegations are without merit.

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

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

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

(1) MS-1-003-006-S72R (in design, this is similar for MS-1-001-006-S72R; MS-1-002-006-S72R; and MS-1-004-006-S72R);

(2) MS-1-001-005-S72R (see Cygna Report, Volume III, PS-071);

(3) SI-1-031-704-A32R (2 supports);

(4) CC-1-028-701-A33R.

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

The Applicants also confirmed that the box beams would be

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

(1) CC-1-028-034-S33R (see below for change required for W6x12 beam base attachment);

(2) CC-1-028-039-S33R (see below for change required for W6x12 beam base attachment);

(3) CC-1-020-001-A33K;

(4) CC-1-159-010-S43R;

(5) CT-1-008-007-S22K;

(6) CT-1-008-008-S22K.

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

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

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

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

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

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

The third memo, dated 4/2/82 (Attachment A-3 to Finneran Affidavit) was an answer to the previous request for information, and was authored by Ron Wisniewski (ITT Grinnell home office) to Gus Abele. 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."

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

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

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

The chain of codes and laws is as follows:

(1) In accordance with the provisions of ASME Section III, NA-3250 (PROVISION OF DESIGN SPECIFICATIONS), Applicants prepared a technical specification for nuclear safety-related equipment;

(2) The title of the document generated in compliance with

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

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

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

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

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

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

> "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

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."

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

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

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

(7) Table 1, page 3, of SP-69 does not recommend the use of U-bolts (type 24 is the designation for U-bolt in this material) for insulated lines classified as Hot A-1. And 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.

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

(9) The practices used in the design and construction at 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.)

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

> "(2) A summary description and discussion of the facility, with special attention to design and operating characteristics, unusual or novel design features, and principal safety considerations." (Emphases added.)
>
> "(8) An identification of those structures, systems, or components . . . which require research and development to confirm the adequacy of their design; and identification and description of the research and development program which will be conducted to resolve any safety questions associated with such structures, systems or components; and a schedule of the research and development program showing that such safety questions will be resolved at or before the latest date stated in the application for completion of construction of the facility." (Emphases added.)
>
> "(9) The technical qualifications of the applicant to engage in the proposed activities in accordance with the regulations in this chapter." (Emphasis 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.

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

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

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

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

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

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

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

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

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

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

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

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

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

(1) 2323-S1-0538-07 (see CASE Exhibit 669B, items 9Q-9S) -- major member added, changed to truss support (see CASE Witness Doyle at Tr. 6227);

(2) CC-1-028-034-S33R and CC-1-028-039-S33R -- 6" wide flange member; web failed; needed redesign (see 12/13/83 Affidavit of NRC Staff Witness Dr. Rajan, attached to NRC Staff's 12/13/83 Motion to Reopen Record to Admit the Affidavit of Dr. Jai Raj N. Rajan);

(3) CC-2-007-025-A43R -- support changed to eliminate two-way load (see Applicants' 5/23/84 Motion for Summary Disposition on U-Bolts Acting As Two-Way Constraints, Table 3, Problem AB-1-62E, Second page 2);

(4) CC-1-107-008-E23R -- major change (see 10/14/83 Affidavit of W. Paul Chen on Open Items Relating to Walsh/Doyle Concerns, page 26);

(5) CC-1-116-038-F43R -- 1/4 inch wall of 8-inch tube failed; rebuilt (see Applicants' Witness Finneran at Tr. 4793/4-8, also CASE's 8/23/83 Proposed Findings of Fact and Conclusions of Law (Walsh/Doyle Allegations) at pages XIII - 3 through - 6);

(6) CS-1-239-007-A42R -- changed by CMC 58004 (see SIT Report, NRC Staff Exhibit 207, page 42);

(7) CC-2-008-709-A43K -- the SIT uncovered a numerical error in Applicants' preliminary calculations which resulted in underestimation of bending stress and could result in an overstress condition; Applicants indicated their subsequent review identified an overstress condition which would be rectified (SIT Report, pages 41-42).

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

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

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

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

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

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

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

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

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

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

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

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

(1) Richmond bolts of A307 steel in bending;

(2) Oversize holes for non-friction joints;

(3) Coupling and prying (Mx and Mz moments) Richmond/tube steel structures;

(4) Actual vs. generic stiffness;

(5) Coupling of moments for double axial restraints;

(6) U-bolts which are actually two-way restraints but designed as one-way restraints;

(7) Cinching and thermal problems with U-bolts;

(8) Thermal problems with box frames with zero (0) clearance;

(9) Thermal locking at anchors;

(10) Problems with moment restraints and upper lateral restraint.

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

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

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

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

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

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

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

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

1. Stresses and Deflections at Local Areas:

In reference to the Applicants' ability to catch any errors in engineering during the vendor certification program, examination of the results of reviewing only 9 calculations during the evaluation of the Cygna Phases 1 and 2 material will indicate the fallacy of that thou[illegible].

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

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

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

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

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

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

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

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

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

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

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

2. Double Axial Restraints (snubbers or struts):

(1) Either of the two supports (snubbers or struts), when input as a moment restraining system, will experience substantially higher loads than are evident when the node point is input into the pipe stress model as a single unit acting along the centerline of pipe with the total load later divided equally to the two supports. This is a recognized problem in industries associated with piping systems; see, for example, ANSI B31.1, paragraph 121.3.1 (a) and (b). The facts on this item are that after two years of resting secure in the knowledge that the Applicants were convinced of the problems in this procedure and had instituted corrective measures, we learned that their knowledge only extended to several systems, and other systems were still being accepted which were not being introduced into the computer as two-way restraints (force and moment).

(2) When pressed on this issue, Cygna performed analyses which revealed that for the supports analyzed, the following was noted:

(a) When input as a single entity, the load on either snubber of the system analyzed was 1328 lbs., but when both snubbers were input into the computer excentric to the centerlline of pipe, the division of loading was no longer 50/50.

(b) The most loaded snubber had a load of 3933 lbs., almost three times the previous condition. This would also have an effect on the base plate and anchor bolts. (See Tr. 12,851.)

(c) The facts involved in noncompliance in this case are as

follows:

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

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

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

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

Ms. Williams admitted that the restraint effect was taken into

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

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

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

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

(1) Box frames, U-bolt structural clamping devices, and other hardware supported by the pipe must be included in as dead weight in the pipe stress analysis.

(2) The SIT found that an assessment of this contribution to the piping loads is made on a case-by-case basis . . . if the

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

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

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

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

(a) In accordance with the provisions of ASME Section III, NA-3250 (PROVISION OF DESIGN SPECIFICATIONS), Applicants prepared a technical specification for nuclear safety-related equipment;

(b) The title of the document generated in compliance with ASME Section III, NA-3250, is NUCLEAR SAFETY CLASS PIPE

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

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

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

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

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

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

> "g. Manufacturers' Standardizatior Society (MSS)
>
> "(1) MSS SP-58, Pipe Hangers and Support-Materials and Design
>
> "(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."

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

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

4. Cinched-Up U-Bolts:

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

(a) In almost two years of attempts, the NRC Staff and the Applicants have failed to show that cinching is no problem.

(b) Cygna Energy Services, hired as a consultant by the Applicants for an independent assessment program, was challenged on their uncontesting acceptance of this method of clamping. They spent over two months in analyzing the problem using the most sophisticated and accurate means currently available.

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

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

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

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

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

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

realized that the undertaking was far larger than could be answered in that time period . . . (Tr. 12,406/9-12).

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

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

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

(a) In accordance with the provisions of ASME Section III, NA-3250, PROVISIONS OF DESIGN SPECIFICATIONS, Applicants prepared a technical specification for nuclear safety-related equipment;

(b) The title of the document generated in compliance with ASME Section III, NA-3250, is NUCLEAR SAFETY CLASS PIPE HANGERS AND SUPPORTS, SPECIFICATION 2323-MS-46A;

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

> "The Manufacturer who completes or substantially completes any component, appurtenance, core support structure, or component support required to be in compliance with this Section has the responsibility for 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

following is included:

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> "(1) MSS SP-58, Pipe Hangers and Support-Materials and Design
>
> "(2) MSS SP-69, Pipe Hangers and Supports-Selection and Application"

(e) 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."

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

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

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

(j) Also, Comanche Peak practices evade the provisions of 10 CFR 50.55(a)(a) regarding design to standards commensurate with the safety function.

(k) Comanche Peak practices evade the provisions of 10 CFR 50.34(a)(8) on the requirement to prepare a plan for research and development for unique designs in the PSAR.

The next item for consideration is in reference to:

5. Box Frames:

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

(1) Stresses in the box frame and most particularly the welding in the box frame are indeterminate.

(2) Stresses in the pipe due to the constraint of the thermal growth of the pipe caused by the box frame are indeterminate.

(3) We again have the problem of no positive means of engagement between the pipe and the box frame.

(4) The use of box frame deviates from the provisions of SP-69 in that this is not a rigid support in the direction of loading, whether

from below or regardless of direction in a seismic event.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

> "Items 16 to 23 (stability part of the structure) are not designed. Acceptability of this support is entirely based on the review of the design of the structral components not related to the stability part of the structure. (See Observation PS-02).
>
> "The methodology used to check the weld between items 8 and 9 is incorrect. However, the weld is acceptable (composite section). See Cygna calculation 84042, 4-F, Set B3, Rev. 0. See Observation PS-07."

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

> Item 2: "There are no design calculations for the bumper portion of this restraint (see Observation PS-02)."
>
> Item 22: "Weld of T.S. to Item 5 is not considered in calculations, weld stresses acceptable per Cygna Calculation (File 4-F, 84042, Calculation Set B2, Rev. 0)."

PS-071, Item 13, page 6 of 10. It should be noted that this problem could be critical if the error were reversed and a column 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

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

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

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

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

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

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

PS-072, Item 2, page 1 of 9, and
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)."

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

"STRUDL model does not match as-built support drawings with respect to:

1. Member Lengths;
2. Load Application Point.

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

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

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

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

Same comments apply as for Item 1 preceding.

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

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

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

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

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

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

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

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

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

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

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."

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

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

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."

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

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

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

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

PS-078, Item 1, pages 1 of 10 and 2 of 10,
PS-078, Item 2, page 2 of 10:

> Item 1: "Input data calculations for STRUDL model shown on 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.
>
> "Members 5 & 6
> "Iy should be 359.95, but 681.51 used in STRUDL input Sy should be 71.99, but 136.3 was used in design.
>
> "Members 8 to 11
> "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.
>
> "Reanalyses of the frame was required in order to obtain the correct forces & moment for designs. Per TUGCO's calculation dated June 8, 1984, the frame is re-analyzed with beam (Item 22) boxed with 3/4" plates. The modified support is acceptable (Reference Cygna communications report, dated May 24, 1984, Question 41). See Observation PS-01."
>
> Item 2: "The STRUDL analysis assumed fixed ends at nodes 4, 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.
> Per TUGCO's calculation, dated June 8, 1984, the frame was modified. In the re-analysis Nodes 4, 8, 14 & 17 are modeled

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

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

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

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

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

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

It should be noted, however, that Cygna could not review the 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)."

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

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

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

Same comments apply here as for all of the above.

Item 23: "No cover plate provided at tube end moment joint (Material Item 18). It is acceptable per Cygna Calculation 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.

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

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

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

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

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

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,

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

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

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

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

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

"On support drawing sheet 1 of 3 plan view at el. 899' 9-1/2" shows structural tubes located at higher elevation 903' 7". Minor drafting inconsistency."

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

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

"6. **Tubesteel Prying on Richmond Inserts**

"In the designs which employ tubesteel/Richmond insert combinations, Cygna noted that the engineer released the rotation about the Y and Z axes (see sketch) in the STRUDL model for the frame. While release of the Y rotation is appropriate since the bolt is free within the tube, release of the Z rotation assumes that the tube will not bear against the washer at point 'A' and create a load due to prying on the bolt. TUGCO has provided justification for this and 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

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

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

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

Item 17: "Weight of the spring is not considered in STRUDL 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."

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

> Item 2: "Stress in pad was not checked, in this Revision but will be reviewed by NPSI (Secaucus). See Note 2."
>
> Item 8: "Snubber setting was not checked. However, it is acceptable as per Cygna Calculation C6."
>
> Item 12: "Prying action of tubes due to bending is not considered. See Note 6."

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

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

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

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

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

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.

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

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

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

1 Support required major modification to meet the code requirements due to calculational errors used to obtain the section properties for 2 members (see Phase 3 Cygna Report, Volume 3, PS-078).

2 other supports had errors in the calculations for the section properties (see PS-082 and PS-083).

4 supports had calculational errors in the weld analysis (see PS-069, PS-074, PS-083, and PS-087).

4 supports have calculations missing for structural members (see PS-069, PS-070, PS-073, and PS-082).

1 support has a calculation for section property of a weld which is incorrect (see PS-083).

2 supports have no base plate A/B calculations (see PS-073 and PS-087).

5 supports have missing weld calculations (see PS-070, PS-072, PS-073, PS-075, and PS-079).

1 support has severe warping problem while note on drawing prohibits warping (see PS-071).

1 support failed to include friction loads (see PS-087).

2 supports had calculations which used the wrong loads (see PS-073 and PS-086).

1 support incorrectly used the NPSI base plate computer program (see PS-085).

1 STRUDL model assumed to apply to a suport did not -- for answers to calculation problems another support calculation had to be consulted (see PS-081).

1 support required check for buckling but calculation not done (see PS-077).

1 support required check for crippling at concentrated loads but this was not done (see PS-075).

4 supports did not have calculations for the snubbers (see PS-075, PS-076, PS-079, and PS-087).

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 suports have been modified:

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

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

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

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

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

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

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

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

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

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

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

A11. I have in this regard only one general statement on the notes in Volume 1 of the Phase 3 Report, and in this I will only address Note 16 because the points would be similar for all of the excuses offered by the Applicants.

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

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

The highly sophisticated finite element procedure used by Dr.

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

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

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

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

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

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

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

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

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

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

(1) The flip flop of equations and assumptions for the upper lateral restraint (see CASE Witness Doyle, Tr. 6018-6032; NRC Staff Witness Chen, Tr. 6051; and Applicants' Motion for Summary Disposition Regarding Upper Lateral Restraint Beam).

(2) When finite element analysis proved that serious problems existed for the pipe and structure in the box beam arrangement (see Tr. 12,710-12,712, where Cygna's Dr. Bjorkman discusses the problems), Applicants reverted to hand calculation which could be easier manipulated (see Attachment A to Applicants' Motion for Summary Disposition relative to box frames with zero inch gaps).

(3) Finite element analysis of cinched-up U-bolts indicated fatal problems with this approach to clamping. While Cygna's Dr. Bjorkman did not accept the results of this analysis, he suggested that refinements to the model were required (see Tr. 12,882). The Applicants again chose to displace the highly sophisticated and extremely accurate finite element procedure with hand calculations which could be more easily manicured (see Applicants' Motion for Summary Disposition of

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

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

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

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

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

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

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

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

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

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

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

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

1. Cinched-Up U-Bolts:

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

As an example, with reference to the June 18, 1984, memo to Cygna, 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,

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

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

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

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

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

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

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

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

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

> MR. WALSH: "Have the stresses, due to the pretensioning of the bolts, been added to the normal expansion of the pipe?"
>
> JUDGE BLOCH: "First, is that addressed in the SIT report?"
>
> WITNESS CHEN: "As fr[illegible] the load combination -- the addition of stresses that Mr. [illegible] has just identified, no. But I believe that an assess[illegible]ade of the stresses resulting from preloading we [illegible] was made, and was written of[illegible] on the basis of engin[illegible]ring [illegible]gment and usual industry practice."

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

states, in part:

> "In the case of insulated piping (e.g., main steam, feedwater, and residual heat removal piping), the temperature difference between 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."

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

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

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

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

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

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

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

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

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

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

Applicants' view of this problem is that:

(1) Analysis was not required out-of-plane since these installed supports were only in the preliminary phase of construction and justification would come later. (See pages 3 to 4 of Applicants' Motion for Summary Disposition of CASE's Allegations Regarding U-Bolts Acting As Two-Way Restraints.)

(2) Applicants, in line with their premise that all construction at Comanche Peak is preliminary and finding that their initial premise was incorrect, removed a number of these supports and replaced them with new supports. (See page 5, paragraph 2, of Applicants' Motion for Summary Disposition of CASE's Allegations Regarding U-Bolts Acting As Two-Way Restraints.)

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

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

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

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

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

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

that the load increased 28%.

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

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

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

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

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

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

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

In reality, the reason for replacing these U-bolts was that the U-bolt was not qualified to accept a 952 lb. lateral load for normal upset for support CC-2-126-005-F43R, a 318 lb. lateral load combined with the normal load for support 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

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

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

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

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

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

designed.

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

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

> "Measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances 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."

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

> ". . . the holder of the permit shall notify the Commission of each deficiency found in design and construction, which, were it to have remained uncorrected, could have affected adversely the safety of operations of the nuclear power plant at any time throughout the expected lifetime of the plant, and which represents: . . .
>
> "(ii) A significant deficiency in final design as approved and released for construction such that the design does not conform to the criteria and bases stated in the safety analysis report or construction permit. . . "

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

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

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

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

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

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

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

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

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

"(2) Lateral loads on the U-bolts due to thermal expansion 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."

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

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

3. Generic vs. Actual Stiffnesses in Piping Analysis

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

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

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

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

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

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

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

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

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

> "The dynamic interaction between the pipe and pipe clamp is a complex design problem. From a design standpoint, there are many uncertainties that could affect the actual system response such as consideration of total support system flexibility, mechanical non-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

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

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

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

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

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

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

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

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

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

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

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

(1) Fermi 1 accident, caused by failure of a zirconium deflector which wasn't really required in the first place.

(2) Brown's Ferry accident, caused by non-fireproof materials ignited by a worker's candle.

(3) Three Mile Island accident, caused by failure of a 3/4 inch air valve.

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

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

required redesign.

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

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

I say again -- what QA/QC program?

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

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

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

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

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

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

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

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

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

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

affidavit?

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

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

(1) The filing of my deposition/testimony, September 1982.

(2) Phases 1 and 2 of the independent design review by Cygna Energy Services.

(3) Phase 3 of the independent design review by Cygna Energy Services.

(4) Applicants' filings of Motions for Summary Disposition.

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

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

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

Services) can be generally summarized as follows:

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

8. In the Phase 3 review by Cygna Energy Services, one support had such gross calculational errors that the support failed and was redesigned.

9. When 77.5 per cent of the calculations for one area and 67 per cent of the calculations in another have gross errors, the accuracy of the remaining plant systems is suspect.

10. When 31 per cent of the original supports alleged to have serious faults are rebuilt and 6-1/2 per cent of the 31 reviewed (by Cygna and later by CASE) had to be rebuilt, the safety of the plant is indeterminate.

11. There is no doubt that the independent review process is neither independent nor reliable.

12. The NRC Staff has failed in its assigned mission to insure the health and safety of the public.

13. The QA/QC program at Comanche Peak has not only failed, it is non-existent.

14. Evasion of the truth by Applicants and their agents and the NRC Staff has been rampant in the hearings before the Atomic Safety and Licensing Board.

15. The review of three systems at Comanche Peak (residual heat removal, main steam, and component cooling), all of which were final vendor certified, resulted in a <u>calculation error rate</u> of 6 + 18 + 46 divided by 9 + 66 + 22 = <u>72 per cent</u>. (An error in this case could be one error or a multiplicity of errors, because only the support was counted as an error

regardless of the number of errors.)

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

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

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

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

The safety of this plant is therefore in doubt unless a 100 per cent reinspection -- by parties not dependent on the nuclear industry for their livelihood -- identifies the massive errors which have been incorporated, with oversights and proper corrective measures as required to bring the plant up to the level of confidence required to 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 J Doyle
(Signed) Jack Doyle

Date: Oct 1 1984

STATE OF Massachusetts

COUNTY OF Norfolk

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.

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, et al.	}{	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

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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