2/7/84

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of APPLICATION OF TEXAS UTILITIES GENERATING COMPANY, ET AL. FOR AN OPERATING LICENSE FOR COMANCHE PEAK STEAM ELECTRIC STATION UNITS #1 AND #2 (CPSES)	§	Docket Nos. 50-445 and 50-446

TESTIMONY OF CASE WITNESS MARK A. WALSH

Q: Do you have any comments about CYGNA's Executive Summary?

A: Yes, I do. On page 1-3, CYGNA states that the time period for the design and construction of pipe supports was from 1980 to the present. On page 1-8, CYGNA states that their assessment program "followed the flow of information from the preliminary design stage to the as-built condition." I do not believe that this time period of their evaluation is appropriate, since most pipe supports were released for construction prior to 1980, as can be seen in the exhibits in Mr. Doyle's testimony and its attachment, CASE Exhibit 669 (Deposition/Testimony of Jack Doyle) and CASE Exhibit 669B (Attachment to Doyle Deposition/Testimony).

In addition, it is obvious that CYGNA is biased toward the Applicants or that they did an inadequate independent assessment of Comanche Peak. This is apparent because CYGNA did not question the Applicants' program of the CMC's being approved without calculations, the use of A500 Grade B tube steel allowables, not addressing the cumulative effect of their findings in an analytical manner, and items discussed in the Walsh/Doyle allegations,

with the exception of the two footnotes on checklist PS-01 in which they reference the Applicants' statements and reference an unfinished report by the NRC Staff.

Q: You stated that CYGNA was biased, in your opinion. Why would they be biased?

A: I believe they would be biased for several reasons. The biggest reason is for future services at other nuclear plants. Since more and more plants are being required to have an independent assessment program, it would be to CYGNA's best welfare to have a reputation of evaluating these plants and finding that nothing is too seriously wrong, <u>in their opinion</u>.

Another reason I have reached this conclusion of (GNA's being biased is as follows. CYGNA did not require the Applicants to address the cumulative effects of their findings, nor did CYGNA adequately address them. CYGNA did not address the Walsh/Doyle allegations (it's not clear whether they have even been provided with CASE's Proposed Findings of Fact on the Walsh/Doyle Allegations). It's not even clear whether or not CYGNA was supplied with a copy of the Board's 12/28/83 Order on design QA. CYGNA did not use rational conclusions on many of the items they referenced. They indicated a passive behavior when describing the root cause of the problems; their description of the cumulative results were conservative. Finally, I would like to indicate that the CYGNA team did not state within their report that they consulted with the NRC Staff. (This appears to be suggested in Applicants' 2/1/84 Answer to CASE's Motion for Reconsideration of Board's 12/28/83 Memorandum and Order (Quality Assurance for Design), bottom of page 4, "subject to scrutiny by the NRC.") Yet the Board found in its 12/28/83 Order that

the Staff had approved Applicants' method of waiting until the end to correct design deficiencies. CYGNA consulted with the NRC Staff and relied at times on the SIT Report and another unfinished NRC report, as well as the Applicants, but not on CASE. Yet CASE is the organization that initially provided the Board with information in regards to the inadequate designs of pipe supports.

Q: In regards to CYGNA's Appendix E, the portion titled "Independent Design Review, Pipe Support Design Review Criteria, for Comanche Peak Nuclear Plant - Unit 1," what comments do you have?

A: In Section 3.0 Codes, Standards and reference documents on page 4 of 11, CYGNA uses ASME Boiler & Pressure Vessel Code Section II, Subsection NF, 1977 Edition. The correct edition is 1974 including Winter Addenda. This would indicate that CYGNA was evaluating the plant to a different criteria than the FSAR indicates.

In Section 4.1 under "Stiffness," CYGNA states:

> "The stiffness calculation shall consider the combined effects of the support frame and mechanical components (except springs). The flexibility of the building structure shall not be included in the stiffness calculation."

CASE witness Jack Doyle has argued that the stiffness of the U-bolt must be considered in the stiffness calculations. It would appear that CYGNA and Mr. Doyle agree on that aspect. The problem is that Applicants have stated they do not need to consider the stiffness of the U-bolt and have not done so; however, CYGNA did not note this in any of the observation records. Consequently, one of two problems wxists. One possibility is that the Applicants have wasted this Board's time and resources in claiming they are not required to consider the stiffness of a U-bolt when they actually do. Or two,

CYGNA did not perform a satisfacotry job by not noting any instances where Applicants did not consider the stiffness of the U-bolt.

In Section 4.1.2 titled "Gaps," CYGNA states:

> "A gap shall be provided to accommodate radial expansion and construction tolerances." (Emphasis added.)

In addition, CYGNA has stated:

> "In unrestrained directions, the support design shall allow clearance for the most severe thermal plus seismic movements of the pipe." (Emphasis added.)

These two items are addressed in the Walsh/Doyle allegations. Mr. Doyle stated, and the Board concurred, that cinching up of U-bolts (thus eliminating any gap) would induce stresses into the pipe and additional load into the U-bolt due to radial expansion of the pipe. The Applicants and NRC Staff disagree with Mr. Doyle's assertions (and CYGNA's). In addition, when the Applicants were confronted with unstable pipe supports utilizing U-bolts, their response was to cinch them up too (an improper fix). The SIT confirmed the Applicants' position (and supported the Applicants) in the remedy for the unstable supports, where in the SIT report it claimed a new Brown & Root procedure required all U-bolts to be cinched up, Construction Procedure No. 35-1195-CPM 9.10, Rev. 8.

It appears quite odd to me that a Brown & Root procedure requiring U-bolts to be cinched up (which conflicts with CYGNA's guidelines) was unnoticed by CYGNA -- not only in the paper work, but in the walkdown they performed, particularly since they have thousands of these cinched-up U-bolts at Comanche Peak.

In Section 4.1.10, CYGNA states "All seismic supports shall be plus and

minus restraints." I agree with CYGNA in regards to this statement. During the September 1982 hearings, Applicants' witness Reedy commented on stability; his comments contradict CYGNA's criteria. (Tr. 4969/24-25, 4970/1-7.) Also, it was indicated that the particular support was not vendor certified, and therefore might not need to be modified if the loads imparted tension into the members. This philosophy is contrary to CYGNA's position. Also to be noted is that CYGNA did not observe any pipe supports that were not able to take plus or minus loads, yet the Applicants have stated they design supports whenever possible to take one direction loads.

In Section 4.1.11, CYGNA states: "Changes in the initial geometry . . . shall be justified." I recall Applicants' witnesses describing the CMC's written by the field engineers. When the CMC is written, the CMC documents the changes the field has made. If any calculations are made they are not retained. (See Tr. 4970/14-24.)
This has been the Applicants' position, yet CYGNA did not find this in their review.

As I stated in my Affidavit of January 30, 1984 (attached to CASE's 2/1/84 Answer to Motions for Reconsideration of Board's Memorandum and Order (Quality Assurance for Design) by Applicants and NRC Staff), the design change process is a sham at Comanche Peak. Yet CYGNA did not see any of these problems.

Q: What comments do you have in regards to the observation record contained in Appendix F of the CYGNA Report?

A: In observation PS-02-01, the embedment lenghts shown on the drawing are less than those shown in the calculations. This problem is considered generic to Comanche Peak.

This has adverse consequences in regards to the capacity of pipe supports to function as intended. This situation and its results are best described in an example. Referring to exhibit 4.4-1, page 3, of Appendix E, of the CYGNA Report, one can see the capacity of a 3/4 inch expansion anchor with varying amounts of embedment. For example, with 5 inches embedment, the capacity in tension is 4125 lbs., with a factor of safety of 4. With 3-1/4 inches embedment, the capacity in tension decreases to 2537 lbs. with a factor of safety of 4. The factor of safety of 4 <u>must</u> be maintained so that the requirements of IE Bulletin 79-02 can be fulfilled. If the engineer needed 5 inches embedment to have a factor of safety of 4, then with a 3-1/4 inch embedment the factor of safety will be (4)(2537/4125) = 2.46. This is clearly insufficient.

CYGNA's resolution to this problem did not consider the aspect shown above. Instead, they preferred to show embedment of an expansion anchor versus its total length. I do not question the total length of an anchor versus its embedment, but I do question the aspect of a calculation showing 5 inch embedment required and only 3-1/2 inch embedment being provided. CYGNA's resolution (to remove the minimum embedment from the drawing) will only conceal the problem.

In observation PS-09-01, the engineer did not check the seismic displacement of the pipe when a spring hanger was used. This is required so that if a spring is almost fully compressed due to dead weight plus thermal loads from the pipe, the movement of the pipe in a seismic event will not fully compress the spring hanger. If a spring hanger becomes fully compressed, two major problems will occur. One of these is that the pipe will have a rigid support and this will induce unaccounted stresses within the pipe.

The second consequence would be that the support would receive unaccounted loads that had not been previously considered. As shown by Mr. Doyle in his discussion of the upper lateral restraint, very small displacements can produce very large loads. I do not agree with CYGNA's resolution for the above-stated reasons.

In observation PS-12-01, the PUH style U-bolt allowable was used when a PUS style U-bolt was used in construction. Since I do not have this support drawing at this time, I cannot comment on the load on the support. But I would like to comment on the allowable load CYGNA refers to. CYGNA states that the allowable load on a PUS style U-bolt is 4706 lbs. CASE Exhibit 669B (Attachment to Doyle Deposition/Testimony), page 13N, lists the allowable loads used for a PUS U-bolt. As shown on that Exhibit, there is no value listed as 4706 lbs. If CYGNA was increasing the allowable for the upset condition, they are in error; as can be seen in CASE Exhibit 669B, page 13N, there is no allowable increase for the upset condition.

In observation PI-00-02, Gibbs & Hill used an allowable increase of 20% in the upset and emergency conditions; however, the code of record does not allow for such an increase. CYGNA's resolution is as follows: In paragraph NC-3645 "Attachment," of the applicable code, the designer is cautioned against geometries which cause excessive localized bending stress.

The Code does not say when geometries which cause excessive localized bending stress are used that the user may increase the allowable stress. In regards to the statement that the Winter 1981 edition of the ASME Code allows an increase, the Code would also indicate that the pipe stress analyses should be completely re-evaluated for the Winter 1981 Code, not just where problems with overstresses occur in the applicable code.

In observation P1-00-03, Gibbs & Hill does not have any written procedure to consider an adequate number of nodes in the dynamic analysis; this may lead to an underestimate of loads to supports and stresses in the pipe. I do not agree with CYGNA's resolution. Gibbs & Hill may instruct their engineers to review the dynamic analysis, but I am not confident that all engineers will review this instruction and an engineer may decide not to perform the analysis to 60 hz, which may lead to an underestimation of the loads and stresses. I believe Gibbs & Hill should meet the requirements of ANSI N45.2.11, paragraph 3.1, which states, in part:

"Applicable design requirements . . . shall be identified, documented . . . " (Emphases added.)

In observation PI-01-01, CYGNA reported the pipe analysis used 1/2 inch thick pipe, instead of a 3/8 inch thick pipe (the correct value). I do not agree with CYGNA in regards to the impact or the resolution.

The increase in dead weight will be approximately 25%. The seismic increase will be greater than 25% for the following reasons. When Gibbs & Hill analyzed the system, the dynamic analysis was based on the stiffness of the pipe and attached masses, including the contents. The stresses in the pipe and loads imposed on the supports were based on a stiffness of a 1/2 inch pipe; the 3/8 inch thick pipe is less stiff, and therefore the loads and stresses will be higher.

In observation PI-02-02, the pipe support was not modelled at the correct location. Stresses due to dead weight and seismic may increase by 10 to 20%. I agree with CYGNA in this regard, but I am also concerned with the increased loads imposed on the supports. If the supports were already close to allowables,

then the supports may exceed the allowable stress. If the supports exceed the allowable, they may go plastic or completely fail. This oversight by Gibbs & Hill is not in compliance with IE Bulletin 79-14, which requires the location of the pipe support to be considered.

In observation PI-02-04, a reinforcing pad on anchor SF-1-037-005-S33A was analyzed as 10 inches long, but the drawing shows the pad as being 8 inches long. I am concerned with the method used to resolve the problem. CYGNA states "per discussions with Gibbs & Hill." This is not in accordance with ANSI N45.2.11 where documentation is a requirement. Also, this apparently was an oversight by Gibbs & Hill since it was not documented, requiring a verbal discussion.

In observation PI-02-05, the wrong thickness of pipe was used (schedule 80 instead of 40). I am concerned with the stress ratio of .98 (actual load/ allowable load). Previous observations (PI-02-04, PI-02-03, PI-02-02, PI-02-01) have dealt with stress problem 1-70. These problems with their cumulative effect have not been addressed by CYGNA and with stress ratios of .98, I believe this would have been the prudent thing to do.

In observation CTS-00-01, Gibbs & Hill did not consider selfweight excitation of the supports. CYGNA's resolution is vague and the conservatism mentioned is not clear to me. It appears that CYGNA is saying that small frames are O.K., but large frames are not discussed.

In observation CTS-00-04, Gibbs & Hill used improper height to width ratios for cable tray frames and used only acceleration values in the downward vertical direction (precluding the possibility of vertical loads being directed upwards). I am concerned with the probable cause shown in Attachment A of CTS-00-04. (Since I have not seen calculations performed by Gibbs & Hill, I cannot at

this time comment on the resolution proposed by CYGNA.) In the probably cause, CYGNA states that "engineering judgement" may have been the reason for the preceding deficiencies. I have repeatedly heard this statement from the Applicants in regards to the Walsh/Doyle allegations. I am more prone to believe the designer/engineer did not consider all possibilities and was somewhat knowledgeable. I question how CYGNA can state that the error was based on engineering judgement instead of incompetence or negligence, a possibility which CYGNA does not even acknowledge. It appears to me that this in itself indicates CYGNA's bias in favor of Applicants.

In observation CTS-00-05, Gibbs & Hill failed to consider loads from additional restraint directions. Again, I have not reviewed the calculations referenced in the resolution (because I do not yet have them), but would like to comment on the probable cause. CYGNA's belief of the probably cause is "inconsistent procedures." I believe CYGNA is being too gentle with the Applicants when it discovers the Applicants have made a mistake or error. The fact that Gibbs & Hill was cited for "Failure to consider the effects of the loads from the additional restraint direction may result in unaccpetable stress levels and non-functional supports" indicates that this is not inconsistent procedures, but negligence.

In observation CTS-00-06, Gibbs & Hill had analyzed a frame with the member in the wrong orientation; i.e., had loaded the member about its strong axis and in reality it is loaded about its weak axis. I again object to CYGNA's passive behavior toward the Applicants. In the discussion CYGNA provides in the probable cause, it states that the problem exists because of "insufficient review of documents" and lack of "consistent evaluation of the various design considerations (i.e., connections)." The Gibbs & Hill engineer/

designer has negligently modelled a member that would indicate the least amount of bending stresses. In addition, I would like to point out that the stiffness of the channel differs by (13.1 = I_x/.693 = I_y) = 18.9 or 1890%. A new stiffness calculation was not reported by CYGNA which would significantly change the stresses within the frame.

Observation CTS-00-07: In this observation, Gibbs & Hill had in an initially assembled a pinned-pinned condition and with that assumption the base plate failed. Gibbs & Hill then assumed a fixed-fixed condition and the base plate was acceptable. CYGNA believes the actual condition is a pinned-pinned condition. I have two points of consideration in this observation.

The first item is that Gibbs & Hill will play with assumptions until a structure is acceptable to Code allowables. I do not agree with CYGNA's probable cause statement of "insufficient documentation of assumptions." It appears to me that Gibbs & Hill has mismodelled structural items to the extent that the structures will not perform its intended functions.

The second item I would like to address is the lack of information provided by CYGNA in this particular observation as well as the other observation items dealing with cable tray supports. I cannot address the resolutions without valid documentation by Gibbs & Hill when CYGNA states "further analysis by Gibbs & Hill . . . do not exceed code allowables." These resolutions are vague and without technical back-up.

In observation CTS-00-08 is included the result of a cumulative effect of the previous observations on cable tray supports. CYGNA states the probable cause if "inadequate procedures and documentation." I object to CYGNA's position

of inadequate procedures and documentation as the cause of Gibbs & Hill's failure to include those items listed in CTS-00-01 through CTS-00-07. I believe the structural problems related to the cable tray supports were created by the negligence of the Gibbs & Hill engineer/designer, by not considering all aspects required for a safe design, by changing assumptions and by knowingly misrepresenting structural configurations that would cause overstressed supports.

CYGNA states that to evaluate the cumulative effect four factors were considered, as shown in Attachment B. Item 1 is the reanalysis of the supports by Gibbs & Hill. CYGNA states ". . . Gibbs & Hill reanalyzed a large percentage of the tray supports reviewed by CYGNA." (Emphasis added.) I do not know what the large percentage was; i.e., 10%, 15%, 25%, etc. It is apparent that not all the supports have been reanalyzed, only the selected supports that Gibbs & Hill wanted to do. In essence, the reanalysis that Gibbs & Hill has not performed on the supports CYGNA reviewed are still deficient and are likely to remain that way. Item 2 is the percentage of supports reviewed by CYGNA. This is independent of the seven generic errors that were found. Therefore, this cannot be considered as part of the cumulative effect. Item 3 is the process for the dispositioning of field changes. This again is independent of the seven generic observations. As already discussed, the CMC program would be a negative factor. Item 4 is the overall conservatisms used. The only conservative item I observed in the CYGNA report was the increase in the weight of the cables in observation CTS-00-01 by 17.75%. On the other hand, the selfweight excitation of the support is not included and this accounts for 10% of the load on large frames and even greater a percentage for smaller frames.

I disagree with CYGNA's resolution to the combination effect shown

in Attachment B of the Potential Finding Report. On page 6 of 6 in Attachment B, CYGNA gives its reason why the cable tray supports are acceptable. They state that the trays will be highly stressed (implying they will perform in a plastic manner) and are assuming no two supports will be stressed at the same time. I would like to address this very important issue.

Since I do not at this time have the calculations employed by Gibbs & Hill, I cannot argue the values used by Gibbs & Hill in regards to the damping. But CYGNA stated that Gibbs & Hill "employed conventional damping values." (Emphasis added.) This would indicate the CTS are to be designed and analyzed in a conventional manner with conventional allowables. A conventional design would not allow members to be overstressed, particularly at a nuclear power plant. In addition, the FSAR at Comanche Peak allows only an elastic analysis.

CYGNA also stated that CTS have "load-sharing capabilities." I question CYGNA's meaning of load-sharing capabilities. Does it mean that all supports receive an equal amount of load? If one support fails, adjacent supports will then have 50% reserve capacities? Does the cable tray itself have the capacity, if one support fails, to transfer the load to adjacent supports? The cables within the cable tray will not break, overheat and cause a fire due to being stretched or lose their capacity to transmit electric current? Certainly there is no documentation to support such assumptions.

Overall, it appears that CYGNA has decided to use generalities when evaluating the cumulative effect. I was surprised that they did not state that the cumulative effect was not significant based on "engineering judgement," although this is what CYGNA has done in essence. One conclusion I have drawn is that the supports in question are inadequate from the design aspects, just

based on the information CYGNA has provided. Whether the Applicants reanalyzed the supports or not, the fact is that errors existed (and some still exist).

In observation WD-03-01, a drawing showing 1/2" clearance between the pipe and its support in the unrestrained direction, the actual condition consisted of 0" gap on one side of the unrestrained directions. The potential impact is an increased load on the pipe support and increase in stresses within the pipe.

I disagree with CYGNA's resolution to this problem. CYGNA stated that their function was to perform an independent assessment of Comanche Peak. In this particular observation, CYGNA observed a potential safety hazard. CYGNA indicated the problem to the Applicants, and the Applicants' response was that they had also noticed the deficiency, but that it was "acceptable as is." CYGNA did not question the Applicants as to why it was acceptable. CYGNA should have investigated further to determine if there is a potential safety problem. In lieu of this further investigation, CYGNA concluded ". . . Comanche Peak's as-built verification is working effectively."

In observation WD-07-02, temperature indicator X-TI-4837 was not installed. In the resolution of this observation, CYGNA reported that TUGCO will "install the temperature indicator when all area work is completed." I was under the impression that the system was completed and turned over to start-up, as indicated on page 1-2. I would think the start-up group would have a hard time checking this indicator if it was not installed. In addition, CYGNA did not state what procedure (by number) TUGCO had that would state the indicator would be installed after the start-up group was completed and had turned the system over to operations. Finally, I disagree with CYGNA's response

to the design impact. If the temperature indicator is not required for operations, then the item should not be installed and should be removed from the drawings. But if the item will be required by operations, then a non-conforming conditions existed and should have been noted.

Q: What comments do you have on the Pipe Stress Check List?

A: In reviewing this Check List, I have found a few oddities. The first unusual item found is the status of the system under review. A second item pertains to mass participation and observation PI-00-03. Another item is related to the Walsh/Doyle allegations regarding instability; also, improper modeling of support restraint direction, a concern of Mr. Doyle's.

The first item I would like to discuss is the status of the system CYGNA evaluated. CYGNA stated that the system chosen had been <u>turned over</u> to the start-up group. If the system has been turned over to start-up, I would think that the calculations for that system should be completed. The basis for this belief is the calculations will provide a method for predicting the behavior of the system. But note 4 of check list No. PI-01 stat-s Gibbs & Hill has not performed the acceleration checks on the values, but is in the process of doing so. On check list No. PI-01, sheet 4 of 10, item 10 states "The rigid restraint at node 2711 on the BRHL drawing was deleted in the analysis and noted in 'Corrective and Future Action' list in Calculation File No. 2323-200-1-69-2." It is nice to know that the change is in the calculation file, but that will not correct the problem. The drawing must be revised by issuing a change order, possibly a CMC; it should also be included on an NCR or whatever method Applicants are using for trending deficiencies at this time.

This problem of the calculations not matching a drawing has serious consequences. What assurance does the public have when a calculation requires construction to perform a task, but construction is not given the instruction. This is not an isolated incident. At observation PS-02-01, the embedment of a Hilti bolt on a drawing was less than the required embedment shown in the calculation. But there was no instruction to inform construction to make the change. I am concerned with this problem because a system is turned over and construction has not performed its task, because engineering is not complete, or neglects to tell construction what to do.

On sheet 8 of 10 in the check list No. PI-01, item 22, CYGNA's instruction is to "check that about 20% of total mass has been included." CYGNA notes the Gibbs & Hill analysis for this was unsatisfactory and listed the percentage of mass participation as follows: X direction = 54%, Y direction = 33%, and Z direction = 31%. Also it states "See Observation PI-00-03." Observation PI-00-03 deals no procedures for checking an adequate number of nodes in a dynamic analysis. This problem can be considered generic, since it also was observed in stress problem AB-1-70, page 8 of 10. The percentage of mass used is as follows: X direction = 45%, Y direction = 29%, and Z direction = 48%. Here also, CYGNA refers back to Observation PI-00-03.

Another concern I have with this problem is its effect on marginal stress ratios. At Observation PI-02-04, the stress ratio is .88 with an allowable of 1. My concern is that when the total mass is used, the seismic loads and stresses will double or triple.

Also, the addition of mass to the pipe, when pipe supports are attached, was a concern of Mr. Doyle's. In the SIT Report, on page 36, third full

paragraph, through page 37, the SIT claims the additional weight from a support is analyzed when significant. The effects of the weight of a pipe, its contents, and attachments is most critical during a dynamic event.

The seismic loads generated in a pipe stress analysis are always dependent on the mass (weight divided by the acceleration due to gravity). If there is no mass, then there are no dynamic forces. Consequently, the total mass in a dynamic analysis will have significant effects.

Finally, I would like to address the improper modeling of the direction of restraint from the pipe supports, within the pipe stress analysis. This item is No. 10 in PI-02. Mr. Doyle was concerned with this aspect, i.e., supports not in their intended direction of restraint; see CASE Exhibit 669B, page 11RR. The SIT claimed the Applicants had procedures established to account for supports built inclined to the intended direction of restraint. The SIT claimed supports included within 5 degrees would not cause a significant impact. Supports inclined greater than 5 degrees would be modelled to the actual angle of inclination, as the SIT stated the Applicants told them. See SIT Report, pages 44 and 45, item 1. The Board has been given the impression by the NRC Staff that the concerns of Mr. Doyle had been already addressed and that Mr. Doyle's concern was incorrect. Apparently, Mr. Doyle's concern was correct since CYGNA observed the same problem. Also, I would like to add that CYGNA's response (note 3) has no technical basis.

This error by the pipe stress group is not the only error committed. Two additional errors have been committed. The pipe support engineer should have requested the inclined load from the pipe stress analyst. This is the concern Mr. Doyle had while analyzing supports when the as-built drawing

showed the support was inclined, yet there was no load in the inclined direction. This shows the iterative design process does not function at CPSES. Also, the problems and concerns Mr. Doyle and I had while at CPSES still exist.

The second error committed was on CYGNA's part. CYGNA should also have noticed the inclined load was required for the design of the pipe support. (See Check List PS-05.) I have seen no proof within the CYGNA report to show the stresses within the support will be negligible or the inclined load will not adversely affect the pipe support. If the support is damaged due to the inclined load, the support for all practical purposes will not exist in its intended direction of restraint.

Pipe Supports Check List: Although many items were discussed in the section of the observation record, CYGNA neglected to include other potential findings. Also, it appears CYGNA was relying on TU conclusions in regards to the Walsh/Doyle allegations and did not pursue unsatisfactory conditions.

I was under the impression that CYGNA was supposed to be performing an independent assessment of CPSES. This assessment should have included <u>independent conclusions</u>, and not relied on TU officials' previous conclusions. Although I have noted previous situations, from the observation record, where CYGNA failed to pursue deficient items, I will not rehash those items. My concern with the Check List on pipe supports is notes 1 and 2 on check list PS-01. These notes are referenced in check list PS-01 through PS-31, at check list item Nos. 11a and 12c.

Check list item No. 11a is in regards to the stiffness of the pipe support. It is marked <u>not satisfactory</u>, and refers to note 2 of check list No. PS-01. Note 2 refers to the generic study performed by the Applicants. This study

was not accepted by the NRC Staff at the time of CYGNA's review. The NRC Staff required the Applicants to perform a study utilizing actual support stiffness. The results from that study confirmed Mr. Doyle's concern; i.e. when actual support stiffnesses are utilized, the loads transferred to the pipe supports dramatically increased by 200%. CYGNA's requirement of the support stiffness to be checked is appropriate, but CYGNA's response was not independent and the nonresponsive attitude could jeopardize the public health and safety.

Check list item No. 12c of CYGNA's report is in regards to the loadings of the Safe Shutdown Earthquake. Here again, CYGNA has indicated an unsatisfactory procedure is used at CPSES. CYGNA refers to note 1 of check list No. PS-01. Note 1 of PS-01 claims the pipe support vendors do not include support loads due to self weight excitation. CYGNA again refers to a conclusion performed by the Applicants of a generic study. This lack of including self weight excitation is a concern to me and Mr. Doyle. In addition, the generic study has never been shown to be valid to this Board. CASE has addressed this issue in its Proposed Findings of Fact, Chapter X .

I also question some of CYGNA's comments, where CYGNA shows the Applicants had made errors. The first item is in check list No. PS-07, item 10. In this observation, a torsional moment used in a calculation was 28848 inch pounds. The correct value is 52824 inch pounds. CYGNA dismissed this discrepancy by stating ". . . the effect of this error is minor because a doubling of the bolt shear stress does not impact the bolt qualification." I strongly disagree with CYGNA's response. To substantiate this position, a review of Exhibit 4.5-1 of CYGNA's report will reveal the following: a 3/4" diameter Hilti bolt has a capacity of 4283 pounds in shear, with a factor of safety

of 4; doubling the load on the Hilti bolt will reduce the factor of safety to 2. A factor of safety of two is not acceptable, as indicated in IE Bulletin 79-02.

In regards to the Cable Tray Support check list, there is a generic problem, and this is listed as item #6. The problem is similar to the tube steel-Richmond insert connection that is part of the Walsh/Doyle allegations. Also, the Applicants claim their design for pipe support base plates is bearing connections and not friction connections. The problem is the holes in base plates are larger than the bolts and are analyzed as bearing connections and not friction connections. It should be noted, for a friction connection the allowable in shear is less than the allowable in a bearing connection, yet for a friction connection a high strength bolt is required. For more information on friction connections, see CASE Proposed Findings of Fact, Chapter XXI, and the affidavit of Mr. Doyle attached to CASE's 11/4/83 Response to NRC Staff's Affidavits on Open Items Relating to Walsh/Doyle Allegations, page 12, line 7, through page 21, line 14.

This item is not discussed in the observation log or anywhere else, yet the pipe supports suffer from the same problem. The problem as stated by CYGNA is "The holes provided for the anchor bolts in the base plate/angle are 1/8" larger than the nominal bolt diameter. The code allowable for hole size is 1/16 inch larger than the nominal bolt diameter."

CYGNA, as well as the Applicants, has not considered why a 1/16 inch larger hole is permitted in a bolted connection. Prior to high strength bolts, no increase in hole size was permitted. This allowed for all bolts to get an equal amount of load at the time when the load was applied. When high strength

became economically feasible to use, then an increase in hole sizes was allowed. This increase in hole size permitted less accuracy when drilling the holes for bolts. Using high strength bolts, the friction force developed from torquing the bolts will be equal to all bolts until the load applied exceeds the friction force. In addition, the AISC code allows for a long slotted connection where the short dimension is 1/16" larger than the bolt diameter and the long dimension is approximately two times the bolt diameter.

The increase in damping, CYGNA refers to, has a small effect compared to the effect caused by the change in the natural frequency. In table 3.7B-1 of the FSAR, the damping for welded structures under SSE is 4% and for bolted structures the damping is 7%. The 7% damping is considering all bolted connections in a frame, not just the base plate. To consider the effects of an increase in damping, one should review a response spectra curve.

Figure 3.7B-1 from Applicants' FSAR (Applicants' Exhibit 3), copy attached as Attachment A hereto, is a response spectra curve of the SSE, located at the ground elevation. Elevations higher than the ground elevation will exhibit higher accelerations. The type of structure (i.e., concrete or steel) will also play an important part in the accelerations at different elevation within the building. Since the response spectra curve shown in Figure 3.7B-1 is for ground acceleration, an item completely rigid will exhibit the same acceleration as the ground, and for the response spectra curve, the value is 12% of gravity. An item can be considered rigid when its natural frequency is 33% as shown as what I have indicated as Point A (see Attachment A). One will note, damping plays no part in the acceleration when a support is rigid. Note also, the displacement for a rigid support is less than .0015

inches.

The load which causes the displacement is from the weight of the support and the tray with its contents. The weight is in the horizontal direction and is actually the mass times the acceleration due to gravity that is contributing to the horizontal displacement. When a support is rigid, the seismic acceleration it will experience is .12 g's at ground level, and this is independent of damping.

Now consider a support that displaces 1/8 of an inch (.125 inches) using 4% damping its horizontal acceleration at ground level is 35% of gravity, as indicated on Attachment A as point B. With 7% damping, its horizontal acceleration would be 28% of gravity. It is apparent that the higher damping will produce smaller seismic loads. But equally apparent is the acceleration from a rigid condition equalling 12% of gravity goes to 28% of gravity with 7% damping, in essence the seismic load will double.

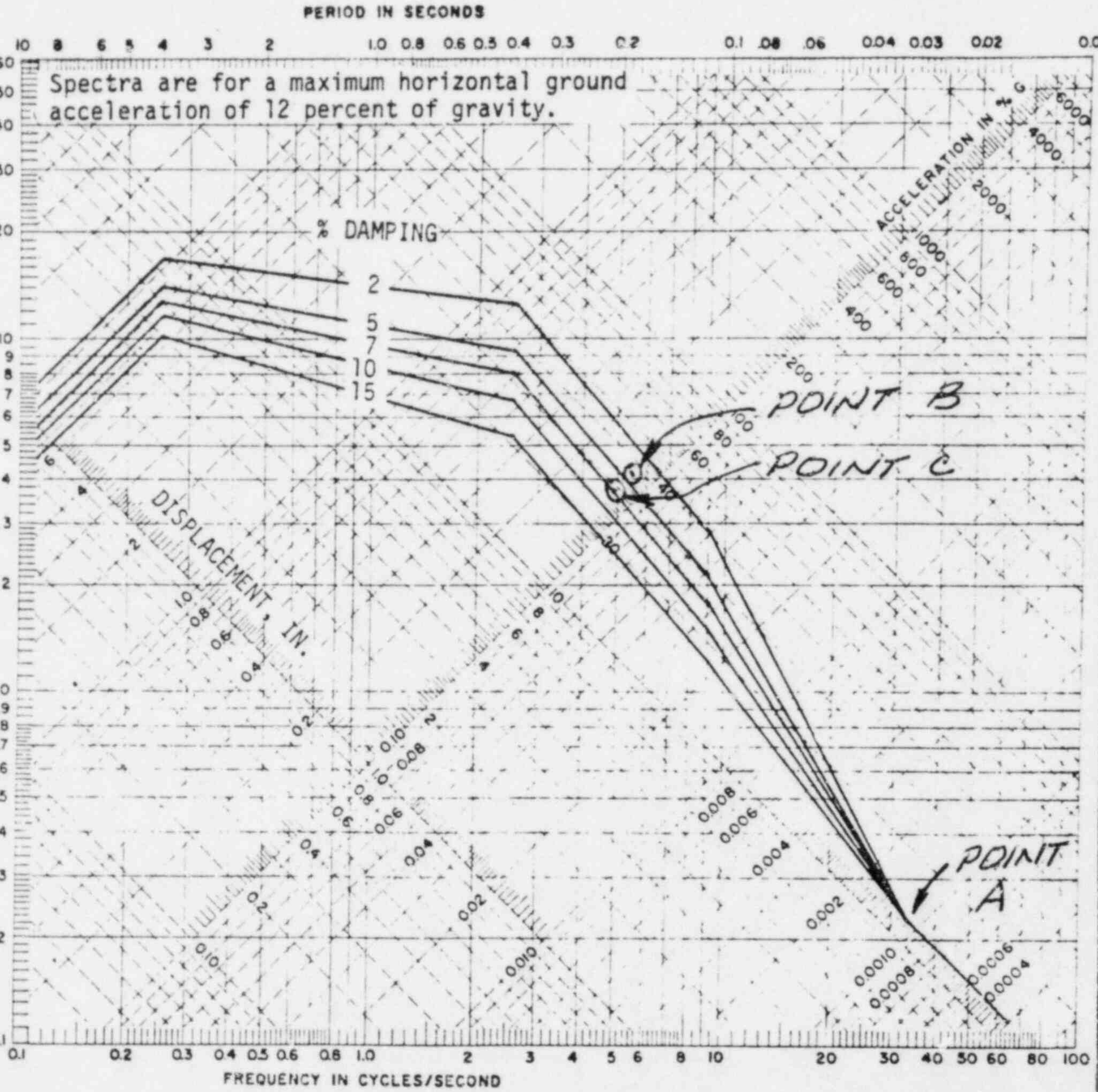
As has been demonstrated above, a 1/8 inch displacement makes a significant difference on seismic loads. CYGNA's comment "Plate slippage will increase damping and thereby lower applied seismic loads" is unfounded. Although the Applicants may have increased the dead weight by 17.5% on some frames, this is quickly offset by the exclusion of the frames' self weight excitation and the neglect to consider the effects of oversized holes as well as the other items not included in the original analysis.

Q: Do you have anything further to say?

A: Yes. I wish I could comment more on the CYGNA report but I just don't have sufficient time or documents to properly address all the issues. In addition, the CYGNA report has shown the Applicants have not used proper

design procedures, even based on what little I have seen. CYGNA's conclusions are basically based on engineering judgement. Had the Board relied only on the CYGNA report without input from me or Jack Doyle, they would have been misinformed and led to believe one and one is five.

ATTACHMENT A



COMANCHE PEAK S.E.S.
FINAL SAFETY ANALYSIS REPORT
UNITS 1 and 2

DESIGN RESPONSE SPECTRA FOR HORIZONTAL SAFE SHUTDOWN EARTHQUAKE

FIGURE 3.7B-1