

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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In the Matter of

TEXAS UTILITIES GENERATING
COMPANY, et al.

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

Docket Nos. 50-445-DL
and 50-446-DL

CASE'S STATEMENT OF MATERIAL FACTS
AS TO WHICH THERE IS NO GENUINE ISSUE
REGARDING LACK OF INDEPENDENCE AND/OR CREDIBILITY OF CYGNA

1. The Cygna Report (No. TR-83090-01, Draft Final Report, Independent Assessment Program for Comanche Peak Steam Electric Station (Phases 1 and 2), Prepared for Texas Utilities Services, Inc., Prepared by Cygna Energy Services, November 5, 1983; and No. TR-84042-01, Final Report, Independent Assessment Program of Comanche Peak Steam Electric Station (Phase 3), Prepared for Texas Utilities Generating Company, Prepared by Cygna Energy Services, July 16, 1984) forcefully conveys the idea that the contents are the firm position of Cygna as relates to the methodology utilized to build Comanche Peak. (Affidavit of CASE Witness Jack Doyle, at page 1.)
2. Over and over, Cygna bases their write-off of problems with the caveat that Applicants answered the question satisfactorily, but no analysis is made of why so many of Applicants' answers are flawed. (Id., at pages 1 and 2.)

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3. Cygna reversed its position on the use of U-bolts as clamps. And while discussing "basic box frame and U-bolt, clip angle, clamp, support, assemblage," Cygna's Ms. Williams and Dr. Bjorkman stated that in their experience, they had not seen other examples of that particular configuration. (Id., at page 2, item (1).)
4. In reference to the adequacy of the clip angle/U-bolt arrangement:
 - (a) Ms. Williams was certain of the adequacy; this was Cygna's firm position on this issue. The basic position of Cygna was predicated on the adequacy of the clip/U-bolt assembly to maintain stability. (Id., at pages 2-3.)
 - (b) There is no doubt that the specific support which was being discussed was support No. SI-1-325-002-S32R (CASE Exhibit 891, expanded and renumbered CASE Exhibit 928). On the fourth page of CASE Exhibit 891, which is Page 5 of 13 in the calculations, the last sentence states, "It is assumed that the U-bolt will prevent rotation and will not see any load." In that calculation, there was no analysis for either the U-bolt or the clamp angles which retain the U-bolt. (Id., at page 3.)
 - (c) Regarding CASE Exhibit 891, Ms. Williams testified that the U-bolt is critical and the bolting of the U-bolt critical. Ms. Williams also testified that if you take away the U-bolt, the support would not be stable. She further testified that the support would not be stable if the U-bolt is not cinched up, that if you had clearance around the U-bolt you might as well not have the U-bolt, and that for the support to be stable, the U-bolt must be cinched up. (Id., at page 3.)

- (d) Ms. Williams testified that Cygna believed that it would be correct to assume that the U-bolt will prevent rotation without calculations. (Id., at page 4.)
- (e) When questioned as to what the basis was for determining that this support was stable, Ms. Williams stated regarding what she knew of the basis, that Cygna believed the U-bolt will develop a sufficient clamping force to resist the rotation. When asked for more information as to why Cygna was satisfied that it will develop enough clamping force, Ms. Williams stated that they felt that because they are constructed of the same materials, and that they also believed Cygna could demonstrate this through analysis. (Id., at page 4.)
- (f) Ms. Williams testified that she was not saying whether Cygna asked if this was a use intended by the manufacturer, and that Cygna was saying that they felt it would develop sufficient strength to resist the rotation, and on that basis they felt it was acceptable. (Id., at page 4.)
- (g) Still regarding the matter of the clip/U-bolt assembly, Ms. Williams testified that Cygna had evaluated and had a position on each one of these issues. (Id., at page 4.)
- (h) Ms. Williams continued to defend the adequacy of the clip/U-bolt assembly, and testified that there were hand calculations, notes, field notes that people run checks on, and that the reviewer does his own calculation and justifies it in his mind and the team members' mind. (Id., at page 4.)

(i) Ms. Williams testified that:

"I think it doesn't matter how many engineers I parade up here; we are going to get down to a difference of opinion, and the only way we are going to be able to justify that is to produce some calculations that everyone can evaluate. A good example of that is the U-bolts. There isn't anybody else I can bring up on the stand right now who is going to tell you anything different than what I have already told you."

(Id., at page 5.)

(j) Still regarding the clip/U-bolt assembly, Ms. Williams testified that Cygna did have some discussion on our judgment on the matter, and they felt that they could demonstrate that it was acceptable.

(Id., at page 5.)

(k) Cygna's position at that time was as follows:

- (1) The U-bolt was critical to stability.
- (2) The U-bolt/clip assembly was evaluated.
- (3) The U-bolt/clip assembly was adequate.
- (4) During team discussion, Ms. Williams evaluated the engineers' judgement.
- (5) Weighing the evidence, Cygna judged the clip/U-bolt assembly as adequate.

(Id., at page 5.)

5. Within about three months, Cygna's position changed from that in Statement 4 preceding. It was the result of CASE's prefiled cross-examination following the cut off of Cygna's February 1984 testimony that Cygna was made aware that the clip angle for the clip/U-bolt assembly failed and therefore the assembly failed. (Id., at pages 5 and 6.)

6. The new position of Cygna came forth during the April 1984 hearings and, summarized, was as follows:

- (a) Regarding page 1 of Ms. Williams' prepared direct testimony, which sets forth Doyle Question Number 1, in the Cygna response, Ms. Williams was asked to describe the scope of the Cygna review with respect to U-bolts found in any one of CASE Exhibits 891, 894, or 897 and how Cygna treated that during the course of their review leading to the draft report. Ms. Williams testified that she reviewed them as if they were pipe clamps, that first of all they detected the fact that there were U-bolts used in this particular system, then they analyzed those U-bolts as if they functioned as pipe clamps and evaluated the support accordingly. She also testified that at the time of the review, they felt the U-bolts to be a satisfactory method of support. (Id., at pages 6 and 7.)
- (b) Ms. Williams then testified that since that time, they had learned that there are installation procedures requiring cinching and find that that was cause for some concern. (Id., at page 7.)
- (c) When asked how she felt now about whether Cygna had made a sound judgment in the initial report when they assumed that a U-bolt was a pipe clamp and whether that was a valid design judgment, Ms. Williams testified that "I think that these analyses clearly indicate that more work is required." (Id., at page 7.)
- (d) When asked whether or not there had been a sound basis at the time Cygna made the judgment for deciding the U-bolt was a pipe clamp,

Ms. Williams testified that she had talked to the reviewers, she looked at the drawings, she looked at the information that was made available to them at the time, and she thought that they made a reasonable judgment. She then stated that "This is new information. We have new analyses, and we do think it has to be pursued further." (Emphasis added.) (Id., at page 7.)

- (e) When asked if Cygna's previous position had been that the U-bolt clip angle arrangement would develop sufficient clamping force to prevent rotation of the box frame about the axis of the pipe, Ms. Williams stated:

"I don't see those exact words here. What I see is a discussion of U-bolts and the fact that my understanding was that our reviewers considered them to be clamps. And then there's a statement here where I say that I will explain what I know of the situation, and we discuss U-bolts and the fact that they can develop sufficient clamping forces to resist rotation.

"I don't see any specific evaluation of the type of detail that we have responded to in Doyle #7."

(Id., at page 7.)

- (f) Judge Jordan asked if this is the way the system was designed to operate, that the box frame itself would provide clamping force adequate to prevent any motion, and if that is the design of the plant? Cygna Witness Mr. Bjorkman stated that "[f]rom looking at the drawing, it appears that way." And Ms. Williams testified:

"I don't think we can really speculate on what the designer was thinking, but the calculation does show the addition of the U-bolt to prevent rotation. We evaluated it without the U-bolt because we didn't think that was a substantial approach to the problem."

Judge Jordan then asked "It's your opinion then, even if the U-bolt was left off, the frame itself would provide adequate support for the pipe?" . . . to which Ms. Williams replied:

"That's how we evaluated it. I'm not sure that, to be conservative, they shouldn't approach the design in a more traditional manner. There's a lot better designs for that particular application and I don't think that's the approach we would take. However, we accepted it as adequate."
(Emphasis added.)

(Id., at page 8.)

(g) Referring to Cygna's answer to Doyle Number 7, when asked whether she was "now in a position where you feel that the clip angle is insufficient to resist or to support the pretensioning forces that are exerted," Ms. Williams testified, "They will not support an 80 pound torque." (Id., at page 8.)

(h) When asked whether or not there was a change in Cygna's position between the transcript of the February hearing and their then-current testimony (4/26/84), Ms. Williams testified:

"The sections of the transcript that I have read thus far deal with U-bolts and the analogy to clamps. It doesn't say U-bolt/clip angle arrangement, first point.

"Second point is that the only thing that has changed from the time that I provided this testimony, in response to your question, is discussions with our reviewers to understand exactly what internal discussions took place and their thinking on assessing the adequacy of the support.

"It's a level of detail greater and greater understanding on my part, but not necessarily a change."

(Id., at page 9.)

(i) Any quantification by Cygna of the specific U-bolt under discussion is erroneous at best, because the support for the U-bolt failed. (Id., at page 9.)

- (j) Ms. Williams testified that Cygna evaluated it without the U-bolt because they didn't think that was a substantial approach to that problem. This is a total reversal from the answers she had given previously during the February 1984 hearings. (Id., at page 9.)
- (k) Ms. Williams conceded that the U-bolt/clip assembly does not work. She testified that Cygna agreed that the clip angle is incapable of resisting the support or the pre-torquing of the U-bolt, and that they had stated the thinking of the reviewers, in assessing the adequacy of that support, as part of response to Doyle Question Number 7. (Id., at page 10.)
- (l) Ms. Williams also testified that the calculation says that this U-bolt/clip arrangement was instituted by the Applicant as a means of preventing instability in that particular support. (Id., at page 10.)
- (m) When asked whether the effort by the designer was inadequate to assure that support's ability, for the clip angle/U-bolt arrangement, to perform its function, Ms. Williams testified:

"Again, we're not commenting on that. We're saying we felt the support would perform its intended function. Now we looked at the clip angle subsequent to the review and during the review. We feel that they are a weak (sic) link in that design and not a good way to address the instability problem, if that's what they were attempting to do as stated in the calculation.

"However, we felt the support would adequately perform the function."

Ms. Williams testified that that judgment was stated in Cygna's response, which is that sufficient friction forces will develop

between the pipe and the box frame. When asked how these friction forces are developed, if there is no clamping action afforded by the box frame, Ms. Williams testified:

"It's just based on zero clearance heating up the pipe. We don't think it's a good design. We've stated that in our response, as well."

(Id., at page 10.)

(n) It is clear from examining the two transcripts that the new (April 1984) position of Cygna is as follows:

- (1) The clip angle fails.
- (2) Cygna knew the clip angle failed.
- (3) It is friction on the box frame which stabilizes the support.
- (4) The original position of U-bolt adequacy was never entered in the record, but rather a philosophical discussion on the general use of U-bolts vs. clamps was carried on by CASE and Cygna for two days. (Id., at page 11.)

(o) The testimony of Cygna's Ms. Williams during the February 1984 hearings and the April 1984 hearings is contradictory in several respects (Id., at pages 6 through 11).

7. (a) In answering Doyle Question No. 12, in Ms. Williams' prefiled testimony dated March 18, 1984, Ms. Williams dismissed the potential problems with double struts and double snubbers by stating that:

"Supports cannot be installed to these tolerances. Further, support hardware is generally not supplied to such detailed dimensions. For example, there are gaps of 0.02 inches around each support pin which can accomodate (sic) two-thirds of this motion. . . "

(Id., at page 11.)

- (b) In Cygna's prefiled testimony dated April 12, 1984, the reason why coupling was no problem had been changed. This was after CASE critiqued the original excuse. When questioned on this point, Ms. Williams stated (Tr. 12,729):

"Yes, I'm aware of that statement and in the hast (sic) of trying to get this product out I didn't catch, but I don't agree with it."

(Id., at page 11.)

- (c) However, during cross-examination, Ms. Williams went back to the gap theory to explain why two axial snubbers did not have to be modelled to take the pipe-induced moments:

". . . But obviously, when you place these one-way restraints, you're going to limit the rotation, unless you assume some gaps there or you're getting extremely complex."

When asked if, using that technique, code allowables are exceeded, Ms. Williams testified:

"The numbers that came out of that run exceeded the manufacturer's allowables for the struts. But again, you're still basing that on analytical assumptions and we're saying that there are enough variables involved and there's enough discussion within the industry as to whether you need to evolve to that level of detail to get an accurate enough assessment of the adequacy of the adequacy of the (sic) piping."

(Id., at pages 11-12.)

- (d) Ms. Williams and Cygna reversed their position in the Phase 3 Cygna Report, Volume 1, Appendix G, Observation No. PS-03, Observation Record Review, Attachment A, Page 1 of 1, where it was stated:

2.0 Resolution

"In their initial response dated April 19, 1984, TUGCO had stated that the effect is negligible due to the clearances in

the snubber or strut. This does not consider the test results from the Energy Technology Engineering Center report NUREG/CR-2175, which shows that mismatches in clearances on the components in a trapeze support can lead to load imbalance by themselves. Nor does it consider that pipe support vendors normally size a riser clamp for the full load on one side, when used with struts, due to thermal rotation.
.."

(Id., at page 12.)

(e) Cygna could have included the fact that the full load per strut concept is also a code requirement (ANSI B31.1 121.3.1(c) and MSS SP-69 12.1 requires a rigid support). (Id., at page 12.)

(f) By the statement quoted in (d) above, Cygna has again reversed their position once again. (Id., at page 12.)

8. Cygna produced a finite element analysis to determine the effects of thermal expansion, and mechanical loads on box frames used as clamps. The results of this finite analysis indicated that the stress levels were very high. (Id., at page 13.)

Cygna's Dr. Bjorkman testified that the clamping force was somewhere on the order of 70,000 to 75,000 pounds. (Id., at page 13.)

Dr. Bjorkman indicated that this analysis was fairly representative of reality and would not require much more refinement to begin to utilize it, and that what would be needed is to incorporate additional loads in the problem, the right allowables, check welds, etc. (Id., at page 14.)

9. (a) From the preceding, it is obvious that the box frame strut concept presents serious and as yet unknown problems. (Id., at page 14.)

- (b) The above information was discarded out-of-hand by Cygna (in the Cygna Phase 3 report) in favor of an equation by Applicants. (Id., at page 14.)
 - (c) The equation is fundamentally wrong in several critical areas, specifically: the manner of determining the thermal gradients is incorrect; the failure to include energy transfer barriers resulted in erroneous thermal sources for the box frame; the time element which is critical to conclusions of temperature differentials was not considered by Applicants. (Id., at page 14.)
10. (a) Cygna did a great deal of work on trying to determine the effects of prestressing, thermal expansion, and mechanical loads on the cinched-down U-bolt problem.
- (b) The results of their lengthy work led Cygna to conclude that serious problems existed.
 - (c) Dr. Bjorkman concluded that more work was required to clarify the effects on U-bolts. However, in the Phase 3 Cygna Report, Cygna backed off from their own research on this matter in favor of Applicants' math/test gyrations. Cygna, in the report at Note 12, considers this to be an open item. However, Cygna does reveal, in Note 12, their desire to accept this note at the end of the test/analysis program, and this without critical review.
 - (d) First, this sample represents only a minor portion of the vast number of sizes, configurations, and materials used. For example, the precise wall thickness of pipe (not to mention those pipes with minimum wall violation) are not considered.

- (e) The Applicants' tests and analysis indicate that the procedures used in these tests and analysis were loose, to say the least. The reality is that the actual dimensions vary. (See Id., at pages 17 and 18 for other specific examples.)
- (f) Cygna's statement of the representative nature of the tests and analysis does not mean much when Applicants' own material in a single document contradicts the position of Cygna.
- (g) Cygna has shown an eagerness to accept the Applicants' excuses to justify a fait accompli -- any excuse. Cygna backed off from their research in favor of Applicants' justification.
(Id., at pages 15 through 18.)

- 11. (a) With 72 per cent of the calculations in Phases 1 and 2, and Volumes 2 and 3 of the Phase 3 review containing erroneous equations or missing equations, Cygna has seen fit to write the errors off (notwithstanding the fact that three supports exhibited structural failure).
- (b) It was not that long ago that Cygna was aware of the fact that even minor errors, if numerous, represented a significant problem; Ms. Williams testified that a pattern of missing equations and truncated equations would have some possible implication, even though on a particular design it didn't.

Ms. Williams also testified that the information on the 80 foot pound cinching was not part of the design documents that Cygna was looking at, and she testified:

"JUDGE BLOCH: Okay. And then as soon as you found it was omitted, shouldn't it have become an observation right then. As soon as you found that the document did not have all of the design criteria for assuring the safety of the structure, shouldn't it have been an observation right then?

"WITNESS WILLIAMS: The question is should we write one now?

"JUDGE BLOCH: Right.

"WITNESS WILLIAMS: Yes."

Ms. Williams further testified that, in the ideal situation, equations should not be truncated on a calculation without explanation, and that according to ANSI N45.2.11, you should have a thorough set of documentation of your analyses.

(Id., at pages 18 and 19.)

12. Mr. Doyle and CASE are concerned about the cumulative effect. First, it is not sufficient to state that on such-and-such a support an error exists and then move on to the next item. It is the collective recurrence of error which holds the greater significance.

Second, to neglect an item which by any criterion is reportable (structural failures) merely because Applicants state that they will modify the support is not adequate under the provisions of 10 CFR 21.

(Id., at page 19.)

13. It is obvious that Volume 1 of the Phase 3 Cygna Report is an attempt to buy off Applicants' supports as long as a piece of paper, any quality of paper, is presented by Applicants which will allow Cygna the use of the caveat "Applicants have addressed the problem." But Applicants have addressed these problems before, only to be proven wrong. (Id., at page 20.)

14. Beyond this, Cygna's engineering judgement has proven faulty on many occasions in the past. For example: Ms. Williams states that not all plants consider support masses in their stress analysis; but MSS SP-59 (to which Applicants are committed in Specification MS-46A) requires consideration of suspended masses. Although Cygna states that calculations must comply with ANSI N45.2.11, there is no mention in the report of this non-compliance. (Id., at page 20.)
15. (a) In one respect, the Cygna Report is adequate, in that the quantity of raw material presented is sufficient to make the point that Comanche Peak presents a safety hazard. The Phases 1 and 2 and Phase 3 Reports show that of 97 supports which were final "vendor certified," four fail.
- (b) If this ratio holds for the 40,000 pipe supports (not to mention cable tray supports, conduit supports, etc.), then Comanche Peak has at least 2,000 pipe supports which will fail.
- (c) A sufficient amount of raw material exists to make a judgement on the quality of the engineering.
- (d) The conclusions of Cygna in Volume 1 of the Phase 3 Report represent a wish list and not an evaluation of the raw material.
- (e) The raw material proves beyond a doubt that 10 CFR Part 50, Appendix B, and also the provision of ANSI N45.2.11 requiring sufficient data for calculations, are an unknown quantity at Comanche Peak.
- (f) Therefore, a 100 per cent review by others not dependent on the nuclear industry for their livelihood is in order.
- (g) Volume 1 of the Phase 3 Cygna Report should be trashed.
- (Id., at page 21.)