780

2/25/85
DOCKETED
USNRC

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

'85 FEB 27 P1:43

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of

TEXAS UTILITIES ELECTRIC COMPANY, et al.

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

Docket Nos. 50-445 and 50-446

OFFICE OF SECRETARY
DOCKETING & SERVICE
BRANCH

(Application for an Operating License)

NOTIFICATION OF NEW AND SIGNIFICANT INFORMATION

AND

CASE'S SUPPLEMENT TO
CASE'S 10/15/84 MOTIONS AND ANSWER TO
APPLICANTS' MOTION FOR SUMMARY DISPOSITION
REGARDING STABILITY OF PIPE SUPPORTS

Pursuant to the Board's 10/31/84 Memorandum (Multiple Filings), CASE (Citizens Association for Sound Energy), Intervenor herein, files this, its Notification of New and Significant Information and CASE's Supplement to CASE's 10/15/84 Motions and Answer to Applicants' Motion for Summary Disposition Regarding Stability of Pipe Supports.

CASE's 2/25/85 Supplement consists of the attached Cygna letter 84042.035 dated February 19, 1985, from Ms. Nancy Williams, Cygna Project Manager, to Joe George, TUGCO Project General Manager. (Also attached are some recent applicable newspaper articles.)

Cygna's letter represents a complete change of Cygna's original position on the issue of stability, and supports the testimony of CASE Witnesses Jack Doyle and Mark Walsh, the statements made on this issue in CASE's 8/22/83 Proposed Findings of Fact (Walsh/Doyle Allegations) (Sections III and IV), as well as CASE's 10/15/84 Answer to Applicants' Motion for Summary Disposition.

D503

With regard to the four criteria set forth in the Board's 10/31/84 Memorandum (Multiple Filings) for supplementing answers to Motions for Summary Disposition, CASE offers the following:

(1) Relevance: The subject of Cygna's letter is "Stability of Pipe Supports," and it is directly relevant and material to this issue.

(2) What new material in the last round filing is being responded to: As discussed in more detail in the following, this is new and significant information which supplements CASE's previous pleadings.

(3) Why the party was unable to anticipate this material in its last filing: Obviously CASE could not have anticipated Cygna's change of position regarding this issue.

(4) The safety significance of the point that is being made. As has been discussed previously, the safety significance is well-established; this is one of the specific issues chosen by Applicants to attempt to prove, in response to the Board's 12/28/83 Memorandum and Order (Quality Assurance for Design), that the design of the entire plant is adequate and safe.

As is obvious from a reading of Cygna's letter, Cygna has now verified CASE's concerns and conclusions regarding the issue of stability. (It should also be noted that the letter contains information which also applies to other issues which overlap with the issue of stability, such as local displacements and stresses, cinched-down U-bolts, etc.)

Applicants provided Cygna with a copy of the 6/17/84 Affidavit of John C. Finneran Jr. regarding Stability of Pipe Supports and Piping Systems (listed as reference (3) in Cygna's letter); this is the same Affidavit

which was attached to Applicants' 6/17/84 Motion for Summary Disposition Regarding Stability of Pipe Supports. Since Cygna has specifically addressed and referenced portions of Applicants' Affidavit, we believe the Cygna letter is self-explanatory and can be easily correlated with Mr. Finneran's Affidavit attached to Applicants' Motion for Summary Disposition and CASE's response.

While Cygna's entire letter is instructive, we refer the Board especially to the following cross-referenced items which have been specifically discussed by Cygna:

System Stability vs. Individual Support Stability:
Cygna letter, pages 4 and 5, "System Stability," and page 5, "Commentary on TUGCO's Position"
Finneran Affidavit, pages 2 through 8
Applicants' Statement of Material Facts: statements 1, 2, and 3
Case's Answer to Applicants' Statement of Material Facts: pages 1 through 8

Cygna has confirmed the concerns raised by CASE Witnesses Jack Doyle and Mark Walsh, and specifically addresses Applicants' first Statement of Material Facts, referencing Finneran Affidavit at pages 5-7, where Applicants state:

> "Instability of a particular pipe support, when viewed in isolation from the piping system, is of little or no significance. The relevant consideration is whether the entire piping system and associated supports are stable when considered as a single system."

Cygna states:

Page 4:

"If individual support stability is not assured, system stability is not guaranteed. The instability of one support can trigger the progressive instability of adjacent supports

by causing the limits of the forces and displacements to which the adjacent supports were originally designed to be exceeded. This may result in the formation of plastic hinges in the pipe (due to overload) which in turn may develop into a collapse mechanism. This situation would not, however, prevent successful execution of a linear, elastic pipe stress computer analysis."

Page 5:

". . . the issue is not piping system stability, but rather the stability of the individual support itself. The key point is whether the individual support can resist the applied load within the initial eccentricities and displacement limits imposed upon it."

Box Frames With Single Struts or Snubbers:

Cygna letter, page 6, first and second paragraphs (box frames with zero-inch gap attached to a single strut or snubber; and Applicants' fixes)
Finneran Affidavit, pages 9 through 12
Applicants' Statement of Material Facts: statement 5
CASE's Answer to Applicants' Statement of Material Facts: pages 18 through 20

Cygna has confirmed the Walsh/Doyle concerns and stated "Cygna classifies these supports, without modification, as unstable." Further, Cygna found that two of the three fixes utilized by Applicants to modify this type of supports to improve their stability "result in supports which must still be classified as unstable," and the third fix (cinching down of U-bolts) remains an open issue at this time.

U-Bolts, Single Struts, and Thermal Gap:

Cygna letter, last paragraph on page 6 continued top of page 7 (single struts with U-bolts and a thermal gap; and Applicants' fixes)
Finneran Affidavit, pages 15 through 18
Applicants' Statement of Material Facts: statements 7 and 8
CASE's Answer to Applicants' Statement of Material Facts: pages 27 through 43

Cygna has confirmed the Walsh/Doyle concerns and stated "Cygna classifies all single struts with U-bolts and a thermal gap . . . as unstable . . . " Cygna also found that one of the two fixes utilized by Applicants to modify this type of supports was "unacceptable," and the other fix (cinching down the U-bolts) remains open.

Double Strutted Frames:

Cygna letter, first full paragraph on page 7 (double strutted frames supporting a single pipe and double strutted trapeze supports with uncinched U-bolts); and second full paragraph on page 7 (double strutted trapeze supports with cinched U-bolts)
Finneran Affidavit, pages 19 through 21
Applicants' Statement of Material Facts: statement 9
CASE's Answer to Applicants' Statement of Material Facts: pages 44 through 49

Cygna has confirmed the Walsh/Doyle concerns and stated that Cygna classifies these support configurations as unstable.

Single Struts or Snubbers with Snug U-bolts:

Cygna letter, third full paragraph on page 7 (single strut or snubber with a cinched U-bolt)
Finneran Affidavit, page 21
Applicants' Statement of Material Facts: statement 9
CASE's Answer to Applicants' Statement of Material Facts: pages 44 through 49

Cygna has confirmed the Walsh/Doyle concerns and stated that until the issue of U-bolts used as pipe clamps (cinching down of U-bolts) is resolved, Cygna classifies this support configuration to be unstable.

Number of Unstable Supports:

Cygna letter, "Classification of Cygna Review Scope," last paragraph on page 7 continued on page 8
Finneran Affidavit, pages 21 and 22
Applicants' Statement of Material Facts: statements 10 and 11
CASE's Answer to Applicants' Statement of Material Facts: pages 49 through 54

Applicants stated that a total of 27 safety-related supports for all Unit 1 and common areas were potentially unstable, and that this figure is consistent with Mr. Finneran's representation to the Board in an affidavit filed June 3, 1983, that only 21 of 13,681 supports certified at that time had been identified as potentially unstable. (It is important to remember that neither Applicants nor Cygna have addressed potentially unstable supports in Unit 2.) Cygna has stated that 65 supports out of the 226 which they looked at are potentially unstable. (See further discussion on pages 7 and 8 following.)

There are a few additional comments which are appropriate at this time. First, it should be noted that Cygna now agrees with Messrs. Doyle and Walsh and disagrees with one of Applicants' basic premises regarding instability; Cygna addresses what was stated in Applicants' first Statement of Material Facts, referencing Finneran Affidavit at pages 5-7:

> "Instability of a particular pipe support, when viewed in isolation from the piping system, is of little or no significance. The relevant consideration is whether the entire piping system and associated supports are stable when considered as a single system."

In fact, Cygna specifically states:

Page 4:

"If individual support stability is not assured, system stability is not guaranteed. The instability of one support can trigger the progressive instability of adjacent supports by causing the limits of the forces and displacements to which the adjacent supports were originally designed to be exceeded. This may result in the formation of plastic hinges in the pipe (due to overload) which in turn may develop into a collapse mechanism. This situation would not, however, prevent successful execution of a linear, elastic pipe stress computer analysis."

Page 5:

". . . the issue is not piping system stability, but rather the stability of the individual support itself. The key point is whether the individual support can resist the applied load within the initial eccentricities and displacement limits imposed upon it."

Cygna has also confirmed what CASE has been saying: that many of these types of supports are unstable or potentially unstable (contrary to Applicants' assertions). The magnitude of the problem is readily apparent, even using simple arithmetic. Applicants stated (pages 21 and 22 of Finneran Affidavit) that a total of 27 safety-related supports for all Unit 1 and common areas were potentially unstable, and that this figure is consistent with Mr. Finneran's representation to the Board in an affidavit filed June 3, 1983, that only 21 of 13,681 supports certified at that time had been identified as potentially unstable. (It is important to remember that neither Applicants nor Cygna have addressed potentially unstable supports in Unit 2.) However, the 65 supports which Cygna states are "potentially unstable" equal 29% of the 226 supports reviewed by Cygna; this translates into 11,600 (of the approximately 40,000 supports at Comanche

Peak) which are potentially unstable, if Cygna's sample were representative. (And it should be noted that Cygna's Ms. Nancy Williams believes Cygna's sample is "fairly representative," according to public statements; see attached 2/21/85 DALLAS MORNING NEWS article). Even if one were to accept the suggestion by Texas Utilities spokesman Dick Ramsey (see attached 2/21/85 DALLAS MORNING NEWS article) that "48 'unstable' supports could be reclassified as stable if Cygna's ongoing analysis finds the supports acceptable," the remaining 17 represent 8% of the 226 supports reviewed by Cygna; this translates into 3,200 supports (out of the approximately 40,000 supports at Comanche Peak) which apparently are unstable, if Cygna's sample were representative. Although these obviously are not firm figures and Cygna's sample may not in fact be representative (although if it is not, the Cygna Reports could not have resolved the Board's concerns about design issues), one thing is now apparent -- contrary to Applicants' representations to the Licensing Board, there is a much more severe and widespread problem regarding unstable pipe supports at Comanche Peak than Applicants have ever recognized or admitted.

In Applicants' Statement of Material Facts (statements 4, 5, 6, 7, 8, 11, and 15) and in Mr. Finneran's Affidavit (pages 9-18, 26-29), Applicants sought to convince the Board that they had promptly identified and corrected all unstable supports, and that there was no need for separate design guidelines regarding stability (see also CASE's Answer to Applicants' Statement of Material Facts, pages 8-43, 50-54, and 58-59). Cygna's findings refute Applicants' representations, since some potentially unstable supports went through the entire design review cycle -- including review and approval by the responsible design organization -- without having been

identified as potentially unstable (see pages 14 and 18 of Finneran Affidavit; see also Cygna letter, especially page 6, second and thi. paragraphs, which addresses fixes by Applicants which resulted in supports which were still unstable).

Applicants also sought to convince the Board that "The conditions which could cause instability of the supports in question are unlikely to occur" (Applicants' Material Fact 13, Finneran Affidavit at 24; see also CASE's Answer to Applicants' Statement of Material Facts, page 55). Obviously, Cygna's letter refutes this representation of Applicants.

Further, Applicants sought to convince the Board that there is no safety concern because of the potentially unstable supports (Applicants' Material Fact 11, Finneran Affidavit at 19-21, 9-18, and 27-28; see also CASE's Answer to Applicants' Statement of Material Facts, pages 50-54, 58-59). This is specifically refuted by Cygna's statements at the bottom of page 4 continued on page 5, where Cygna discusses the importance of assuring individual support stability and that individual unstable supports may lead to developments which may result in a collapse mechanism.

Cygna's letter is of special importance because it represents independent verification of the position of CASE and its witnesses, Jack Doyle and Mark Walsh, by the outside consultant chosen by Applicants themselves. Cygna has stated that it does not have: a list of all the Walsh/Doyle allegations or a full understanding of the extent or implications of each of the allegations, any of the transcripts of hearings

prior to February 1984, any findings of fact /1/, CASE's responses to Applicants' Motion for Summary Disposition or other CASE documents (see transcript pages 15, 37-49, 67-76, and 105-107 of the 12/20/84 meeting between Cygna and the NRC Staff regarding Independent Assessment Program - Comanche Peak Steam Electric Station).

CASE again calls the Board's attention to the discussions in our 10/15/84 Motions and Answer to Applicants' Motion for Summary Disposition Regarding Stability of Pipe Supports, especially pages 11 and 12:

> "CASE further submits that, based on the record in these proceedings (including the Motions for Summary Disposition and answers), the problem of instability at Comanche Peak is one which Applicants have been slow to recognize and which they have, in fact, fought hard against being forced to recognize and deal with, that they are even now finally taking steps to deal with some aspects of the problem only because of these proceedings, and that the preponderance of evidence clearly shows that **Applicants would not have corrected these problems of instability had it not been for the oversight of the Licensing Board and the persistence of Messrs. Walsh and Doyle and CASE in these proceedings**, and that, even now, Applicants are attempting to avoid dealing with some types of instability.
>
> "The Board discussed the problem of instability at some length in its 12/28/83 Memorandum and Order (Quality Assurance for Design). The Board gave Applicants another opportunity to allow them to salvage their multibillion dollar investment. This (and other Motions for Summary Disposition) was that chance. But what has been, and is being, revealed is that the Board's original concerns were not quite accurate -- because the problems with stability (and others) are far more severe and widespread than the Board (and even CASE) had first imagined."
>
> (Emphases in the original.)

/1/ It should be noted, however, that to CASE's knowledge Cygna at one time did have a copy of CASE's 8/22/83 Proposed Findings of Fact (Walsh/Doyle Allegations). CASE President Juanita Ellis personally hand-delivered a copy to Cygna during the February 1984 hearings; CASE Witness Jack Doyle also recalls that Mrs. Ellis gave Cygna a copy. Cygna kept the copy for a while, then mailed it back to CASE.

Cygna's letter further confirms that CASE's assessment quoted above, and the conclusions in the Board's 12/28/83 Memorandum and Order, were and still are correct.

Further, there is still no indication that the "somewhat knowledgeable" field engineers (on which Applicants have attempted to place much of the blame for unstable pipe supports at Comanche Peak) are not still in the field making the same mistakes they made in the past. Cygna's letter now also calls into question the credibility and/or competence of those engineers who were in charge of those "somewhat knowledgeable" field engineers, as well as the original designers who, even after final reviews, did not even recognize that some of the supports were potentially unstable.

It should also be noted that there is no indication as of this writing (either in, or outside of, the record of these proceedings) that Applicants have changed their position regarding stability; they are still refusing to admit (for the most part) that the problem even exists, much less the magnitude of the problem (see public comments by Applicants' representatives in the attached newspaper articles).

Applicants have fought long and hard to convince the Licensing Board that there is no problem with unstable pipe supports at Comanche Peak. When they finally were forced to admit that there were some potentially unstable supports, they attempted to downplay and underestimate the extent of the problem (both in numbers and types). This latest new and significant information from Cygna further calls into question the design of the entire rest of the plant. There is no reason to believe that Applicants have

identified and/or dealt with other design problems any better than they have with the problem of instability of pipe supports.

Finally, CASE wants to make the Board aware that we believe that there is currently a move afoot to dump Cygna and sweep the design/design QA issues (along with the hardware/construction problems) right out of the hearings process, to be considered by the Applicants and NRC Staff without proper independence criteria, or scrutiny from the Licensing Board, CASE or the public, or adequate control and oversight. CASE opposes any such attempts to subvert the consideration of these important issues, which are part of a duly-accepted contention in these operating license proceedings and must therefore be considered by the Atomic Safety and Licensing Board. We will be discussing this in more detail in a pleading which we are currently working on regarding Cygna, design/design QA issues, and other aspects of the proceedings; we hope to have this pleading in the mail within the next week or two.

Respectfully submitted,

Juanita Ellis

(Mrs.) Juanita Ellis, President
CASE (Citizens Association for Sound Energy)
1426 S. Polk
Dallas, Texas 75224
214/946-9446

Dallas Times Herald

THURSDAY, FEBRUARY 21, 1985 5 Sections 25 Cents

Consultant raises doubts about Comanche safety

By JACK BOOTH
Staff Writer

The owners of the Comanche Peak nuclear plant suffered a major setback Wednesday when a consultant raised doubts about the safety of eight types of pipe supports at the plant.

The findings by Cygna Energy Services could cause lengthy delays in licensing proceedings for the plant and probably will rule out a quick decision on pipe support issues.

Texas Utilities Electric Co., saying rigorous analysis and work by its consultant Cygna showed the supports were stable, had asked the U.S. Atomic Safety and Licensing Board last June to end two years of hearings on the supports and declare them safe.

But in a nine-page letter released Wednesday, Cygna said it has changed its position and now believes the company erred in its computer studies.

As a result, the letter said, the possibility exists that a series of steel supports could collapse, causing pipes full of radioactive coolant to break and whip around like loose fire hoses, damaging everything in their path.

The report said eight types of supports are either unstable or questionable. A spot check of 226 supports turned up 65, or 29 percent, that were potentially unstable, the letter said.

Texas Utilities spokesman Dick Ramsey said he did not know how many of the plant's 40,000 pipe supports are affected by the report.

He said studies now under way could resolve many of the questions, but he conceded the report contradicts some of the statements in last June's request for a speedy licensing decision.

See COMANCHE on Page 8

Comanche consultant reverses report

COMANCHE — From Page One

The report was hailed as a major victory for the Citizens Association for Sound Energy, a Dallas public-interest group that raised the pipe support issues more than two years ago.

Association President Juanita Ellis said the report confirmed a key allegation raised by two former plant design engineers, Mark Walsh and Jack Doyle. Initial testimony by the pair prompted the licensing board in December 1983 to rule that the safety of the plant's design was in doubt and would have to be confirmed through additional studies.

"It sounds like they're quoting me right down the line," Doyle said after reading the new Cygna report. "It's well established now that the supports are unstable. That is not to say that they can't be fixed, but it's going to cost them a buck or two."

Ellis said hundreds or even thousands of supports may be questionable if Cygna's sample of 226 supports is representative of the plant as a whole.

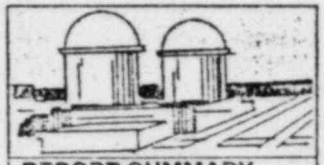
She said a major finding of the report was that the utility was wrong in arguing that a defect in one support would be unimportant if surrounding supports were sound. The report said instability in one support could cause a chain reaction leading to failure of a row of supports.

Another important finding, Ellis said, was that some of the attempts by the utility to fix unstable supports had failed, and the repairs themselves were unstable.

Ramsey said he could not estimate when the utility would have the results of new studies of pipe support problems. Those studies are being conducted by one of several consulting teams.

The Dallas Morning News

The Dallas Morning News, 1985 | Dallas, Texas, Thursday, February 21, 1985 | H-3 | 25 Cents



REPORT SUMMARY

A Cygna Energy Services letter concerning a review of pipe supports at the Comanche Peak nuclear plant said:

- That 29 percent, or 65 of 226 pipe supports examined, appeared to be unstable.
- That the study samples are not dissimilar to other pipe supports in the plant.
- That "from a practical standpoint" many of the potentially unstable designs may actually perform their intended function.
- That questionable supports should be modified or that each support or the entire system should be proved stable.

The Dallas Morning News

Pipe supports at N-plant found potentially unstable

By David Real
Staff Writer of The News

More than a quarter of 226 pipe supports inspected by an independent design consultant at the Comanche Peak nuclear power plant are potentially unstable and require a plantwide review to rule out the possibility of a domino-like collapse of the piping system, officials of Cygna Energy Services of San Francisco said Wednesday.

The findings support one of the criticisms leveled almost three years ago by two former Comanche Peak engineers, Jack Doyle and Mark Walsh, who questioned the adequacy of the design of the plant's pipe supports.

The engineers' concerns prompted Peter Bloch, chairman of the the Atomic Safety and Licensing Board, to declare in late 1983 that the "record before us casts doubt on the design quality" of Comanche Peak. The plant's owner, Texas Utilities, ordered the Cygna audit on Bloch's recommendation.

Cygna's comments were contained in a letter that recommends that the utility evaluate pipe supports throughout the plant and either modify the supports to solve the problem or prove that each support is stable or that the entire system is stable if any individual support fails.

The supports are needed to keep highly pressurized pipes from breaking apart during earthquakes or from whipping around out of control and causing more damage if a pipe breaks during plant operation.

A special Nuclear Regulatory Commission task force is scheduled to review pipe supports with utility officials at Comanche Peak Tuesday and Wednesday.

The nine-page letter — three pages of which define the complex issue of pipe support stability — reports that 29 percent, or 65 of 226

Please see COMANCHE on Page 11A.

Comanche Peak pipe supports found potentially unstable

Continued from Page 1A.

pipe supports examined, appeared to be unstable.

However, Texas Utilities spokesman Dick Ramsey said that the report concedes that 48 "unstable" supports could be reclassified as stable if Cygna's ongoing analysis finds the supports acceptable.

"Cygna recognizes from a practical standpoint that many of these potentially unstable designs may actually perform their intended function," the report stated.

Ramsey said the study sample's pipe support problems are not necessarily representative of all pipe systems in the plant.

But Nancy Williams, Cygna project manager for the Comanche Peak pipe support review, said the study samples are not dissimilar to other pipe supports in the plant. She said the pipe supports examined are part of the component cooling water system and the main steam system.

"I don't think they're going to end up having to go back in the plant and fix 29 percent of their supports because they can't guarantee positive connection," she said. "I think they have to carefully look at all the supports they have and come up with a realistic and technically correct assessment as to which ones need to be modified. Now, how many that is, I don't know.

"I think we have a fairly representative sample," she said.

She said Cygna is concerned that during the life of the plant, a pipe may move and rotate a pipe support clamp to the extent that the pipe support may not function as originally designed.

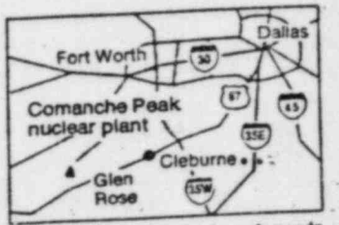
"We think that some of these pipe supports are clearly unstable," Ms. Williams said.

Ramsey said that he could not estimate what impact the report might have on the plant cost and schedule.

Doyle said he felt vindicated by the report.

"We've been waiting three years for this day," Doyle said. "This particular finding also shows that in other areas there is considerable doubt about the validity of the utility's experts."

Ms. Williams said the Cygna findings verify some of the concerns raised by Walsh and Doyle, although more analytical work needs to be done to confirm or deny the concerns.



Rcd. 2/20/85

CYGNA ENERGY SERVICES

101 California Street, Suite 1000, San Francisco, CA 94111-5894 415/397-5600

February 19, 1985
84042.035

Mr. J. B. George
Project General Manager
Texas Utilities Generating Company
Comanche Peak Steam Electric Station
Highway FM 201
Glen Rose, Texas 76043

Subject: Stability of Pipe Supports
Texas Utilities Generating Company
Comanche Peak Steam Electric Station
Independent Assessment Program
Job No. 84042

References:

(1) N.H. Williams (Cygna) letter to V. Noonan (U.S. NRC), "Open Items Associated with Walsh/Doyle Allegations," 84042.22, dated January 18, 1985.

(2) N.H. Williams (Cygna) letter to V. Noonan (U.S. NRC), "Revision to Open Items Schedule," 84056.055, February 14, 1985.

(3) Affidavit of John C. Finneran Jr. regarding Stability of Pipe Supports and Piping Systems, dated June 17, 1984.

(4) Cygna Phase 3 Final Report TR-84042-1, Rev. 1, November 20, 1984.

Dear Mr. George:

As committed to in Reference 1 and subsequently revised in Reference 2, Cygna has completed an evaluation of the pipe support stability issue. This evaluation considered the support designs reviewed by Cygna as part of Phases 2, 3 and 4 as well as TUGCO's position described in Reference 3. Since stability is a very complex issue, we will summarize our position in six parts: (1) Definition of Stability, (2) Dynamic Versus Static Stability, (3) System Stability, (4) Commentary on TUGCO's Position, (5) Classification of Cygna Review Scope, and (6) Conclusions.

Definition of Stability

Prior to performing an evaluation of this issue, criteria were developed to define what constitutes an unstable pipe support. Individual pipe supports can be classified into two broad categories: (1) supports which, in the total absence of the pipe, are stable, and (2) supports which, in the total absence of the pipe, are unstable. Implicit in our definition for the second category is the fact that the instability is a rigid body type which may be completely removed or accommodated by proper attachment to the pipe. That is, by restraining certain degrees of freedom at the attachment to the pipe, such as with a pipe clamp, the instability may be removed. Alternatively, by limiting the motion following instability through the presence of the pipe and adjacent supports, the instability may also be eliminated. Since there is no stability issue with respect to supports of the first category, only supports of the second category need be discussed.

In order for a support of the second category to be stable, there are two requirements to be met, one involving force transfer between the pipe and support and the other involving the geometric relationship between the pipe and support. The force requirement is met if adequate forces, which develop instantaneously and can be relied upon by design, exist between the pipe and the support hardware to resist the factored load. The following definitions are provided for clarity:

- develop instantaneously (immediately): Resisting forces are activated at the same instant that piping loads are applied. An example of forces which cannot develop immediately are binding forces which require a rigid body motion of the support (rotation, translation) to become effective.

- by design: The mechanism for and magnitude of the resisting forces are calculatable and known, or have been evaluated extensively by test or by use in the specific application.

- factored load: Applied load times a safety factor.

In addition to the above described force requirement, the geometric relationship between the support and the pipe must remain within set limits during the operational life of the plant. If sufficient clamping forces between the pipe and support are not present, small pipe movements may cause large changes in the position of the support relative to the pipe. Piping system vibration occurring during start-up, normal operation or shut-down can cause the support to move (rotate, translate) relative to the pipe. This support movement is unfavorable if, for a support initially perpendicular to the pipe, the direction of pipe

movement in the absence of the support is such that the displaced centerline of the pipe intersects the arc made by the rigid body motion of the pipe center within the support. The new position of the support on the pipe may be well outside the displacement (eccentricity) envelope for which it was designed and for which stability has been assured. Since the support did not restrain the movement of the pipe during this process, adjacent supports must now resist an additional load for which they may not be adequate. Therefore, a sufficient condition for individual pipe support stability of the second category is a design in which, upon the application of the factored load from the pipe, adequate resisting forces can be developed immediately and the position of the support attachment on the pipe does not move relative to the pipe with time.

Considering the definition presented above, we will now discuss some specialized situations in which the instantaneous development of resisting forces required for stability does not occur. For these designs momentary instability (of the rigid body type) could be tolerated, provided that it can be demonstrated that sufficient forces eventually develop to completely remove the instability (i.e., stop the motion and allow the support to function as designed). For example, when considering the instability of a support which requires the development of binding forces to ultimately maintain stability, one could assume the support does not act and then determine the resulting pipe deflection in the released direction. If that deflection is a sufficient multiple (say 4) of the deflection required to develop the necessary binding forces, it then becomes appropriate to further investigate the ability of the support to resist both the binding force and the applied load. During such an investigation, it is essential to demonstrate that the binding force mechanism possesses both sufficient strength and stiffness. In other words, while certain designs may exhibit sufficient strength to develop and resist the necessary binding forces, they may not posssess sufficient stiffness to limit the rigid body displacement and thus resist the applied load. The alternative to this approach is to limit the consequences of the instability. This could be accomplished by showing that the piping and remaining supports are acceptable in the absence of the unstable support. In either approach, before the design can be considered satisfactory, pipe stresses and other support reactions must be checked for the new displacements occurring at the support and the pipe must be checked for the effects of the binding forces.

Dynamic Versus Static Stability

The preceeding discussion addresses only stability due to statically applied loading. The question arises as to whether a support could be unstable statically under the application of maximum load, yet stable when the same load is applied dynamically. This is a very complex analytic problem to resolve which is further complicated by the fact that the maximum loading on a pipe

support is generally some combination of static and dynamic loads. Cygna is unaware of any established precedent for the acceptance of statically unstable supports based on dynamic arguments. In some cases dynamic loading can contribute to pipe support instability rather than helping to preclude it. The time phasing of static and applied seismic (random) forces can either exacerbate or alleviate individual support instability. Therefore, to demonstrate analytically that a statically unstable support is dynamically stable would require an extensive evaluation using large nonlinear dynamic models and time-history analyses. Add to this the variety of possible geometric configurations and input motions that must be considered, as well as the existence of static system preload (dead load plus thermal), and the problem becomes extremely costly to evaluate. This is a particularly unfavorable approach in view of the potentially inconclusive nature of the results.

For many of the same reasons stated above, any testing program developed to prove dynamic stability would also have to be very extensive. Tests which are severely displacement limited and sinusoidal (non-random) in nature can only prove that a support is stable under small amplitude displacement sinusoidal input. Such tests would not necessarily demonstrate stability under conditions which reflect the real nature of the random input motion.

System Stability

Generally, the term system stability is associated with the arrangement of a structure's restraint configuration such that it is not possible for the structure to undergo rigid body motion. We will refer to this as geometric stability. With respect to piping systems, geometric stability is assured when a pipe stress computer analysis is successfully executed. This computer analysis would have detected a system of supports which does not restrain each of the three translational and three rotational global degrees of freedom. Encountering such a geometrically unstable system is an extremely rare situation since almost all piping systems contain some type of anchor (e.g., equipment nozzle, penetration, structural anchor, etc.).

When discussing system stability as it relates to pipe support stability, the major concern is the ability of the piping system to provide the appropriate stabilizing restraint for each support. This type of global stability can only be assured if each support is individually stable in its own right, either through its design (supports of the first category) or by adequate attachment to the pipe (supports of the second category). If individual support stability is not assured, system stability is not guaranteed. The instability of one support can trigger the progressive instability of adjacent supports by causing the limits of the forces and displacements to which the adjacent supports were originally designed to be exceeded. This may result in the formation of plastic

hinges in the pipe (due to overload) which in turn may develop into a collapse mechanism. This situation would not, however, prevent successful execution of a linear, elastic pipe stress computer analysis.

Demonstration of system stability by removal of an unstable support from the system and subsequently showing that each remaining support can resist the new forces is not sufficient by itself. In addition, it should be shown that removing the unstable support does not affect the stability of other supports. That is, overall system stability should be reevaluated in the absence of the removed support.

Commentary on TUGCO's Position

Cygna has reviewed the Reference (3) Affidavit using the criteria described above. The Affidavit (pages 2-8) discusses system stability and its relation to individual support stability. In it, TUGCO states:

> "In addition, if the total support scheme does not provide proper multidirection support required by the piping configuration, the analyst will be unable to successfully run the piping analysis computer program, (see Tr. 12025 (Bjorkman testimony)). In summary, the piping analyst assures the stability of the piping system by limiting deflections, which negates any need to assess stability separately."

Cygna agrees with the first statement, since this is our basic definition of geometric stability. The second statement, however, does not follow. A piping analyst does not limit deflections to those required to assure system stability, since, in general, these deflections are not known. Rather, the analyst inputs each support as a restrained node and reports the resulting deformations to the designer for consideration. Therefore, the issue is not piping system stability, but rather the stability of the individual support itself. The key point is whether the individual support can resist the applied load within the initial eccentricities and displacement limits imposed upon it.

The stability issue is best illustrated in Figure 1(c) of the Affidavit, (page 4). The concern is not whether an adjacent support can provide a horizontal reaction component (since it is already known by analysis that it can and the system is geometrically stable), but rather whether the clamp (U-bolt) can provide sufficient resisting forces to prevent rotation of the clamp (U-bolt) about the pipe or slippage along the pipe axis. If the clamp (U-bolt) cannot provide sufficient resisting torque, the individual support is unstable and system stability as well as progressive support instability must be re-evaluated.

Of the specific support configurations discussed in the Affidavit, the most unique is the box frame with zero-inch gap attached to a single strut or snubber (Affidavit, page 9). This is unusual because it relies solely on the relative thermal expansion between the pipe and frame during normal operation to create clamping forces. The resulting frictional forces which resist support rotation around the pipe and translation along the axis of the pipe would stabilize the support. The lower bound value of stabilizing frictional force which exists over the operational life of the plant was never determined either analytically or by test. Furthermore, since clamping forces do not exist at ambient conditions, it is possible for the support to move (rotate and translate) relative to the pipe. This movement of the support could be caused by normal vibration during start-up, operation or shut-down, combined with pipe thermal translation compatible within the rigid body displacement envelope of the support. Subsequent to this movement the support may be in a position on the pipe which is outside of the displacement range for which it was designed and for which stability could be assured. Furthermore, due to the compatible rigid body motion of the pipe and support, the support would be unable to restrain the thermal movement (load) for which it was designed and adjacent supports would have to resist this load -- a load for which they were not designed. This situation may also develop at temperatures above ambient since the maintenance of zero gap over the life of the plant could be difficult to achieve. For these reasons, Cygna classifies these supports, without modification, as unstable.

In Figure 4 of the Affidavit (page 13) three methods are shown which have been utilized to modify the box frame supports to improve their stability. Two of these methods, "indexed lugs" and "additional struts" only provide rotational stability. They do not prevent translation of the support along the axis of the pipe with time. Therefore both of these modification schemes result in supports which must still be classified as unstable. The third modification scheme, the addition of cinched U-bolts, can prevent both rotation and translation of the support provided it can develop sufficient lower bound clamping forces. Since the final evaluation on the use of cinched U-bolts has not been completed, the acceptability of supports with this configuration remains an open issue at this time.

Cygna classifies all single struts with U-bolts and a thermal gap (Affidavit, page 15) as unstable since the stability of this type of support has never been analytically or experimentally demonstrated. Cygna understands that all of these supports have been modified in an effort to enhance stability (Affidavit, page 18). These modifications consist of either cinching the U-bolts or adding supplementary steel that would prevent the rotation of the U-bolt crosspiece. Cygna believes we have addressed those supports for which supplementary steel was added to create "stability bumpers" in Reference (4) Observation PS-02. Cygna found these bumpers unacceptable since there were no calculations to

demonstrate that they possessed sufficient strength and stiffness to maintain stability. The stability of the supports which were modified by cinching the U-bolts remains open as part of the U-bolt analysis/testing program.

Double strutted frames (Affidavit, page 19) supporting two or more pipes were not encountered during any of the Cygna review phases. However, Cygna did find examples of double strutted frames supporting a single pipe and double strutted trapeze supports with U-bolts, which are configurations similar to those discussed in the Affidavit. As previously discussed for single strutted frames, both the double strutted frames and trapeze supports with uncinched U-bolts suffer from the problem of not having the demonstrated ability to maintain their relative position on the pipe over time. In addition, the double struts cannot be relied upon to resist compressive load until the frame (U-bolt) has rotated about an axis parallel to the struts and has bound itself in a cocked position against the pipe. Neither the stiffness requirements of the frame (U-bolt) necessary to maintain a stable position nor the binding forces and displacements required to restrict the unstability have been evaluated. Cygna therefore classifies these supports as unstable.

In the case of double strutted trapeze supports with cinched U-bolts, the most likely mode of instability is that due to rotation of the support about an axis parallel to the struts. If the frictional resistance between the pipe and the trapeze crosspiece is not sufficient, the frictional bond will be broken and the entire destabilizing twisting moment must be resisted by the bending strength (and stiffness) of the U-bolt binding against the pipe. Since neither the frictional forces nor the U-bolt have been evaluated for their capability to resist this nonlinear destabilizing moment, Cygna classifies this configuration as unstable.

The stability of a single strut or snubber with a cinched U-bolt (Affidavit, page 27) is directly related to the resolution of the issue of U-bolts used as pipe clamps. Until the resolution of that issue, which includes the satisfactory determination that lower bound preloads can provide the clamping force necessary to resist the factored piping loads, Cygna considers all such supports to the unstable.

Classification of Cygna Review Scope

Cygna has examined the 226 pipe supports within the Phases 2, 3 and 4 review scope. Thirty-seven supports were identified as supports which, in the total absence of the pipe, are stable. Of the remaining 189 supports which in the absence of the pipe would be unstable, 124 possess sufficient positive attachment to the pipe to ensure stability. The 65 potentially unstable supports may be classified as follows:

- Single strut with box frame or cinched U-bolt (23)
- Double strut trapeze with cinched U-bolt (25)
- Multi-strut box frame (8)
- Single strut with uncinched U-bolt, stability bumpers (2)
- Double strut, double trunnion with cinched U-bolt (1)
- Double strut trapeze with box frame (2)
- Double strut trapeze with uncinched U-bolt (3)
- Triple strut box frame (1)

There are two reasons for classifying these supports as unstable: 1) the unconventional methods used to develop the restraining forces between the pipe and the support, and 2) the lack of any demonstration that the restraining forces developed by these supports are sufficient to maintain the support's stability. Supports which are designed with cinched U-bolts to provide the necessary positive connection to the pipe may be reclassified as stable if the U-bolt testing/ analysis program and the application of the results to the individual supports in question is found to be acceptable. It should be noted, however, that this program does not address the stability of supports which do not use U-bolts, nor does it evaluate the twisting strength of U-bolts used in trapeze supports.

Conclusions

Throughout this letter, Cygna has applied a very rigorous definition of rigid body instability. Cygna recognizes from a practical standpoint that many of these potentially unstable designs may actually perform their intended function. However, we also recognize that the inability to quantify the actual behavior which may help stabilize the support in practice necessitates that stability be viewed under more idealized conditions. For that reason the individually unstable supports identified above, and any similar configurations throughout the plant, should be evaluated using one of the following approaches:

- Modify to provide adequate restraint at the pipe/support connection
- Demonstrate system stability in the presence of the unstable supports
- Quantitatively show that the individual supports are stable

Please call to discuss any questions or clarification necessary since this is a complex subject.

Very truly yours,

N.H. Williams
Project Manager

NHW/ajb

cc: S. Treby (U.S. NRC)
S. Burwell (U.S. NRC)
V. Noonan (U.S. NRC)
D. Wade (TUGCO)
J. van Amerongen (EBASCO/TUGCO)
R. Ballard (G&H)
J. Ellis (CASE)
D. Pigott (Orrick, Herrington & Sutcliff)
J. Finneran (TUGCO)

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 Notification of New and Significant Information and CASE's Supplement to CASE's 10/15/84 Motions and Answer to Applicants' Motion for Summary Disposition Regarding Stability of Pipe Supports have been sent to the names listed below this 25th day of February, 1985, by: Express Mail where indicated by * and First Class Mail elsewhere.

* Administrative Judge Peter B. Bloch
U. S. Nuclear Regulatory Commission
4350 East/West Highway, 4th Floor
Bethesda, Maryland 20814

* Judge Elizabeth B. Johnson
Oak Ridge National Laboratory
P. O. Box X, Building 3500
Oak Ridge, Tennessee 37830

* Dr. Kenneth A. McCollom, Dean
Division of Engineering,
Architecture and Technology
Oklahoma State University
Stillwater, Oklahoma 74074

* Dr. Walter H. Jordan
881 W. Outer Drive
Oak Ridge, Tennessee 37830

* Nicholas S. Reynolds, Esq.
Bishop, Liberman, Cook, Purcell
& Reynolds
1200 - 17th St., N. W.
Washington, D.C. 20036

* Geary S. Mizuno, Esq.
Office of Executive Legal
Director
U. S. Nuclear Regulatory
Commission
Maryland National Bank Bldg.
- Room 10105
7735 Old Georgetown Road
Bethesda, Maryland 20814

Chairman, Atomic Safety and Licensing
Board Panel
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Chairman
Atomic Safety and Licensing Appeal
Board Panel
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Mr. Robert Martin
Regional Administrator, Region IV
U. S. Nuclear Regulatory Commission
611 Ryan Plaza Dr., Suite 1000
Arlington, Texas 76011

Lanny A. Sinkin
3022 Porter St., N. W., #304
Washington, D. C. 20008

Renea Hicks, Esq.
Assistant Attorney General
Environmental Protection Division
Supreme Court Building
Austin, Texas 78711

Anthony Z. Roisman, Esq.
Trial Lawyers for Public Justice
2000 P Street, N. W., Suite 611
Washington, D. C. 20036

Mr. Owen S. Merrill
Staff Engineer
Advisory Committee for Reactor
Safeguards (MS H-1016)
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dr. David H. Boltz
2012 S. Polk
Dallas, Texas 75224

Michael D. Spence, President
Texas Utilities Generating Company
Skyway Tower
400 North Olive St., L.B. 81
Dallas, Texas 75201

Docketing and Service Section
(3 copies)
Office of the Secretary
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Juanita Ellis

(Mrs.) Juanita Ellis, President
CASE (Citizens Association for Sound Energy)
1426 S. Polk
Dallas, Texas 75224
214/946-9446