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

November 6, 1984
83090.021

Mr. S. Burwell
Licensing Project Manager
U. S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, Maryland 20814

Subject: Response to NRC Questions
Comanche Peak Steam Electric Station
Independent Assessment Program - Phases 1 and 2
Texas Utilities Generating Company
Job No. 83090

References: (1) NRC letter of March 30, 1984 from D.G. Eisenhut to M.D. Spence and L.L. Kammerzell.

(2) Minutes of meeting between NRC/TUGCO/Cygna on April 19, 1984, pgs. 87-91 and 160-162.

(3) Minutes of meeting between NRC/Cygna on July 3, 1984, pgs. 43-49 and 50-55.

Dear Mr. Burwell:

In response to the attached telecon between N. Williams (Cygna) and D. Wade (TUGCO), Cygna has prepared the following responses to the NRC questions which remain open at this time. Questions associated with cable tray supports are not provided in this letter since those reviews are still ongoing.

NRC Question #1

Is it appropriate for hardware to be installed in a manner different from that shown on the design drawing if this is allowed by a procedure? (Reference 3, pg. 44).

Cygna Response

Cygna has reviewed the Phase 1, 2 and 3 assessment scopes and has determined that the only example of this situation is the practice of reversing snubbers 180° from the design drawing orientation.

In this case, a procedure was used to modify a design drawing without a design change or nonconformance report (NCR). It is Cygna's opinion that the design drawing takes precedence over the procedure and that changes to the drawing, i.e., the end to end reversal, would require a drawing revision including the complete drawing review and approval process. Alternately, an NCR could be issued and dispositioned "accept as is" by TUGCO engineering with the NCR

8412110032 841106
PDR ADOCK 05000445
A PDR

2222 See Attached Dist
1/1

attached to the as-built drawing. Since the installation procedure (CP-CPM 9.17 Revision 2) applies to snubbers on a generic basis, snubbers which are reversed must be verified to be acceptable by TUGCO engineering via a controlled design change method such as a drawing revision, design change notice or NCR. TUGCO engineering did not approve procedure CP-CPM 9.17 Rev. 2, therefore, the existing condition violates the following requirement of 10CFR50 Appendix B, Criterion III:

> Design changes, including field changes, shall be subject to design control measures commensurate with those applied to the original design and shall be approved by the organization that performed the original design unless the applicant designates another responsible organization.

Cygna would like to point out that this example has no design impact at CPSES. It is primarily a question of accepting a design deviation without appropriate engineering approvals. If additional documentation exists which demonstrates that Criterion III has been satisfied, then Cygna concurs with TUGCO's use of installation procedures to allow for the end for end reversal.

NRC Questions #2

If certain support designs at CPSES deviate from standard industry designs, is it valid to use standard engineering procedures to design them? (Reference 2, pg. 160.)

Cygna Response

Some possible examples of nonstandard designs discovered during the Cygna reviews are:

1. The consistent use of tube steel in pipe support designs without providing local stress checks when appropriate.

2. The practice of sometimes using trunnions in place of shear lugs.

3. The practice of neglecting self weight excitation for relatively large frames.

4. Use of Richmond Inserts through tube steel for attachment details.

5. Cinching of standard U-Bolts to perform the function of a clamp.

6. Use of box frames (with 0" gap) as pipe clamps.

Cygna has attempted to address this question during the course of the Phase 3 reviews. To document the results of this review, a set of General Notes to the Phase 3 pipe support checklists was prepared and included in Volume 2 of Final Report TR-84042-01. A copy of these notes is attached for your convenience. Each apparently "nonstandard" design at CPSES was reviewed by Cygna for acceptability and any generic implications. The corresponding general note, observation, or report section which addresses each of the above examples is as follows:

Example 1 - Pipe Support Checklist General Note 3
Example 2 - Pipe Support Checklist General Note 2, Observation PI-06-01 and Section 5.1 of the text
Example 3 - Pipe Support Checklist General Note 7
Example 4 - Pipe Support Checklist General Note 6
Example 5 - Pipe Support Checklist General Note 12
Example 6 - Pipe Support Checklist General Note 16

Example 5, cinching of U-bolts, is still open pending acceptance of the U-bolt testing and analysis program recently completed by TUGCO. While these applications are not necessarily standard compared to those suggested by the Codes or used by other design organizations, TUGCO has performed analyses to show that these designs do meet the stress allowables set forth by the ASME Code, Subsection NF. Cygna's detailed review shows these designs do meet the Code allowables and are adequate to perform their intended function.

If you wish to discuss these matters in more detail, please feel free to call at your convenience.

Very truly yours,

N. H. Williams

N. H. Williams
Project Manager

dmm
Attachments
cc: Mr. J. B. George
Mr. D. H. Wade
Mr. D. Pigott
Mr. S. Treby
Mrs. J. Ellis

Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phases 1 and 2	Job No.	83090
		Date:	10/12/84
Subject:	Phases 1 and 2 Open Items List from NRC	Time:	3:00 P.M.
		Place:	CPSES
Participants:	D. Wade	of	TUGCO
	N. Williams		Cygna

Item	Comments	Required Action By
	S. Burwell (NRC) had telephoned D. Wade to relay a list of open items remaining for close-out of the Phase 1 and 2 reviews. D. Wade relayed these items to N. Williams for action by Cygna:	
1.	With information available from the Phase 4 cable tray walkdowns, can Cygna issue a letter stating whether or not the cable trays have been constructed in accordance with the latest drawings?	
2.	Referencing the April 19 (pp. 160-162) and July 3 (pp. 50-65) NRC/Cygna meeting transcripts, the NRC would like Cygna's assessment of whether any problems have been identified due to the use of "non-standard" pipe support designs. For example, the effect of "non-standard" supports on the design assumptions and procedures.	
3.	Regarding the July 3 NRC/Cygna meeting where the scope of Cygna's welded attachment review was discussed, the NRC understands that further work is still being performed. N. Williams replied that double trunnions used as axial and/or rotational restraints was the only action item still open from Phase 3. Further, J. Minichiello (Cygna) had a discussion with D. Terao (NRC) on September 21, 1984, where this was explained. D. Wade will contact the NRC again to determine whether the work performed to date is sufficient to address the NRC concerns with the use of welded attachments at Comanche Peak.	

Signed: N. H. Williams /ajb

Distribution: N. Williams, D. Wade, J. Van Amerongen, J. Minichiello, L. Weingart, G. Bjorkman, ~~J. Ruec, W. Horstman, E. van Stijgeren, S. Burwell, S. Treby, J. Ellis,~~ Project File

Item	Comments	Required Action By
4.	With the information available from the Phase 4 cable tray support reviews, can Cygna issue a letter stating whether or not the design drawings match the construction drawings?	
5.	Referencing the April 19 (p. 91) and July 3 (pp. 44-49) NRC/Cygna meeting transcripts, the NRC would like Cygna's opinion on the appropriateness of maintaining information in procedures which allows for installation of pipe supports in a manner different than that shown on the drawing. N. Williams will review these questions with the appropriate Cygna reviewers and provide those responses which Cygna has sufficient information available at this time to prepare a response as soon as possible. Cygna has not yet completed those aspects of the cable tray support reviews necessary to respond fully to the NRC questions. N. Williams agreed to explore the possibility of extracting the necessary information, but it did not appear promising.	

GENERAL NOTES TO PIPE SUPPORT CHECKLISTS

1. Component Weights

As a matter of standard practice, the pipe support design organizations do not include standard component weights (i.e., strut, spring, snubber, clamp) as part of the pipe support design load. They normally consider the weight of the frame members when using the STRUDL program for design, however, they neglect the standard component effect. Since these components weights are typically small in comparison to the applied pipe load (5% or less), they will have little impact on design, even in the case of the weight being orthogonal to the applied load. In addition, it is common practice to neglect these weights for struts, snubbers, and rods. Cygna has seen examples in industry where the weight of large constant supports is included in the design of the wall or ceiling attachments but these are typically no more than 5% of the pipe load and can be considered negligible. Therefore, Cygna finds this procedure acceptable.

2. Pad/Trunnion Stresses on the Main Steam Line

In the pipe support calculations involving pads or trunnions welded to the Main Steam piping, Cygna did not find many examples of stress checks. Instead, the drawings carried the note "Pad (or trunnion) qualified per Appendix G of ASME B&PV Code." Per TUGCO document CPP 12978, attachments welded to the Main Steam and Feedwater lines require impact testing (per Subsection NC-2311 of the ASME B&PV Code) or assurance that the stress levels are low enough to preclude non-ductile failure. In order to qualify pads or trunnions already assembled, NPSI (Secaucus) performed detailed finite element analyses of each geometry and compared the maximum stresses to allowables derived from Appendix G (Prevention Against Non-Ductile Failure), which resulted in stresses much lower than standard Code allowables. Cygna reviewed two examples of the NPSI models/calculations and found their method acceptable, although one model contained input errors which did not impact the conclusions. Furthermore, as part of their normal design practice NPSI had previously committed to reviewing each welded attachment analysis against the final pipe support loads (refer to Communications Report dated 6/18/84). Thus, Cygna considers the approach acceptable.

3. Local Stress Effects

In reviewing the pipe supports for Phase 3, Cygna noted many instances of the following:

a) Use of wide flange or back to back channels without stiffener plates at connections and without calculations to show the joint is acceptable.

b) Use of tubesteel in frames without checking whether the webs of the tube are adequate to transmit the load, especially when the end is a load transfer point.

c) Use of composite sections, made up by welding a plate to a tube section, without considering the additional stress in the weld at the load transfer point **(see Observation PS-07).**

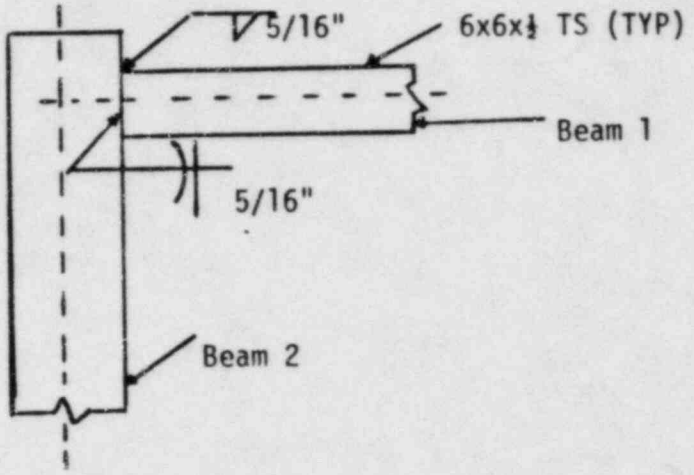
It is important to note that Cygna did see instances where each of these items were properly considered, either by calculation or good design practice. In response to Cygna's question on project guidance in this area, TUGCO stated in a 6/8/84 letter:

> "Although the various design guidelines may not require that specific calculations be performed on structural connections the effects of localized stress are often evaluated with approximate calculations. The individual design engineer assesses each situation on a case-by-case basis. From his inspection, he may judge the effects negligible or may add gussets or stiffeners; or he may elect to calculate the actual stresses and determine if there is a necessity for stiffening. In all cases, however, the designer is guided by the limits set forth in subsection NF and specification MS-46A. It has always been a matter of good engineering practice to make these considerations. It is not industry practice to provide guidelines to engineers for these considerations, nor is it necessary."

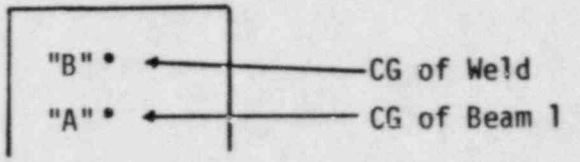
Cygna has reviewed each design in Phase 3 for the acceptability of the engineering judgment noted. In certain cases, Cygna was able to confirm that judgment since the applied loads were small. In other cases, Cygna performed their own calculations to determine the adequacy of the joint. In no case did Cygna find a design error, i.e., each joint would transfer the applied loads. It is the lack of calculations or notes in the design calculations that has caused Cygna to make this comment. Without at least a statement such as: "connections OK by judgment", Cygna had no way of knowing whether certain joints had been checked or not. Conversely, if stiffeners were added to a joint without calculations, Cygna had no means of determining that the stiffeners were properly designed, without performing our own calculations. Thus, while the lack of calculations in this area made the review more difficult, Cygna did <u>not</u> find any instances of overstress due to inadequate engineering judgment.

4. 3-Sided Welds

In certain connections, Cygna noted the use of 3-sided (see sketch) welds used to transfer the loads from one member to another. In most instances, the designer did not transfer the loads from the center of gravity of the beam (Point A) to the center of gravity of the weld (Point B). It is TUGCO's position that the designers use engineering judgment in determining if the effect will significantly impact design. That is, if the stress levels are low, the designer does not transfer the loads. For Cygna's assessment, **see Observation PS-05.**



Weld Detail

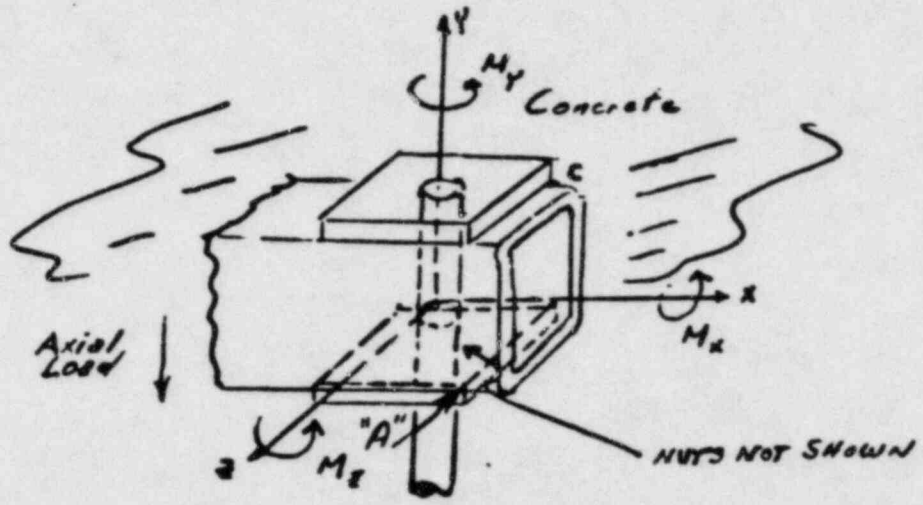


5. Use of .6Fy for U-Bolts

In designing the larger, non-standard U-bolts (i.e., 2-3/4" diameter rods, 2-1/4" diameter rods), the pipe support organizations have used an allowable tensile stress of .6Fy; actual bolt stresses were based on the tensile area of the threaded region. This conforms with the ASME Code Section III, Appendix XVII, Paragraph XVII-2211. In order to provide further justification for this procedure, ITT Grinnell performed a test program for 1/2" diameter and 1" diameter U-bolts (Reference Attachment to TUGCO letter dated May 2, 1984). Based on the results of those tests, ITT has shown quite clearly that .6Fy is an acceptable tensile stress allowable for U-bolts.

6. Tubesteel Prying on Richmond Inserts

In the designs which employ tubesteel/Richmond insert combinations, Cygna noted that the engineer released the rotation about the Y and Z axes (see sketch) in the STRUDL model for the frame. While release of the Y rotation is appropriate since the bolt is free within the tube, release of the Z rotation assumes that the tube will not bear against the washer at point "A" and create a load due to prying on the bolt. TUGCO has provided justification for this and other analytical assumptions (i.e., the bolt does not carry any load in bending; the effect of bolt hole offset on bolt load) by performing both testing and analysis. Details of the justification may be found in the TUGCO letter dated 5/8/84 and in the "Affidavit of John C. Finneran, Jr., Robert C. Iotti and R. Peter Deubler Regarding Design of Richmond Inserts and their Application to Support Designs." In the letter to Cygna, TUGCO shows that prying due to rotation about the Z axis is not present when only vertical loads exist. When torsional moments (M_x) exist, the study done by TUGCO shows that even with small amounts of torsion (1000 in-lb vs 40000 lb tension load), the effect of prying is due to torsion, with no contribution from moments about the Z axis. For large torsional loads (4000 in-lb vs. 2000 lb tension), the same effect holds true. Cygna then reviewed all tubesteel/Richmond insert joints within their scope and determined that the configuration analyzed by TUGCO (4 x 4 x 3/8 TS with 20" bolt spacing) is representative of the most flexible configurations and, therefore, most conservative. As a result, Cygna finds the method used by TUGCO to model these connections is acceptable.



7. **Support Self-Weight Excitation**

As Cygna found in the Phase 2 review, the design organizations at CPSES do not usually consider additional support load due to the seismic excitation of the support mass in the unrestrained direction. In the case of simple support combinations, such as clamps, struts, and base plates, the effect is minimal since the mass is very small. In the case of frames, Cygna has found some examples where self-weight excitation was considered, usually by applying 1.0g in all 3 directions. However, this practice was not commonly employed in the supports which Cygna reviewed. Since the issue of self-weight excitation has been raised and reviewed by the NRC (reference the NRC SIT Report, Item 3h), Cygna did not perform any additional technical evaluations. Cygna did note that the mainsteam supports inside containment involve fairly massive frames, although the applied loads are already sufficiently large such that the added effect may be minimal.

8. **Effect of Support Stiffness**

As noted in the Phase 2 Cygna Report, the design organizations do not calculate actual support stiffnesses for Class 2 and 3 piping systems. Rather, they limit deflections of frames to 1/16" and do not consider the deformation of standard components, such as struts, clamps and snubbers, or the base plates. Since the effects of support stiffness on the piping analysis has been raised by the NRC (the NRC SIT Report, Item 3j), Cygna did not perform a technical evaluation of this concern other than to note it is necessary to consider the effects.

9. **Cross-Sectional Properties for Tubesteel**

In the review of pipe supports, Cygna noted that two of the pipe support design organizations, NPSI and ITT Grinnell, use cross-sectional properties for tubesteel from the AISC Manual, 7th Edition. Another design organization, PSE, uses the properties from the AISC Manual, 8th Edition. When Cygna questioned the apparent inconsistency, TUGCO referenced the "Affidavit of J.C. Finneran and R.C. Iotti Regarding CASE's Allegation Involving Section Property Values." As explained in that filing, the tubesteel at CPSES is A500 GRB, cold-formed, for which the section properties from the 8th Edition of the AISC Manual are more appropriate. The differences in section properties between the two editions are minor and have negligible impact on design. As further noted in the TUGCO response to Cygna (TUGCO letter 6/8/84), TUGCO will issue a DCA to specification 2323-MS-46A to note this exception to the AISC 7th Edition. Cygna considers this question adequately addressed and the matter closed.

10. **"Cinched" U-Bolts on the Component Cooling Water System**

In reviewing the pipe supports for the Component Cooling Water System, Cygna noted a number of instances where a U-bolt is tightened around a pipe to provide stability for the support. Cygna asked TUGCO to provide justification that the U-bolt would not be overstressed. In response to Cygna's request for one example, TUGCO provided calculations in their 6/8/84 letter and subsequently revised them on June 18, 1984. Cygna has reviewed the TUGCO calculations and agrees that there will be no adverse stress effects in the U-bolt for the component cooling water systems. For the pipe, see Note 12, which discusses the Westinghouse test and analysis program for U-bolts.

11. **Rear Bracket Dimensions**

In reviewing the designs at CPSES, Cygna used the certified vendor catalog and load data available at the site. In Revision 17 of the Design Report Summary (DRS) for rear brackets (ITT Grinnell), Cygna noted dimensions which did not agree with those used by the support designers. The use of larger dimensions would affect weld lengths and, therefore, design. As explained by TUGCO in their 6/8/84 letter, Revision 16 of the DRS is the appropriate revision for the dimensions since the majority of the brackets were purchased prior to the issuance of Revision 17 in April, 1983. TUGCO provided Cygna with a copy of Revision 16 and Cygna verified that the dimensions used correctly correspond to Revision 16. To further confirm the appropriate dimensions, Cygna measured rear brackets in those supports chosen for a latter walkdown and confirmed that the installed bracket dimensions are the same as those in the DRS revision used by the designer. Based on the outcome of that walkdown, Cygna considers this matter adequately addressed.

12. **"Cinched" U-Bolts: Effects on Piping, Stability, and the U-Bolt**

In reviewing supports on the Main Steam and other systems, Cygna noted instances where a U-bolt was tightened around the pipe. This was typically done by TUGCO to provide stability for the support by having the U-bolt act as a clamp. Cygna asked TUGCO if the local stresses in the pipe and the additional stresses in the U-bolt had been considered during the design process. In response to this same question by the ASLB, TUGCO had contracted Westinghouse to perform a test/analysis program. The details of this program are described in Westinghouse letter EQ&T-EQT-737, dated 3/5/84.

The objectives of this test/analysis program were to ensure that:

1) Stress levels in the U-bolt remained within acceptable limits;
2) Stress levels in the piping remained within acceptable limits;
3) Stress levels in the crosspieces remained within acceptable limits;
4) The U-bolt would maintain the support in a stable configuration (i.e., would not slip) under maximum allowable strut/snubber angularity (5°);
5) The U-bolt would maintain its stability characteristics over time (i.e., would not relax).
6) The U-bolt would maintain its stability characteristics under normal vibration loading.

As part of the program, TUGCO selected the following piping:

a) 4" sch 160 (stainless) with temperature = 559°F
b) 10" sch 40 (stainless) with temperature = 210°F
c) 10" sch 80 (carbon steel) with temperature = 210°F
d) 32" with T = 1.25" (carbon steel) with temperature = 557°F

These represent a broad range of piping and material combinations at CPSES and would provide assurance that the worst combination of wall thickness, pipe size, and temperature effects have been considered.

At the time of Cygna's review, only preliminary results from this study are available (reference, EBASCO letter dated 6/15/84 from R.C. Iotti to N.H. Williams). Cygna is continuing with an evaluation of this design and will make the results available at a later date. Cygna considers this an open item in this Phase 3 report and finds all supports utilizing "cinched" U-bolts acceptable contingent solely upon the acceptability of that test/analysis program. A list of those supports utilizing "cinched" U-bolts for stability is provided below:

Support Number	Checklist No.
CC-1-020-001-A33K	PS-009
CC-1-028-007-S33R	PS-017*
CC-1-028-701-A33R	PS-036
MS-1-001-003-S72R	PS-069
MS-1-001-004-S72R	PS-070
MS-1-001-005-S72R	PS-071
MS-1-002-003-S72R	PS-082

Support Number	Checklist No.
MS-1-002-005-S72R	PS-084
MS-1-003-003-S72R	PS-099
MS-1-003-004-S72R	PS-100
MS-1-003-005-S72R	PS-101
MS-1-004-003-S72R	PS-119
MS-1-004-005-S72R	PS-121

* Support design revised per TUGCO letter 6-8-84.

13. **Embedded Plate Design**

During the review of supports attached to embedded plates, Cygna noted that in most cases the designers assume a fixed joint at the embedded plate. The governing criteria in Appendix 4 of G&H Specification 2323-MS-46A states that the connections to embedded plates shall be assumed "pin" joints (i.e., forces only, no moments) unless stiffeners are provided, but no guidelines are given for these stiffeners. The standard procedure at CPSES is to assume that the attachment to the plate, usually a beam or base plate, provides the stiffener for the embedded plate. The moments are then distributed to the bolts using a conservative estimate for the dimension of the attachment. Also, in these cases, the lower allowables for the embedded plates are used. Cygna did find a case in which TUGCO performed a finite element analysis of the connection to the embedded plate, when their initial approach was too conservative. Based on Cygna's review of the design of connections to embedded plates, we find the approach acceptable.

14. **A563A Nuts with High Strength Bolts**

In certain supports at CPSES, Cygna noted the use of A563 grade A nuts with high strength A193 B7 thru bolts. The ASTM specification states that A563 grade A nuts are suitable only for low strength A307 bolts, based on a comparison of yield and ultimate strength data. TUGCO has stated that their standard practice is to use A194 2H nuts with A193 B7, but they do allow the use of double A563 grade A nuts, since they will have sufficient strength to ensure the acceptability of the joint. Also, all nuts are tightened "snug tight", thus ensuring both nuts will share the load. In all supports within the Cygna scope, CPSES designers did use double nuts wherever A563 grade A nuts were specified for A193 B7 bolts. Thus, the bolted joint design is acceptable.

15. 1-1/8" Bolt Holes Used in Base Plates with Hilti Kwik-Bolts and in Tubesteel with Richmond Inserts

Paragraph NF-4721(a) of the ASME B&PV Code, Section III, provides guidelines for the fabrication and installation of bolting. In it, the Code allows 1/8" oversize bolt holes to be used with 1" bolts made from low strength (yield ≤ 80 ksi) material. Since the tubesteel/Richmond insert combinations seen by Cygna use A36 threaded rod (yield = 36 ksi), this provision is met. Hilti Kwik bolts, however, have a yield greater than 80 ksi, so, in the absence of manufacturer's guidelines, paragraph NF-4721(b)-1 should apply. This paragraph does not prohibit the use of oversize holes with high strength bolting. As noted by TUGCO in their 6/8/84 letter, this interpretation was agreed to by both the CPSES constructor and the authorized nuclear inspector. In addition, the Hilti Product Management Brochure for Hilti installation states that the wedge clearance hole in a base plate should be 1.17" for 1" bolt, to facilitate installation. Therefore, the use of 1-1/8" holes for Hilti bolts does meet the manufacturer's guidlines. Based on the above, Cygna concurs with the bolt hole diameters used at CPSES.

16. Box Frames with 0" Gap

In the Phase 3 support review, Cygna noted rare instances where a box frame was used with a strut in place of a pipe clamp. In these cases, the drawing specified a 0" gap between the pipe and frame. Cygna asked TUGCO to evaluate the stresses in the pipe and frame, due to thermal expansion of the piping. In response to this and a similar question from the ASLB, TUGCO performed calculations on these Component Cooling Water frames; these calculations show that additional stresses in the pipe are less than 10 ksi and that additional support loads are less than 500 lbs. Since the loads are thermally induced and, therefore, self-limiting, both of these additional effects are well within Code allowables for self-limiting loads. Cygna has reviewed the TUGCO calculation (Attachment B to the TUGCO 6/8/84 letter to Cygna) and concurs with the conclusions in that calculation. In addition to the TUGCO calculation for box frames on the CCW system, Cygna performed calculations for a box frame with 0" gap located on the Residual Heat Removal/Safety Injection system. This application of the box frame design was discovered during the Phase 2 pipe support reviews. These calculations concluded that the 16" pipe and the box frame are within code allowables for temperatures as high as 350° F. According to TUGCO and the NRC Special Inspection Team, box frame designs are primarily found on low temperature systems such as the CCW or Service Water system. Discussions with TUGCO indicate the above application on the RHR system is isolated. No examples of box frames with 0" gap were found on the Main Steam system.

17. U-Bolts Used on Trapeze Supports

In a number of trapeze supports reviewed in Phase 3, Cygna noted the use of a U-Bolt to keep the pipe positioned on the frame. In these cases (typically spring supports), there is no upward load on the U-bolt. In effect, the U-bolt is not needed as a load carrying member, but only to keep the pipe in place on the trapeze beam. In these cases, Cygna has referenced this note on the checklist to help explain the U-bolt's function.