CYGNA
ENERGY SERVICES

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April 23, 1985
84056.064

Mr. J.W. Beck
Manager - Licensing
Texas Utilities Generating Company
Skyway Tower
400 North Olive Street, L.B. 81
Dallas, Texas 75201

Subject: Review Issues List Transmittal
Comanche Peak Steam Electric Station
Independent Assessment Program - All Phases
Job Nos. 83090, 84042 and 84056

Dear Mr. Beck:

Enclosed is a complete set of the Review Issues Lists (RIL) which summarizes all the findings and open items identified to date. The disciplines included and the corresponding RIL revisions are as follows:

Pipe Stress	Revision 1	Electrical/I&C	Revision 1
Pipe Supports	Revision 1	Mechanical Systems	Revision 1
Cable Tray Supports	Revision 9	Design Control	Revision 0
Conduit Supports	Revision 1		

All significant changes or additions are noted by a revision bar in the right margin. These lists are still being reviewed by Cygna personnel on a weekly basis and will to be reissued as necessary.

If there are any questions, please do not hesitate to call.

Very truly yours,

N.H. Williams

N.H. Williams
Project Manager

NHW/dco
Attachments

cc: Mr. V. Noonan (USNRC) w/attachments
Mr. S. Burwell (USNRC) w/attachments
Mr. S. Treby (USNRC) w/attachments
Mr. W. Horin (Bishop, Liberman, et al.) w/attachments
Mr. J. Redding (TUGCO) w/attachments
Ms. J. van Amerongen (TUGCO/EBASCO) w/attachments
Ms. J. Ellis (CASE) w/attachments
Mr. D. Pigott (Orrick, Herrington & Sutcliffe) w/attachments
Mr. F. Dougherty (TENERA) w/attachments
Mr. R. Ballard (Gibbs & Hill) w/attachments
Mr. R. Kissinger (TUGCO) w/attachments

ZZZZ See 1/1 Attached Dist

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1. Mass Participation/Mass Point Spacing

References:

1. R.E. Ballard (G&H) letter to J.B. George (TUGCO), "Mass Participation," GTN-69454, September 14, 1984
2. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Phase 3 Open Items - Mass Participation," 84042.017, September 21, 1984
3. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Phase 3 Open Items - Mass Participation," 84042.019, October 2, 1984
4. L.M. Popplewell (TUGCO) letter to N.H. Williams (Cygna) "Cygna Potential Finding Report Mass Participation and the Mass Points Spacing Error in Problem AB-1-61A," December 7, 1984
5. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Phase 3 Open Items - Mass Participation and Mass Point Spacing," 84042.021, February 8, 1985
6. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PI-00-05, and PFR-01

Summary: The pipe stress seismic analyses did not include sufficient modes to comply with the FSAR which requires that the inclusion of additional higher order modes should not increase system response by more than 10%. In addition, the mass point spacing for the dynamic analyses did not always meet project criteria.

Status: Reference 5 documents Cygna's evaluation of the Gibbs & Hill piping reanalyses and lists recommended actions. No response has been received from TUGCO/ Gibbs & Hill at this time.

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2. Incorrect Pipe Schedule Used for Calculation of Nozzle Allowables

Reference: 1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PI-02-05

Summary: Cygna noted one instance in which the nozzle allowables were calculated using an incorrect wall thickness.

Status: Closed out based on expanded review to include the pumps on the diesel generator system.

3. Finite Element Model Error in Flued Head Analysis

Reference: 1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PI-03-01

Summary: The flued head finite element model was found to contain a geometry error due to improper generation of some elements.

Status: Closed based on review of 15 of the remaining 18 flued head analyses.

4. Inclusion of Fluid and Insulation Weight at Valves and/or Flanges

Reference: 1. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PI-00-04 and Section 5.1., Page 5-6

Summary: Cygna found that it was Gibbs & Hill's standard practice not to include fluid and insulation weight at valves and flanges.

Status: Closed for the CCW system based on a Gibbs & Hill study which demonstrated that the effect is minor. The effects must still be considered in a cumulative effects review.

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5. Discrepancies in Pipe Support Loads Between Analyses and Support Design

References:
1. Cygna Phase 3 Final Report, TR-84042.01, Revision 1, Observation PI-00-06
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated August 29, 1984
3. R.E. Ballard (Gibbs & Hill) letter to J.B. George (TUGCO), GTN-69233, dated July 10, 1984
4. Communications Report between J. Finneran (TUGCO), N. Williams and J. Minichiello (Cygna) dated 7/13/84, 2:45 p.m.

Summary: Cygna found that in some instances the latest support loads were not used in the pipe support design calculations.

Status: Closed except as input to the cumulative effects review.

6. Snubbers on Fisher Valves

References:
1. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PI-00-07 and PFR-02
2. L.M. Popplewell (TUGCO) letter to N.H. Williams (Cygna) dated July 9, 1984
3. L.M. Popplewell (TUGCO) letter to N.H. Williams (Cygna) dated August 29, 1984

Summary: The snubbers on the Fisher valve operators were not qualified for the as-built loads. This issue led to questioning whether the valve itself was capable of transmitting these loads and still maintaining operability.

Status: Closed based on TUGCO's requalification of all affected valves and snubbers. Cygna has not, however, reviewed the qualification report. TUGCO should provide a sample Fisher valve qualification report for review. 1

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7. Snubbers Close to Equipment Nozzles

Reference: 1. Cygna Phase 4 Pipe Stress Walkdown Checklists (not issued)

Summary: Cygna noted several snubbers on the Component Cooling Water System (CCW) which were located close to equipment nozzles. Due to their proximity to a rigid attachment point, the dynamic displacements at these locations will be very small such that the snubbers may not perform their intended function.

Status: Closed with Cygna's recommendation that these snubbers be candidates for a snubber elimination program.

8. Lack of Traceability for ANSYS/Relap Runs

Reference:
1. Communications Report between S. Lim (Gibbs & Hill) and L. Weingart (Cygna) dated 3/8/84, 8:45 a.m.
2. Communications Report between H. Mentel (Gibbs & Hill) and J. Minichiello (Cygna) dated 3/13/84, 3:00 p.m., Revision 1
3. Communications Reports between S. Lim (Gibbs & Hill) and L.Weingart (Cygna) dated 3/15/84, 8:15 a.m.

Summary: There are four programs utilized by Gibbs & Hill in performing a steam hammer analysis:

1. RELAP
2. GHFORCE - provides imbalance loads
3. Program to convert to ANSYS format
4. ANSYS

Sufficient documentation did not exist to provide cross referencing of the four runs for a particular Main Steam loop.

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Status: This finding was closed technically, however, it remains open from a QA standpoint. This issue is being addressed as part of Cygna's Phase 4 design input control review.

9. Inclusion of Support Mass In Pipe Stress Analysis

References:

1. Communications Report between G. Krishnan (Gibbs & Hill SSAG) and J. Minichiello (Cygna) dated 3/19/84, 8:30 a.m.
2. Gibbs & Hill letter GTN-68852 dated April 25, 1984
3. Communications Report between H. Mentel (Gibbs & Hill), G. Grace (EBASCO), N. Williams and L. Weingart (Cygna) dated 5/24/84, 10:00 a.m.
4. Prefiled Testimony of Nancy H. Williams, Response to Doyle Question #4, June 12, 1984
5. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Pipe Stress Checklist General Note 1
6. Communications Report between D. Wade (TUGCO) and N. Williams (Cygna) dated 10/11/84, 4:00 p.m.
7. N.H. Williams (Cygna) letter to V. Noonan (USNRC), 84042.022, dated January 18, 1985 "Open Items Associated with Walsh/Doyle Allegations"

Summary: The weight of the pipe supports was included in the stress analyses for the Main Steam Inside Containment only. In Reference 1 Cygna requested justification for this practice. Gibbs & Hill responded in Reference 2 by pointing out that the supports associated with the Main Steam lines were relatively massive and as such, a judgement was made to include their mass in the stress analysis. For other systems, a judgement was made that the effects would be negligible. However, per Reference 4, the effect of this omission on support loads was shown to be as high as 24% on the RHR system.

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Status: In the context of the CPRT plan, TUGCO should demonstrate that support mass effects have been considered in the pipe stress analysis. ⚠1

10. Stress Intensification Factors (SIFs)

References:
1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PI-00-01
2. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PI-00-01

Summary: Cygna found numerous instances where G&H either neglected to input the required SIF into the stress analysis (References 1 & 2) or miscalculated the SIF (Reference 2).

Status: Closed based on expanded reviews; however, this problem should be checked as part of the mass participation reviews.

11. Welded Attachments

References:
1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PI-00-02 and PI-02-03
2. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observations PI-00-02 and PI-06-01

Summary: Cygna found several problems with G&H's treatment of welded attachments:

- Use of an increased allowable in the evaluation of local strasses for upset and emergency combinations (Reference 1).
- Use of thermal expansion loads rather than load ranges for evaluation of local stresses (Reference 1).
- Failure to consider local stresses in break exclusion zones (Reference 2).

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- Failure to consider combined effects of two supports at a single welded attachment (Reference 2).

Status: Closed based on the use of rationale from later codes, recalculations, and expanded reviews.

12. Use of Incorrect Pipe Wall Thickness

Reference: 1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PI-01-01

Summary: Cygna found two piping segments which were input to the stress analysis with the incorrect wall thickness.

Status: This problem was considered isolated and closed based on Cygna's recalculation of the pipe stresses.

13. Inclusion of Appropriate Responses Spectra

References: 1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PI-02-01

Summary: Cygna noted that stress analysis problem AB-1-70 did not consider all the appropriate response spectra from all buildings.

Status: Closed based on an evaluation of the omitted spectra and an expanded review to determine if this situation occurred in other stress problems.

14. Support Location Discrepancy

References: 1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PI-02-02

2. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Checklist PI-09, Item 14

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Summary: Supports were modeled at locations outside of allowable tolerances. The Reference 1 observation was closed based on an evaluation of the pipe stresses and an assessment that these occurrences were sufficiently isolated. The Reference 2 discrepancy was noted and evaluated by Gibbs & Hill in their QA binder.

Status: Closed.

15. Use of Incorrect Damping in Seismic Analyses

Reference: 1. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PI-00-03

Summary: Cygna noted that Gibbs & Hill did not consider the lower damping response spectra in some systems with mixed sized piping.

Status: Closed based on Cygna's expanded review.

16. Combination of Safety/Relief Valve Thrust and Seismic Loads

Reference: 1. Cygna Phase 3 Final Report, TR-84042-01, Revision 0, Observation PI-06-02

Summary: In pipe stress problem AB-1-23B, the stresses/loads due to safety/relief valve thrust were not combined with those due to SSE for the emergency case. In the other three Main Steam lines outside containment, the two effects were combined. While not specifically required by the FSAR, Cygna believes it is appropriate to combine the two effects.

Status: As part of the overall review for other effects, TUGCO should demonstrate the piping and supports on this line are acceptable under the combined loading.

17. Force Distribution in Double Ported Safety Valves

Reference: 1. Communication Report between H. Mentel (Gibbs & Hill) and J. Minichiello (Cygna) dated 3/12/84, Item 2b

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Summary: By assuming a 55/45 split in the flow, instead of the 60/40 suggested by Crosby Valve as general practice, the torque on the Main Steam pipe is halved.

Status: TUGCO should demonstrate that the 55/45 is a reasonable assumption. In addition, if the 55/45 is not a reasonable assumption, TUGCO should address the implication this has on the Main Steam lines and any other lines which use double ported safety valves.

18. Fisher Valve Modeling

Reference:
1. Communication Report between H. Mentel (Gibbs & Hill) and J. Minichiello (Cygna) dated 3/12/84, Item 1c
2. Communication Report between Krishnan/Ray (Gibbs & Hill) and Minichiello (Cygna) dated 6/12/84

Summary: Cygna was trying to determine how "flexible" valves (F < 33 cps) were modeled. In our review, Cygna found the valves noted in Reference 2 (other than Fisher valves) were the only "flexible" valves within the Gibbs & Hill scope. Cygna determined that the valve accelerations for those valves were acceptable. Cygna did not, however, address the modeling of the Fisher valve yoke, which is laterally supported at the end. If the yoke is modeled much stiffer than it actually is, this may affect the anlaysis results.

Status: TUGCO should demonstrate that the stiffness used to model Fisher Valves reasonably approximates the actual valve yoke stiffness.

19. Eccentric Mass and Its Effect on Piping and Welded Attachments

Reference:
1. Communication Report between G. Krishnan (Gibbs & Hill) and J. Minichiello (Cygna) dated 3/21/84, Item 1
2. R.E. Ballard, Jr. (Gibbs & Hill) letter GTN-68852 to J.B. George (TUGCO) dated 4/25/84

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Summary: In modeling the masses of the supports in the Main Steam lines inside containment, Gibbs & Hill had not accounted for the eccentricity of the mass from the pipe centerline. In their response in Reference 2, Gibbs & Hill showed that the seismic effects were small on the overall pipe cross-section. They also showed the local effects at the welded attachment were not significant for a 1g load. Further Cygna review showed the seismic accelerations were on this order. Cygna did not review for the effect of fluid dynamic accelerations, nor consider other systems.

Status: TUGCO should demonstrate that the effect of eccentric masses on the steam hammer results is not significant. In addition, TUGCO should demonstrate that other piping systems have similar seismic/dynamic stresses due to eccentric masses.

20. ANSYS Steam Hammer Analyses

Reference:

1. Communication Report between H. Mentel (Gibbs & Hill) and J. Minichiello (Cygna) dated 3/13/84, Item 2
2. Communication Report between G. Krishnan (Gibbs & Hill) and J. Minichiello (Cygna) dated 3/21/84, Item 3
3. R.E. Ballard, Jr. (Gibbs & Hill) letter GTN-68852 to J.B. George (TUGCO) dated 4/25/84

Summary: In reviewing the ANSYS model, Cygna questioned the mass point spacing and time step size used. Gibbs & Hill supplied the results of a sensitivity study in Reference 3. In addition, Cygna questioned the load output in two axial restraints, since they were less than the load input. Gibbs & Hill explained why the results were reasonable in Reference 3. Prior to the Refernce 3 response, however, Cygna did not find any documentation indicating either a sensitivity study had been done or the ANSYS results had been reviewed for "reasonability".

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Status: TUGCO should demonstrate that any water hammer dynamic analyses have acceptable input and output results.

21. Valve Acceleration and Flange Load Generic Studies

Reference:
1. Cygna Phase 2 Final Report, TR-83090-01, Revision 0, Checklist PI-01, Notes 3 and 4
2. Communication Report between H. Mentel (Gibbs & Hill) and J. Minichiello (Cygna) dated 3/19/84, Item 7

Summary: In Phases 1 and 2, Cygna found that Gibbs & Hill did not check valve accelerations or flange loads in every pipe stress calculation. Instead, Gibbs & Hill used a sampling process, which was reasonable, to determine the worst valves or flanges. They then showed, through two general studies, that all valves met the Specification allowables and all flanges met Code allowables. In Phase 3, however, Cygna found one safety valve with an acceleration slightly above (2%) the allowable. This indicates that the sampling method may not be sufficient to address all valves or flanges.

Status: TUGCO should demonstrate that all valves and flanges meet appropriate allowables as part of any overall assessment of the piping.

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1. Box Frames With 0" Gap

References:

1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Box Frames with 0" Gap", 84042.023, dated 1/28/85
2. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/19/84, Item 2
3. L. M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 4/19/84
4. L. M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna), Attachment B, dated 6/8/84
5. "Affidavit of John C. Finneran, Jr. Regarding Consideration of Local Displacement and Stress"

Summary: The original support calculations did not consider the effect of the box frame and pipe interaction (Reference 2).

In addition, later TUGCO calculations (References 4 and 5) used unconservative temperature and frame stiffness assumptions and did not include the effects of Cygna comments.

Status: On hold pending TUGCO response to Reference 1.

2. Design of Welded/Bolted Connections

References:

1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Design of Welded/Bolted Connections," 84042.024, dated 1/28/85
2. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/21/84, Item 1.c.
3. L. M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 4/19/84
4. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PS-06

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Summary: Cygna found no evidence that welded/bolted connections are designed in accordance with paragraph XVII-2442 of Section III of the ASME B&PV Code.

Status: On hold pending TUGCO response to Reference 1.

3. Richmond Insert Allowables

References:

1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Richmond Insert Allowables and Bending Stresses," 84042.025, dated 1/31/85
2. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/16/84, Item 2
3. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/30/84, Item 1
4. L. M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 5/2/84
5. L. M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 5/8/84
6. Communications Report between Bezkor (Gibbs & Hill) and Minichiello (Cygna) dated 6/12/84, Item 4
7. "Affidavit of John C. Finneran, Jr., Robert C. Iotti, and R. Peter Deubler Regarding Design of Richmond Inserts and their Application to Support Design"

Summary: Cygna has concerns with the following issues:

- Justification for single insert allowables based on test concrete strength.
- Justification for bolt loads due to "axial torsion" of the tube steel.
- Interaction results from STRUDL analyses.
- Bending stresses in bolts.

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Status: On hold pending TUGCO response to Reference 1.

4. Punching Shear (U-Bolt - Tube Steel Design)

References:

1. N. H. Williams (Cygna) letter to J. B. George (TUGCO), "Phase 4 Open Items - Punching Shear," 84056.053, dated 1/31/85
2. Communications Report between Finneran (TUGCO) and Minichiello (Cygna) dated 10/4/84
3. TUGCO Calculations dated 10/11/84, received by Cygna 10/18/84
4. Communications Report between Finneran (TUGCO) and Minichiello (Cygna) dated 10/30/84
5. J.B. George (TUGCO) letter to N.H. Williams (Cygna) dated 11/8/84
6. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Phase 4 Open Items - Punching Shear" 84056.058, dated 3/12/85

Summary: Cygna has not found evidence that the stresses in the tube steel or coverplate in support MS-1-002-005-S72R near the U-bolt hole were evaluated. Cygna has found that this absence of supporting calculations is typical for this type of design.

Status: On hold pending TUGCO response to Reference 1.

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5. Mass Participation/Mass Point Spacing

References:

1. N. H. Williams (Cygna) letter to J. B. George (TUGCO), "Mass Participation/Mass Point Spacing," 84042.021, dated 2/8/85
2. R. E. Ballard (G&H) letter to J. B. George (TUGCO), "Mass Participation," GTN-69454, dated 9/14/84
3. N. H. Williams (Cygna) letter to J. B. George (TUGCO), "Phase 3 Open Items - Mass Participation," 84042.017, dated 9/21/84
4. N. H. Williams (Cygna) letter to J. B. George (TUGCO), "Phase 3 Open Items - Mass Participation," 84042.019, dated 10/2/84
5. L.M. Poppelwell (TUGCO) letter to N. Williams (Cygna), "Cygna Potential Finding Report Mass Participation and the Mass Point Spacing Error in Problem AB-1-61A," dated 12/7/84

Summary: Due to the detailed nature of this subject, please see Reference 1.

Status: On hold pending TUGCO response to Reference 1.

6. Stability of Pipe Supports

References:

1. N. H. Williams (Cygna) letter to J. B. George (TUGCO), "Stability of Pipe Supports," 84042.035, dated 2/19/85
2. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/20/84, Item 3
3. L. M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 4/19/84
4. Communications Report between Rencher/Grace (TUGCO) and Minichiello/Wong (Cygna) dated 5/24/84, Item 15

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5. L. M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 7/12/84

6. "Affidavit of John C. Finneran Jr. Regarding Stability of Pipe Supports and Piping Systems"

7. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Appendix J, General Note 12, and Appendix G, Observation PS-02

Summary: The issue of support stability is quite detailed. Please see Reference 1 for a discussion of Cygna's concerns.

Status: On hold pending TUGCO response to Reference 1.

7. Cinching of U-Bolts

References:

1. N.H. Williams (Cygna) letter to J.W. Beck (TUGCO), "Cinching of U-Bolts," 84042.036, dated 3/25/85

2. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/19/84, Item 5

3. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 4/19/84

4. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna), Attachment C, dated 6/8/84

5. "Affidavit of Robert C. Iotti and John C. Finneran, Jr., regarding Cinching Down of U-Bolts" (received 7/12/84)

6. Westinghouse Electric Corp. Report EQ&T-EQT-860, Revision 0, "Comanche Peak Steam Electric Station U-Bolt Support/Pipe Test Program" (received 7/12/84)

7. Westinghouse Electric Corp. Report entitled "Comanche Peak Steam Electric Station U-Bolt Finite Element Analysis", dated 6/12/84 (received 7/12/84)

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8. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "U-Bolt Cinching Test/Analysis Program - Phase 3 Open Item," 84042.015, dated 8/23/84

9. Transcript of Meeting between Cygna Energy Services and Texas Utilities Generating Company and Ebasco Services, Inc., dated 9/13/84

10. R.C. Iotti (Ebasco) letter to N.H. Williams (Cygna), "Additional Information as Follow-Up to Meeting of 9/13/84," 3-Z-17 (6.2), ETCY-1, dated 9/18/84

11. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Status of Cinched U-Bolt Testing and Analysis Program," 84042.018, dated 10/1/84

12. J.B. George (TUGCO) letter to N.H. Williams (Cygna), "Cinched U-Bolt Testing and Analysis Program - Additional Information," dated 11/1/84

13. J.B. George (TUGCO) letter to N.H. Williams (Cygna), "Cinched U-Bolt Testing and Analysis Program - Additional Information," dated 11/16/84

Summary: Please see Reference 1 for details.

Status: On hold pending TUGCO response to Reference 1.

8. Richmond Insert Allowable Spacing

References:
1. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/10/84, Item 1

2. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/12/84

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Summary: Cygna had asked TUGCO how the designers ensured that the allowables they used for pipe support attachments correspond to the installed Richmond Insert spacing. TUGCO responded by stating that their designers used minimum allowables, unless a walkdown was performed to ensure that larger spacings existed, thereby permitting the use of increased allowables. There was no written procedure documenting this direction to the designers.

While Cygna could not find evidence that this unwritten procedure was not followed, Cygna has no assurance that conservative allowables were always used.

Status: See Cable Tray Open Items and Generic Issues, item 3.

9. Embedment Attachment Spacing

References:

1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Pipe Support Review Questions," item 5, 84056.13, dated 7/31/84
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 8/24/84
3. Communications Report between Purdy (Brown & Root) and Minichiello (Cygna) dated 3/4/85
4. Brown & Root Procedure CCP-45, Revision 1, dated 8/18/80
5. Brown & Root Procedure QI-QAP-11.1-28, Revision 24, dated 4/18/84
6. Brown & Root Procedure QI-QAP-11.1-28, Revision 29, dated 1/25/85
7. Communications Report between Warner (TUGCO) and Williams/Minichiello/Russ (Cygna) dated 2/27/85
8. CPSES Procedure QI-QP-19.5-1, "Separation Inspection for Unit 1 and Common Buildings"

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Summary: Cygna has found two pipe support base plates welded to embedded plates with less than 12" required spacing between the edges of the support base plates (per Reference 4). This was not a CPSES inspection item at the time of the Cygna review (Reference 5); however, the Brown & Root procedure was revised to include the proper checks for pipe supports (Reference 6). Since this affects all hardware attached to embedded plates (HVAC, raceway, and pipe supports), not just a single discipline, and since it was not an inspection item in other discipline procedures (per References 7 and 8), this item has generic implications.

Status: TUGCO should provide evidence that the spacing requirement has been or will be checked on a plant-wide basis.

10. Thru-Bolts and Concrete Acceptability

References:
1. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/30/84, Item 2
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 5/2/84
3. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 6/8/84 item 9 and Attachment D

Summary: Cygna is concerned that the loads on the walls may not be acceptable. Although Gibbs & Hill has walked down several highly loaded areas per Reference 3, there is no written procedure documenting the transmittal of as-built loads on concrete structures to the structural group. Thus there is no assurance that each area, particularly near free edges, is acceptable.

Status: TUGCO should demonstrate that the civil structures are acceptable for the applied loading.

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11. Bolt Spacing

References:
1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Pipe Support Review Questions," item 3, 84056.14, dated 8/6/84
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 8/11/84

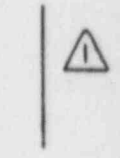
Summary: In certain base plate designs in Phase 4 (CC-2-019-715-A43K, for example), the bolt hole dimensions are detailed as "1-1/2 MIN TYP" from the edge of the plate. In some cases, this could result in a dimension from 1-1/2 to 3-1/2 inches. While this may have little effect on the bolt load, it does effect the maximum plate stresses by as much as 15% for a strut, spring, or snubber with a 5° offset.

Status: TUGCO should demonstrate how this location tolerance is addressed in the design calculations.

12. Support Self Weight Excitation During a Dynamic Event

References:
1. Communitations Report between Rencher/Finneran (TUGCO) and Minichiello (Cygna) dated 3/10/84
2. TUGCO memo CPP-9977
3. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Appendix J, Note 7
4. N.H. Williams (Cygna) letter to V. Noonan (USNRC), "Open Items Associates with Walsh/Doyle Allegations," 84042.022, dated 1/18/85

Summary: TUGCO has not considered the loads due to the support dynamic excitation in the pipe support designs.

Status: In order for Cygna to assess the impact of self-weight excitation on support design, TUGCO should provide Cygna with all TUGCO/NRC/CASE correspondence on this issue. 

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13. Support Stiffness

References:
1. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Appendix J, Note 8
2. N.H. Williams (Cygna) letter to V. Noonan (USNRC), "Open Items Associated with Walsh/Doyle Allegations," 84042.022, dated 1/18/85

Summary: In designing Class 2 and 3 supports, TUGCO has used a deflection criteria for support stiffness. For supports with low design loads, this can result in very flexible supports. This could affect the stress analysis results and redistribute support loads.

Status: In order for Cygna to assess the impact of support stiffness on support design, TUGCO should provide Cygna with all existing TUGCO/NRC/CASE correspondence on this issue. ⚠1

14. Hydrotest Support/Stress Design

References:
1. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/20/84, Item 1
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 4/19/84 with TUGCO Instructions CP-EI-4.0-30, Revision 1, attached
3. D.G. Eisenhut (USNRC) letter to M.D. Spence (TUGCO), Item V.E., dated 11/29/84

Summary: Cygna did not find any evidence in either the support design calculations or the pipe stress analyses that hydrostatic test loads had been considered. TUGCO responded with a copy of their procedure which addresses the design of temporary supports.

Status: TUGCO should provide examples of checks made/temporary supports designed in accordance with Procedure CP-EI-4.0-30. ⚠1

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15. Dynamic Pipe Movements in Support Design

References:

1. Communications Report between Wade (TUGCO) and Williams (Cygna) dated 9/28/83, Pipe Support Item 3
2. Communication report between Wade (TUGCO) and Williams (Cygna) dated 10/4/83, Pipe Support Item 3
3. Cygna Phase 1 and 2 Final Report TR-83090-01, Revision 0, Observation PS-09-01
4. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/20/84, Item 2
5. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 4/19/84

Summary: TUGCO does not include dynamic pipe movements in support design when checking frame gaps, swing angles, or spring travel. Cygna was concerned this could affect design adequacy, and received a response (Reference 2) which only addressed the seismic effects. Other dynamic loads such as steam hammer were not mentioned in the response.

Status: TUGCO should demonstrate that dynamic events (i.e., steam/water hammer) which produce much larger displacements than seismic events do not impact design.

16. Dual Strut/Snubber Design

References:

1. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/22/84, Item 2.b
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 6/8/84
3. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PS-03
4. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Page 5-5

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5. "Affidavit of Robert C. Iotti and John C. Finneran, Jr., Regarding Consideration of Force Distribution in Axial Restraints"

6. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Force Distribution in Axial Restraints - Phase 3 Open Item," 84042.Q14, dated 8/10/84

Summary: While most of the discussion on this subject has centered around axial restraints, Cygna is concerned about all types of dual restraint designs (trapezes, double trunnions, riser clamps with shear lugs). TUGCO has designed each restraint in these cases to take only 1/2 the total load. Also, Gibbs & Hill stated standard practice in local stress analysis assumes the trunnions equally share the load. Cygna finds this inconsistent with other design organizations, which usually assume one side takes more than 1/2 of the overall support load. TUGCO is currently performing an assessment in response to Reference 6.

Status: Open pending TUGCO response to Reference 6.

17. Hilti Kwik-Bolt Embedment Length References

References:
1. Communications Report between Wade (TUGCO) and Williams (Cygna) dated 9/28/83, Pipe Support Item 1

2. Communications Report between Wade (TUGCO) and Williams (Cygna) dated 10/4/83, Pipe Support Item 1

3. Communications Report between Rencher (TUGCO) and Minichiello (CYGNA) dated 10/6/83, Item 1

4. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PS-02-01

Summary: Embedment lengths shown on the support drawing do not match those in the support calculation. Additional investigation by Cygna revealed that this item has no impact on design. For further details refer to Reference 4.

Status: Closed.

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18. Incorrect Data Transmittal

References: 1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PS-10-01

Summary: The displacement transmitted for support RH-1-064-001-S22R had an incorrect sign.

Status: Closed and isolated.

19. Incorrect Standard Component Allowables

References: 1. Communications Report between Wade (TUGCO) and Williams (Cygna) dated 9/28/83, Pipe Support Item 4

2. Communications Report Between Wade (TUGCO) and Williams (Cygna) dated 10/4/83, Pipe Support Item 4

3. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation PS-12-01

Summary: The incorrect U-bolt allowables were used in the design of support RH-1-064-011-S22R (formerly RH-1-062-002-S22R).

Status: Closed and isolated.

20. Input Errors in the Design of Support MS-1-001-006-C72K

References: 1. Communications Report between Grace (TUGCO) and Minichiello (Cygna) dated 5/22/84, Item 10

2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 6/8/84 item (41)

3. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PS-01

Summary: Errors were found in the section properties and boundary conditions which will affect the STRUDL results. The STRUDL input was not checked or approved at the time of Cygna's review.

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Status: Closed technically. Open for QA significance.

21. Undersized Fillet Welds

References:
1. Communications Report between Rencher (TUGCO) and Minichiello (Cygna) dated 5/16/84, Item 5
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 6/8/84 item (31)
3. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PS-04

Summary: Two fillet welds were designed under the minimum required by the ASME B&PV code, Table XVII-2452.1-1.

Status: Closed and isolated.

22. Improper Weld Calculations for Three-Sided Welds

References:
1. Communications Report between Grace (TUGCO) and Minichiello (Cygna) dated 5/22/84, Item 1
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 6/8/84 item (32)
3. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PS-05
4. N.H. Williams (Cygna) letter to J.B. George (TUGCO) "Box Frames with 0" Gap," 84042.023, dated 1/28/85 item 3 of the Attachment
5. N.H. Williams (Cygna) letter to J.B. George (TUGCO) "Mass Participation and Mass Point Spacing," 84042.021, dated 2/8/85 pipe support review Item 5

Summary: TUGCO does not always consider the eccentricity between the member center of gravity and the weld center of rigidity when determining weld loads to be used in the design.

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Status: Closed for the supports reviewed in Phase 3 and 4. TUGCO should evaluate these calculations for any revision to the pipe stress analysis which increases loads, such as those reevaluations associated with References 4 and 5.

23. Improper Weld Calculation for Composite Sections

References:
1. Communications Report between Finneran (TUGCO) and Williams/Minichiello (Cygna) dated 7/11/84, Item 1
2. Communications Report between Finneran (TUGCO) and Minichiello (Cygna) dated 7/11/84
3. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 7/12/84
4. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation PS-07

Summary: When welding cover plates to tubesteel or wideflanges to form composite sections, the method used for the weld design is not always correct and all the loads are not always considered.

Status: Closed based on additional calculations for the Phase 3 review scope. However, these errors should be corrected if loads increase in later revisions to the stress analyses.

24. Untightened Locknuts on Struts

References:
1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation WD-01-01
2. TUGCO Memorandum from M.R. McBay dated 6/9/83

Summary: During the Phase 1 walkdown, Cygna noted one support on which the upper locknut on the strut was not tightened. This situation could lead to rotation of the strut and a subsequent redistribution of load among neighboring supports.

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Status: Closed based on previous identification of the deficiency by TUGCO (Reference 2) and proposed corrective and preventative actions.

25. Inverted Snubbers

References:
1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation WD-02-02
2. N. Williams (Cygna) letter to S. Burwell (USNRC), 83090.021, dated 11/6/84

Summary: During the Phase 1 walkdown, Cygna noted four supports in which the snubbers were installed 180° from the configuration shown on the support drawing.

Status: Closed based on lack of design or safety impact.

26. Embedded Plate Design

References:
1. Communication Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/22/84, Item 1
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated 4/19/84, Page 11, Item 1
3. Gibbs & Hill Specification 2323-MS-46A, Revision 5, Section 3, Appendix 9, "Specification 2323-SS-30 - Structural Embedments"
4. Cygna Phase 3 Final Report, TR-84042-01, Revision 0, Appendix J, General Note 13

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Summary: In Paragraph 3.4 of Appendix 4 to Reference 3, Gibbs & Hill requires that all attachments to embedded plates shall be assumed to be "pin connections" (force transfer only). They further state that moment connections to the embedment require stiffening. As noted in Reference 2, however, Gibbs & Hill has not provided any guidelines for the stiffeners. As also noted in Reference 2, the pipe support design organization assumes that any attachment to the embedded plate will effectively stiffen the local area, but they did not cross-check this assumption with Gibbs & Hill.

Status: While Cygna believes that the design methods used are not unreasonable, Cygna should review the embedded plate design calculations to determine the appropriateness of the pipe support design assumptions. In addition, Specification 2323-SS-30 should be revised to provide guidance in selecting stiffners for the embedded plates.

27. Pipe Support Design Procedures

Reference: None

Summary: In performing the pipe support design review for Phase 2, 3 and 4, Cygna utilized certain engineering standards from ITT Grinnell, NPSI, and PSE when they were referenced in a particular calculation. Cygna did not review all the guidelines or standards from each organization and has returned those that were used.

Status: In order to complete our design process reviews, Cygna requests a controlled copy of the pipe support engineering guidelines/standards from ITT Grinnel, NPSI, and PSE.

28. Use of A563 grade A nuts with high strength Bolting

References:
1. Communication Report between Rencher (TUGCO) and Minichiello (Cygna) dated 3/16/84, Item 1.
2. L. M. Poppelwell (TUGCO) letter to N. H. Williams (Cygna) dated 4/19/84, Item 1.

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Summary: ASTM specification A563 recommends that Grade A nuts be used with A307 (low strength) bolting. However, as noted by TUGCO, their designers, when not using high strength nuts, will specify double nuts, with both nuts snugged. Cygna's scope of review confirmed this statement.

Status: Closed.

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1. Controlling Load Case for Design

References:

1. Gibbs & Hill Calculation Binder 2323-SCS-101C, Set 5, Sheets 16-20, Revision 5
2. Communications Report between P. Huang, S. Chang (Gibbs & Hill) and J. Russ and W. Horstman (Cygna) dated 11/13/84
3. Gibbs & Hill Calculation Binder 2323-SCS-101C, Set 5, Sheets 1-7, Revision 1
4. CPSES FSAR, Sections 3.8.3 and 3.8.4

Summary:

Gibbs & Hill design calculations (Reference 3) assumed that the design of cable tray supports was governed by the 1/2 SSE (OBE) seismic event. The assumption was based on a comparison between a 50% increase in seismic accelerations from the OBE event at 4% damping, the SSE event at 5% damping, and an allowed increase in design stresses of 60% for the SSE event, per Reference 4.

For the design of structural steel members, the 60% increase cannot be applied to certain allowable stresses. For example, in weak axis bending of wide flange beams and bending in base plates, increasing the allowable by 33% will result in a stress level equal to yield. In addition, the allowable loads for concrete anchors (see Review Issue 3) cannot be increased by 60% for the SSE event. Neither of the above limitations were considered in the selection of the governing load case for design.

In order to reduce the loads for SSE, Gibbs & Hill elected to use 7% damping for the cable trays at SSE, as allowed for bolted structures.

Gibbs & Hill provided tables of peak spectral accelerations for OBE at 4% damping and SSE at 7% damping (Reference 1). The reduced SSE accelerations appear to demonstrate that OBE governs for support designs on a generic basis. However, for supports designed using accelerations for a specific building elevation (e.g., elevations 773', 785' and 790' in the Safeguards Building) the ratio of SSE to OBE exceeds 33%. Therefore, SSE can potentially govern the design of these

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supports. Support systems at these building elevations are not included in Gibbs & Hill's dynamic analyses. The supports at the three elevations indicated above may require additional review.

Status: Qualification of supports within Cygna's scope is complete. This issue should be considered in any cumulative effects evaluation for generic applications.

2. Seismic Response Combination Method

References:

1. CPSES FSAR Section 3.7B.2.7
2. Gibbs & Hill Calculation Binder 2323-SCS-215C, Sets 2-6
3. USNRC Regulatory Guide 1.92, Revision 1
4. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Cable Tray Support Design Review Questions," 84056.031, dated August 31, 1984
5. Gibbs & Hill calculation response to IAP Phase 2 questions, Cygna Technical File 83090.11.2.1.50

Summary:

A. Closely Spaced Modes (10% Modal Combination) in Spectral Analysis

In the response spectra analyses performed for the working point deviation generic study (Reference 2), Cygna noted that modal responses were not combined considering closely spaced modes as required by References 1 and 3.

B. Inclusion of Dead Load in SRSS Combination:

Gibbs & Hill design calculations typically included the dead load in the SRSS with the seismic loads. This issue was discovered in Phase 2 of this review, and Gibbs & Hill performed a study to quantify the impact of this error (Reference 5). Gibbs & Hill calculations did not consider the effects of frame aspect ratios on the resultant loads. Reference 4 discusses a Cygna study on

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the effects of aspect ratios for frame types within the review scope. The study results indicated the increases in resultant loads by combining the dead load with the seismic SRSS may be larger than those predicted by Gibbs & Hill.

Status:

A. Gibbs & Hill has revised the working point analyses to account for closely spaced modes in accordance with Reference 3. For a discussion of other discrepancies in the working point deviation study, see Review Issue 12.

B. TUGCO/Gibbs & Hill should consider the effects of the worst case frame aspect ratio on the results of the SRSS study. The above issues should be considered in any evaluation of cumulative effects.

3. Anchor Bolt Design

References:

1. Gibbs & Hill calculations, "Evaluation of Detail 1, single-bolt connection," Cygna Technical File 84056.11.1.259

2. Gibbs & Hill Calculation Binder SCS-212C, Set 7, Sheet 4-11, Revision 0

3. Gibbs & Hill calculations, "Justification of the adequacy of 1" Richmond Inserts for the effects of prying action," Cygna Technical File 84056.11.1.219

Summary:

A. Additional Tensile Forces Induced by Rotation of Base Angles About the Centerline of Bolt Pattern:

Gibbs & Hill has evaluated Alternate Detail 1 and a single anchor base angle using A_4 loads (Reference 1). These loads were chosen since the questions regarding design adequacy originated from discussion of the A_4 design. The resolution of this generic issue requires an evaluation of the worst case load and geometry for all applicable supports. The geometries considered should include the effects of any generic change notices such as those for the base angle edge distance (CMC 1970) and the use of shims under base plates (CMC 1969).

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B. Safety Factor on Hilti Expansion Anchors at SSE Levels.

Also see Review Issue 1.

C. Inconsistent Application of ACI 349-76, Appendix B.

Gibbs & Hill has used the provisions of Reference 1 to qualify several designs. Examples include the qualification of anchorages for Detail "11" (Gibbs & Hill drawing 2323-S-0905, Reference 2) and the use of code provisions as justification for the factors of safety used for Richmond Inserts. However, other code sections, such as B.7.3, which requires a factor of safety of 6.0 for single expansion anchor connections, were not adhered to. Cygna believes that the philosophy of the entire code appendix should be considered prior to employing selected portions of the code.

D. Factor of Safety on Richmond Inserts.

See Item C above.

E. Richmond Insert Design Allowables.

1. Prying action was not considered in the original design of Richmond Insert connections for cable tray supports. To qualify those connections which utilize Richmond Inserts, Gibbs & Hill performed calculations which reference the results of the Richmond Insert testing program (Reference 3). These calculations showed that Richmond Inserts were not the controlling anchorage type, but rather that the Hilti expansion anchors were the limiting case. Cygna has the following comments regarding these calculations:

   a. The calculations do not account for the instances where the allowable values for Richmond Inserts from Gibbs & Hill Specification 2323-SS-30 (Ta = Va = 11.5 kips) were used without the prying factor. This situation could occur whenever a CMC was reviewed. Although Gibbs & Hill has stated that their engineers were instructed to include the

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prying factor, Cygna could not locate any supporting documentation.

b. The original design calculations for concrete connections utilizing Richmond Inserts employed allowable values of tension (Ta = 10.1 k) and shear (Va = 9.5 kips). With the issuance of Gibbs & Hill Specification 2323-SS-30, restrictions were placed on the allowable values for Richmond Inserts. These restrictions dealt with the use of Richmond Inserts in cluster arrangements and Richmond Inserts used in spacings less than those originally considered by Gibbs & Hill, through a corresponding decrease in allowable tensions and shears. Since these restrictions were imposed after the original design of the Richmond Insert connections was completed, Cygna is concerned that they were not properly evaluated by Gibbs & Hill. In discussions with TUGCO, Cygna was told that the smaller spacings of Richmond Inserts were for clustered areas that were reserved for whip restraints. Any use of Richmond Inserts in these areas would require authorization from the responsible group and a corresponding evaluation of the installation.

F. Connection Designs:

The cable tray support designs provide for the use of angles or plates at base connections. These designs also provide for various tolerances in the anchor bolt spacings and member placement. Additionally, field requirements may produce concrete connections which are outside the tolerances provided by the designs.

Gibbs & Hill has not fully evaluated the effects of all allowed tolerances on the base member stresses or the anchorages.

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G. Justification of Prying Factor:

Gibbs & Hill designs globally used a factor of 1.5 to account for the effects of base angle flexibility on anchorage tensile loads. The value of this factor is dependent on the applied load, bolt pattern geometry, and angle thickness. No justification existed for the use of this factor.

H. Detail 1 Tolerances:

General note 14d on Gibbs & Hill drawing 2323-S-0901 and note 2 on Detail 1 of Gibbs & Hill drawing 2323-S-0903 allow the substitution of Richmond Inserts for Hilti expansion anchors at the Hilti anchor spacing. The minimum Hilti anchor spacing is less than the minimum Richmond Insert spacing; therefore, the tensile loads in the Richmond Inserts will be higher than originally calculated.

Status:

A. Gibbs & Hill should provide justification for the use of A_4 loadings for base plate and anchor bolt designs.

B. Cygna has collected data on the issue of the Hilti expansion anchor factor of safety and is evaluating it internally.

C. TUGCO/ Gibbs & Hill should provide justification for the use of the selected Appendix B sections.

D. Cygna has not found sufficient justification for the safety factor of 1.8 for Richmond Inserts under emergency/faulted conditions.

E. Cygna requires verification that controls on the use of Richmond Insert allowables and the inclusion of a prying factor were in place and enforced by all responsible groups.

F. Gibbs & Hill is to provide technical justification for their base plate designs. The above issues should be considered in any evaluation of cumulative effects.

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G. Gibbs & Hill is to provide technical justification for the global usage of a prying factor of 1.5. (9)

H. Gibbs & Hill is to provide technical justification for the allowed bolt substitution.

4. Design of Compression Members

References:

1. Gibbs & Hill Calculation Binder 2323-SCS-101C, Set 1
2. Gibbs & Hill Calculation Binder 2323-SCS-215C, Sets 2-6
3. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Cable Tray Support Review Questions," 84056.022, dated August 17, 1984, question 4
4. Timoshenko and Gere, "Theory of Elastic Stability," 2nd Edition, pages 99 and 100

Summary: In the design of compression members for trapeze-type support frames, Gibbs & Hill did not consider the entire unsupported length of the channels in calculation of their slenderness ratios (Reference 1, Sheets 11 and 18 for support types A_4 and B_4, respectively). If the correct unsupported lengths as well as pinned ends are assumed, the slenderness ratio for these members will exceed 200, which is the limit for compression members per AISC Specification Section 1.8.4.

In order to reduce the slenderness ratios below 200, calculations were performed to show that k = 0.8 (Reference 1, Sheets 128-146, Revision 3, and Reference 2). These calculations assumed that rotational restraint is provided by the clip angle used to attach the hanger to the bottom of the slab. Additionally, since the compressive load is applied at several points over the length of the member, the allowable axial stress was increased based on the buckling analysis of columns with multiple, discrete axial loads (Reference 4).

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Cygna has analyzed one- and two-bolt clip angles under compressive loading and determined that it is reasonable to assume partial rotational fixity for weak axis bending of the attached hanger. The assumption that the tray provides lateral bracing to the frame has not been validated (see Review Issue 18 for a discussion of tray clamps). Cygna believes that it is acceptable to consider the effective increase in allowable axial loads based upon a multiple load application. However, the increase is a function of the applied loads, and must be calculated individually for each support configuration and load case.

Status: Open pending further discussion with Gibbs & Hill/TUGCO regarding the systems concept (Review Item 10) and its application to the design of cable tray supports as well as compliance with the AISC specification.

5. Vertical and Transverse Loading on Longitudinal Type Supports

References:

1. Gibbs & Hill Calculation Binder 2323-SCS-101C, Set 2
2. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Cable Tray Support Review Questions," 84056.025, dated August 21, 1984, questions 3 and 4
3. R.E. Ballard (Gibbs & Hill) letter to N.H. Williams (Cygna), GTN-69437, dated September 10, 1984, with attached calculations
4. Gibbs & Hill Calculation Binder 2323-SCS-101C, Set 5

Summary: Longitudinal trapeze type supports (e.g., L-A_1, L-A_4, L-C_4, etc.) were assumed to act independently of the transverse supports (see Reference 4). Calculations for these longitudinal supports (Reference 1) consider only longitudinal loads in the design of frame members and anchor bolts. Since these supports are rigidly connected to the cable trays with "heavy duty clamps", a tributary tray mass will be associated with these supports. It is Cygna's belief that these supports must be designed for vertical and transverse seismic loads as are the transverse supports (see References 2 and 3).

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Status: Gibbs & Hill should consider these effects and ensure acceptability of this assumption on a generic basis.

6. Support Frame Dead and Inertial Loads

References: None

Summary: Gibbs & Hill did not consistently consider support dead loads. Out-of-plane inertial loads were not considered in the design of two-way cable tray supports. Such loads should, as a minimum, be considered in the design of base connections and anchorages. Assuming that tray clamps are able to transmit the loads from the two-way supports to the cable trays, out-of-plane loads must also be considered in the member design of longitudinal supports (see Review Issue 18). 9

Status: Gibbs & Hill should provide technical justification for ignoring dead loads and out-of-plane inertial support loads.

7. Design of Angle Sections Neglecting Loading Eccentricity

References:

1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Cable Tray Support Review Questions," 84056.025, dated August 21, 1984, questions 3 and 4
2. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Cable Tray Support Review Questions," 84056.027, dated August 27, 1984, question 2
3. AISC Specification, 7th Edition, Sections 1.15.2 and 1.18.2.4
4. Gibbs & Hill calculation "Cable tray support type SP-7 with brace. Brace eccentricity calculations." Cygna Technical File 84056.11-1.228
5. Gibbs & Hill calculation "Verify the adequacy of brace L3x3x3/8 of the governing support Case C_3." Gibbs & Hill Calculation Binder 2323-SCS-101C, Set 1, Revision 1, dated 11/16/84

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6. Gibbs & Hill calculation "Justify the use of two L3-1/2x3-1/2x3/8 angles to take the appropriate load and moment individually in the longitudinal tray supports at the lower brace." Gibbs & Hill Calculation Binder 2323-SCS-101C, Set 2, Revision 6, dated 9/15/84

Summary:

A. Longitudinal cable tray supports typically use angle sections as bracing to resist the longitudinal loads (e.g., SP-7 with brace, L-A_1, L-A_4, etc). For the member design, loads were assumed to produce only axial stresses. The induced bending stresses due to eccentric end connections were not considered. Neglecting these flexural stresses can result in members which are under-designed. For certain longitudinal supports, double angles are required. The design assumes that the angles behave as a composite member. However, no intermittent filler plates are provided as required by AISC Specification Section 1.18.2.4. Thus, the double angles must be considered to act independently.

B. Transverse and longitudinal cable tray supports typically use angle sections as in-plane braces to resist transverse loads and provide bracing points on the vertical members (e.g., A_3, A_4, B_3, B_4, L-A_4, etc). For the member design, loads were assumed to produce only axial stresses. The induced bending stresses due to eccentric end conditions were not considered. Though it is not explicitly stated in the AISC Specifications, it is standard practice (Reference 3, Sheet 3-59) to consider the bending stresses due to end connection eccentricity and check the interaction ratio considering the principal axes section moduli.

C. Single longitudinal braces are typically connected to the frame by welding along the legs of the angle. Some brace designs provide welding on only one angle leg at one end of the brace; while, at the other end of the brace, welding is provided on the other angle leg. Such end conditions may lead to failure by twist buckling.

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Status:

A. Gibbs & Hill provided calculations which considered end eccentricities as well as independent action for each angle in double-angle braces (Reference 6). Case L-B_4 was assumed to provide enveloping brace loads. Calculations (Reference 4) were also provided for support type SP-7 with brace, which has a single angle brace. Cygna believes that the approach is acceptable. However, Gibbs & Hill should provide justification for the enveloping cases.

B. Gibbs & Hill provided a calculation (Reference 5) which considered eccentric load application for in-plane braces. By reviewing the results of the working point deviation study, Gibbs & Hill found that Case C_3 had the highest brace loads. See Review Issue 12 for a discussion of the working point deviation study.

C. Cygna is presently evaluating the possibility of twist-buckling on single-angle braces.

8. Dynamic Amplification Factors

References:

1. Gibbs & Hill Report, "Justification of the Equivalent Static Load Method Using a Factor of 1.0 Times Peak Spectrum Acceleration for the Design of Cable Tray Supports; Comanche Peak Units 1 and 2."

2. Communications Report between J. Jan (Gibbs & Hill), G. Bjorkman (Cygna) dated 10/4/84, 4:00 p.m.

3. Communications Report between J. Jan, P. Huang, J. Pier (Gibbs & Hill), N. Williams, G. Bjorkman (Cygna) dated 9/13/84, 3:00 p.m.

4. Communications Report between J. Jan, J. Pier (Gibbs & Hill), G. Bjorkman (Cygna) dated 10/12/84, 10:00 a.m.

5. Communications Report between J. Jan (Gibbs & Hill), G. Bjorkman (Cygna) dated 10/18/84

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6. Communications Report between J. Jan, et. al. (Gibbs & Hill), H. Levin (TERA), R. Kissinger, et. al. (TUGCO), N. Williams, et. al. (Cygna) dated 10/31/84

Summary: References 2 through 6 established that 1.14 is an appropriate dynamic amplification (DAF) factor. The support DAF study was based on continuous, uniformly supported spans. Current CPSES cable tray support design methodology calculates static loads based on tributary length. Any future use of the 1.14 support DAF must account for the difference between the tributary support reactions and the support reactions based upon continuous cable tray spans. Further, it may not be appropriate to use a DAF of 1.14 if supports are designed using non-uniform tributary span length loads.

Status: No further work is required, but this issue should be considered in any evaluation of cumulative effects.

9. Reduction in Channel Section Properties Due to Clamp Bolt Holes

References:
1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Cable Tray and Conduit Support Review Questions," 84056.015, dated August 6, 1984, Attachment B, question 2
2. Gibbs & Hill letter GTN-69371, dated 8/23/84, Calculation SCS-111C, Set 8, Sheets 34-39

Summary: Cygna asked about the reduction in channel section properties due to clamp bolt holes in Reference 1. Gibbs & Hill provided a response in Reference 2.

The response did not to consider the following items:

A. Cable trays may be placed anywhere in the beam span (for example, see CMC 2646).

B. The resolution did not consider cantilevered supports where one tray is close to the wall and other trays are further out.

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C. The effect of DCA 17838, which provides bolt hole gage tolerances, is not considered.

D. All unused flange holes are not required to be plug-welded and may be present in high moment regions. (See Note 15 on Gibbs & Hill Drawing 2323-S-0901, Revision 4.)

Status: Gibbs & Hill should provide technical justification for the solutions.

10. System Concept

References:

1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Cable Tray Support Review Questions," 84056.031, dated August 31, 1984, Attachment A, question 2

2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna), dated September 28, 1984 with attached calculations

Summary: Gibbs & Hill has assumed that the cable tray and supports act as a system. As part of this "systems" approach, the following behavior was assumed:

A. For vertical loading, torsion in the beam as well as weak axis bending in the hanger due to the load placement eccentricities is taken out by the tray (References 1 and 2).

B. In the design of trapeze support hanger members for compression loads, the trays provide lateral bracing at points along the length of the hanger (see Review Issue 4).

C. The longitudinal and transverse support systems act independently. Therefore, the longitudinal supports are designed for longitudinal loads only, i.e., no transverse or vertical load contribution is considered (see Review Issue 5).

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D. Rotation of the base connection angles about the bolt pattern axis is minimzed by the hanger attachment to the tray (see Review Issue 3).

E. Out-of-plane seismic inertial loads from two-way support frames (self-weight excitation) are resisted by the longitudinal supports (see Review Issue 6).

F. The cable trays are attached by bolts which are eccentric to the weak axis of the beam members. Gibbs & Hill assumed that the effects of the loading were redistributed by the tray to other supports.

Status: Gibbs & Hill should provide justification for the effects due to Items A and F. Items B through E have not been fully justified considering the hardware. Gibbs & Hill is in the process of completing this qualification. Cygna is concerned that Gibbs & Hill's use of a "systems" concept may not be consistent with the actual behavior of the clamps used in the field.

11. Validity of NASTRAN Models

References:

1. Gibbs & Hill Calculation Binder 2323-SCS-215C, Sets 2-6
2. Gibbs & Hill Calculation Binder 2323-SCS-101C, Set 3, Sheets 234-243, Revision ^
3. Gibbs & Hill Calculation Binder DMI-13C, Set 1

Summary: Cygna has questioned the validity of the NASTRAN models used in the Gibbs & Hill generic studies, e.g., working point deviation study (Reference 1) and the qualification of Detail D_1 (References 2 and 3). The models assume a row of one support type, all having identical configuration and spans. This will influence the system frequencies and seismic response. Such models may not be representative of an actual installation where a mixture of support types and spans is used.

Status: Further justification is required prior to applying the results of these studies throughout the plant.

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12. Working Point Analysis Study

References: 1. Gibbs & Hill Calculation Binder 2323-SCS-215C, Sets 2-6

2. Gibbs & Hill Calculation Binder 2323-SCS-216C, Sets 1-5

Summary:

A. Gibbs & Hill's working point study (References 1 and 2) does not fully consider the effects of change documentation and previously approved design deviations. Cut-off elevations were established using an assumed critical case of 8'-6" spans, enveloping frame dimensions and maximum permissible working point deviations. Frames below the cut-off elevations were not checked for compliance with the study parameters. Frames above the cut-off elevation were analyzed on a case-by-case basis but did not consider the effects of change notices. The allowable working point deviations resulting from the study were to be used by QC to accept installed supports. Since changes to any one of the above assumed parameters may effect the acceptability of the study, QC's check of working point deviations alone will not assure support acceptability.

B. The effects of vertical and transverse loads on longitudinal support frames were not considered in the working point study (reference Review Issue 5).

C. The portion of the study that evaluated longitudinal supports only checked member interaction. No evaluation was made to ensure that this component governed the design.

D. Modeling Assumptions

1. Instead of modeling a longitudinal support, the ends of the tray run were assumed to be fixed. The effect of this tray boundary condition on the system response was not justified.

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E. Support Nos. 2992, 2994, 3005, 3017, 3021, 6654, Type A_2

Reference 1 identified the above six supports as follows: "A_2 (except all members shall be MC6x12)," where L = 8'-3" (frame width), h = 4'-2" (frame height).

The Cygna walkdown documented the installed hanger member sizes, as listed below in Table 1. Due to the presence of Thermolag coating, Cygna was unable to determine the installed beam member size. No documentation existed to reconcile the differences between the design requirements and the installation.

TABLE 1
Cable Tray Support Member Sizes

Dimensions (See Note 1)			Member Size
Support No.	Depth (In)	Flange Width (In)	Existing (Note 1)
2992	6	1-7/8	C6 x 8.2
2994	6	1-7/8	C6 x 8.2
3005	6	1-7/8	C6 x 8.2
3017	6	1-7/8	C6 x 8.2
3021	6	1-7/8	C6 x 8.2
6654	6	2-1/8	C6 x 13

Note: 1. Dimensions of the vertical channels are based on measurements by Cygna. Member sizes are determined by selecting the channel type from Reference 3 which most closely matches the measured depth and flange width.

F. Support No. 455, Type SP-8

Cygna's field inspection indicated that the brace connected to the wall on one side of the support is located outside of the bolt pattern on the base angle. The Detail "B" (2323-S-0903) type connection requires a tolerance of b/2 ± 0.2b. In response to Cygna's question, TUGCO issued CMC 99307, Revision 0, to document this discrepancy.

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G. Support Nos. 2998 and 13080, Special Type Supports

These supports were installed in floor slabs with 2" topping. The topping depth was apparently not considered in selecting the length of the anchor bolt. Therefore, the required embedment length was not achieved.

Status:

A. TUGCO provided CMC 2635, Revision 1, to document the installation discrepancy for support number 481.

B. TUGCO provided CMC 9916, Revision 2, to document the installation discrepancy for support number 408.

C. TUGCO provided CMC 99308, Revision 0, to document the installation of the incorrect size base angle for support number 649.

D. TUGCO provided CMC 99309, Revision 0, to document the anchor bolt installation discrepancy for these two supports.

E. TUGCO provided the CMC's listed below to document the installation of the incorrect member sizes.

Support Number	CMC No	Revision
2992	44519	2
2994	99326	0
3005	96079	1
3017	99327	0
3021	30452	2
6654	90714	6

F. TUGCO provided CMC 99307, Revision 0, to document the installation discrepancy for support number 455.

G. TUGCO is to evaluate the effect of reduced embedment length for supports 2998 and 13080. Cygna is evaluating the action required by SDAR 80-05 for supports installed after its issuance.

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21. Design Control

References:

1. Gibbs & Hill Drawings 2323-E1-0601-01-S, 2323-E1-0700-01-S, 2323-E1-0713-01-S
2. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Cable Tray Support Design Review Questions," 84056.022, dated August 17, 1984, questions 1, 2, and 6
3. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Cable Tray Support Design Review Questions," 84056.025, dated August 21, 1984 question 1
4. Gibbs & Hill Cable Tray Support Design Drawings 2323-S-0900 Series
5. Gibbs & Hill Calculations for Support Numbers 3025, 3028, 2861, Cygna Technical File 84056.11.1.225
6. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna), "Responses to Cygna Review Questions," dated September 4, 1984, with attached calculations
7. Gibbs & Hill Calculation Binder 2323-SCS-101C, Set 3, Sheets 206, Revision 6
8. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna), "Response to Cygna Design Review Questions," dated September 11, 1984, with attached calculations
9. Gibbs & Hill Calculation Binder 2323-SCS-101C, Set 5
10. Gibbs & Hill Drawing 2323-S-0901, Revision 4

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11. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Cable Tray Support and Electrical Review Questions," 84056.019, dated August 10, 1984, questions 2.1 and 2.2

12. Gibbs & Hill Drawings 2323-E1-0601-01-S, 2323-E1-0700-01-S, and 2323-E1-0713-01-S

Summary:

A. Lack of consideration of the effects of generic CMC's and DCA's on the original designs:

1. Support type SP-7 with brace is affected by CMC 6187. The CVC was approved and design reviewed by Gibbs & Hill, New York, but its effects were not considered in the SP-7 with brace calculations or any generic reviews.

2. The effect of CMC 1970, which specifies the allowable edge distance for anchor bolt holes in base angles, was not considered in the design of the anchor bolts.

B. Criteria violations in individual support specifications on support plans:

In the generic design of cable tray supports, support dimension and loading limitations are determined for each support type. These limitations are typically stated in the design calculations, but are not shown on the generic support design drawings (Reference 4). The dimensions for each support are specified in a descriptive block on the support plans (Reference 1) and the loading is indicated by the supported tray width shown.

The tray supports listed below were identified as having loadings or support geometries which exceeded the design limitations. Prior to the Cygna review, justifying documentation did not exist for these individual support designs.

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1. Support Nos. 3025, 3028, 2861, Type D_1. Drawing 2323-E1-0713-01-S calls out these supports as type D_1 (except beam to be MC6 x 16.3), L = 11'-9", h = 4'-2", and shows a tray width of 78". The FSE-00159 fabrication drawing sheets reflect these dimensions. However, the Gibbs & Hill design calculations for Type D_1 supports (2323-S-0901) limit L < 8'-0" and tray width to 48".

2. Support No. 2607, Type A_1. Drawing 2323-E1-0601-01-S specifies dimensions of L = 2'-9" and h = 4'-6" for this support. The design calculation for this support type (S-0901) limits h < 2'-4".

3. Support No. 657, Type A_1. Drawing 2323-E1-0601-01 calls out this support as Type A_1, L = 7'-0", h = 2'-0". The design calculation for this support type limits L < 6'-0".

4. Support No. 734, Detail H, Drawing 2323-E1-0601-01-S. This drawing specifies that one beam is to be an MC6x15.1, rotated 90° from its normal orientation. The support design requires the use of C6x8.2 beam sections. CMC 00164 requires the use of "heavy duty clamps" for this support, which introduce longitudinal loads. The support design requires the addition of a longitudinal brace if longitudinal loads are to be resisted.

5. Support No. 3011, Type SP-6. Drawing 2323-E1-0713-01-S specifies dimensions of L = 8'-9" and h = 4'-6". The design calculation for this support type limits L < 6'-0".

6. Support Nos. 2992, 2994, 3005, 3017, 3021, 3111, 6654, Type A_2. Drawing 2323-E1-0713-01-S specifies dimensions of L = 8'-3" and h = 4'-2", and shows a tray width of 78". The design calculation for this support type limits L < 6'-0" and the tray width to 48".

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C. Consideration of as-built support conditions in generic reviews which require a case-by-case review:

1. The SP-7 weld underrun analysis considered 5/16" fillet welds which are specified on the design drawings. However, the FSE-00159 fabrication drawings specify smaller weld sizes. In addition, the underrun analysis did not consider the effects of any design changes to the supports which were reported in CMC's and DCA's.

2. Working point studies (reference Review Issue 12).

D. Inconsistent application of as-built and design information in the evaluation of cable tray supports for Thermolag application:

1. Tray cover weights were not included in the development of the allowable span length table (Procedure CP-E1-4.0-49).

2. Cygna believes that longitudinal supports are not evaluated for the added weight of fire protection. Evidence of the above includes the fire protection review for the tray run containing Detail "N" (Gibbs & Hill Drawing 2323-E1-0601-02-S) which did not note the lack of any longitudinal supports in the tray run.

3. Fire protection evaluations are performed on a tray-by-tray basis. The cumulative effect of multiple trays with fire protection on one support may not be considered.

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E. Tray span between supports used in the original support layout:

1. Reference 9 indicates that cable tray supports are to be designed for 8'-0" spans. Reference 10, Note 13, allows a location tolerance for supports of ± 1/2 Richmond Insert spacing parallel to the tray, and limits the maximum spacing between supports to 9'-0." Gibbs & Hill cable tray support design calculations assume a maximum tributary span of 8'-6," to account for a support spacing of 8'-0" on center and an erection tolerance of ± 6." Cygna reviewed Reference 12 and noted 14 locations where the as-designed tray spans exceeded 8'-0." Cygna's walkdown of these tray segments discovered five locations where the as-built tray spans exceeded 9'-0" (see Reference 11). This indicates that the design and installation limitations for support spacings were not adhered to.

2. Longitudinal support designs indicate that the maximum longitudinal tray span is 40'-0". For several supports within Cygna's review, the support plan drawings (Reference 12) specified these supports to have tributary spans greater than 40'-0" (see Reference 11). In addition, several horizontal tray segments were not provided with longitudinal supports (see Reference 11). This indicates that the design limitations for the location of longitudinal supports were not adhered to.

F. Use of "For Reference Only" Calculations:

Cygna has noted several design reviews of change notices where the CVC was marked to indicate that new or revised calculations were not required. However, attached to the CMC are calculations that are marked "For Reference Only".

G. Cygna is concerned about support design calculation retrievability and completeness.

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H. Lack of Controlled Design Criteria:

1. Cygna has noted instances where the field design review group did not utilize the proper criteria to evaluate support adequacy. The evaluations for fire protection compared the actual load to a design load based upon a 9'-0" tributary tray span. The maximum tributary span assumed in the current design is 8'-6".

2. Cygna has asked what supplements to the 7th Edition of AISC Specifications were committed to in the FSAR. No evidence was found to indicate that proper direction was given to design engineers to utilize the requirements of any supplements to which CPSES was committed.

Status:

A. No further discussion is required.

B. Gibbs & Hill has indicated that the engineer preparing a support layout drawing would be familiar with the design limitations. Based upon engineering judgement, these limitations could be exceeded without preparing supporting calculations, since the support map drawings would be subject to design review.

For the individual supports referenced above:

(1) Gibbs & Hill provided calculations (Reference 5) evaluating these supports. Support numbers 3025 and 3028 were found acceptable, support number 2861 shows 30% overload of anchor bolts.

(2) TUGCO provided calculations (Reference 6) demonstrating the acceptability of support number 2607.

(3) TUGCO provided calculations (Reference 6) demonstrating the acceptability of support number 657.

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(4) Gibbs & Hill/TUGCO have not provided a response.

(5) Gibbs & Hill provided calculations (Reference 7) demonstrating the acceptability of support number 3011.

(6) TUGCO provided calculations (Reference 8) demonstrating the acceptability of these supports.

C. No further discussion is required.

D. Cygna is continuing internal evaluation.

E. Gibbs & Hill has indicated that the engineer preparing a support map drawing would be familiar with the span limitations for transverse and longitudinal supports. Based upon engineering judgement, these limitations could be exceeded without preparing supporting calculations, since the support map drawings would be subject to design review.

For the individual span violations noted above,

1. Gibbs & Hill/TUGCO provided calculations qualifying trays and supports for the transverse span violations.

2. Gibbs & Hill/TUGCO provided calculations qualifying trays and supports for the indicated longitudinal span violations. For tray segments lacking longitudinal supports, the load was applied as additional transverse loads on transverse type supports located around a 90° bend from the unsupported tray segment. For one tray run without any existing mechanism to resist longitudinal loads, segments T120SBC25 and T130SCA45, the addition of a new longitudinal support was required.

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F. Cygna is continuing internal evaluation.

G. Cygna is continuing internal evaluation.

H. Cygna is continuing internal evaluation.

22. Design of Support No. 3136, Detail "5," Drawing 2323-S-0905

(9)

Reference: 1. Gibbs & Hill Calculation Binder SAB-1341, Set 3.

2. Communication Report between B.K. Bhujang (Gibbs & Hill) and N. Williams, et al (Cygna) dated 10/20/85.

Summary: Support No. 3136, located at elevation 790'-6" at the Auxiliary Building/Safeguards Building boundary, is embedded in a fire wall. In reviewing the calculations, (Reference 1) for the design of this support, Cygna located several possible discrepancies. A list of Cygna's questions was provided (Reference 2, Attachment A) to Gibbs & Hill for their review.

Status: Gibbs & Hill/TUGCO should provide a response to Cygna's concerns.

23. Load Placement In STRESS Models

Reference: 1. Gibbs & Hill Computer Output Binder DMI-5P

Summary: For the design of standard support cases A_i, B_i, C_i and D_i, where i = 1 to 4, finite element analyses were performed (Reference 1) using the program STRESS. Single elements were used to model the horizontal members (beams) and the vertical members (hangers). Tray loads were applied at the beam/hanger intersection rather than within the span of the beam where the tray is physically located.

Modelling the load placements in this fashion eliminates the effects of bending and torsion due to vertical loads on the beams, and for cases D_i, will totally remove the load from the support.

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Since support cases A_1, B_2, B_1, B_2, C_1 and C_2 are unbraced frames, they have not been explicitly reevaluated by Gibbs & Hill in the Working Point Deviation Study or similar more refined analyses. 9

Status: Gibbs & Hill to provide justification for the adequacy of these support cases.

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1. Controlling Load Case for Design

References:

1. Communications Report between R. Kissinger (TUGCO), B. Bhujang (Gibbs & Hill), and J. Russ and N. Williams (Cygna) dated 10/1/84

Summary:

A. Gibbs & Hill calculations assumed that the design of conduit supports was governed by the 1/2 SSE (OBE) seismic event. The assumption was based on a comparison between a 50% increase in seismic accelerations from the OBE event at 2% damping, the SSE event at 3% damping, and an allowed increase in design stresses of 60% for the SSE event, per Reference 4.

B. For the design of structural steel members, the 60% increase cannot be applied to certain allowable stresses. For example, using a 33% increase, allowable stresses for weak axis bending of wide flange beams and bending in base plates will equal the yield stress. The allowable loads for concrete anchors cannot be increased by 60% for the SSE event. Additionally, the catalog component allowables are not allowed an increase for SSE loads. The above limitations were not considered in the selection of the governing load case for design.

Status: Discussion with Gibbs & Hill is required. Also see Cable Tray Review Issue 1.

2. Dynamic Amplification Factors

References:

1. Communications Report between P. Huang (Gibbs & Hill) and J. Russ (Cygna) dated 2/5/85

2. Communications Report between P. Huang (Gibbs & Hill) and J. Russ (Cygna) dated 2/6/85

3. Gibbs & Hill Calculation 2323-SCS-100C, Set 4, Sheets 1-11

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Summary: Gibbs & Hill has submitted a calculation for justification of a dynamic amplification factor (DAF) of 1.0. That calculation was based on a Class 5 piping damage study. The results of a similar study for cable tray supports established 1.14 as an acceptable Dynamic Amplification Factor.

Status: A reevaluation of the conduit DAF is required based on the results of the cable tray amplication factor evaluation (see Cable Tray Review Issue 8).

3. Combination of Deadweight and Seismic Responses

References: 1. Gibbs & Hill Calculation 2323-SCS-109C, Set 1, Sheets 154-163

Summary: Deadweight is added to the vertical acceleration, and then combined using an SRSS combination with the horizontal acceleration components.

Gibbs & Hill has submitted calculations which consider the acceleration vector magnitudes and compare the standard combination method to the SRSS method used in the support designs. The unconservatism is small and conditionally acceptable. The effect, however, must be considered with other cumulative effects (see Review Issue 24). Also see Cable Tray Review Issue 2 for a discussion of the effect of aspect ratios on the resultant loads.

Status: TUGCO/Gibbs & Hill consider the effects of the worst case frame aspect ratio on the results of the SRSS study.

4. Measurement of Embedment from Top of Topping

References: None

Summary: Note 5a on Gibbs & Hill Drawing 2323-S-0910, Sheet G-4a allows reduced embedment for certain supports at lower building elevations.

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Such a reduction is not acceptable for 1/4" and 3/8" Hilti Kwik-bolts with 2" embedment requirement since these bolts are embedded in topping only.

The reduction may not be acceptable for other sizes depending on the actual acceleration versus the design acceleration. The affected support types within Cygna's scope are the CSM-18 and CST-17 series.

Status: Technical justification is required for instances allowed by the note.

5. Bolt Hole Tolerance and Edge Distance Violation

References:
1. Gibbs & Hill Drawing 2323-S-0910, Sheet G-1b, Note 15
2. AISC Specifications, 7th Edition, Section 1.16.5, Minimum Edge Distance
3. AISC Specifications, 7th Edition, Section 1.23.4, Riveted and Bolted Construction - Holes

Summary: The AISC Specifications do not provide for bolt hole tolerances. Per Reference 2, bolt holes are 1/16" larger than the bolt size. Reference 1 allows a tolerance, which varies with the bolt size.

Reference 2 requires that a minimum clear distance be maintained for oversize holes. Gibbs & Hill designs do not provide the minimum edge distances required in the AISC Specifications. Support types CA-5a and CSM-42 provide edge distances of 3/4". Per Reference 2, 25/32" is required.

Status: Discussion with Gibbs & Hill is required.

6. Other Loads in the FSAR Combinations

References:
1. CPSES FSAR, Section 3.8.4.3.3

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Summary: Cygna is concerned that all applicable loads as defined in Reference 1 were not specifically considered the conduit support designs.

These concerns include loads due to pipe whip and jet impingement as well as the use of design accelerations which do not envelop Containment Building and Internal Structure spectra.

Status: Discussion with Gibbs & Hill is required to determine if any justification exists. Also see Cable Tray Review Issue 19.

7. Support Self Weight

References: 1. Cygna Generic Conduit Support Review Checklists (not yet issued)

Summary: Cygna's review has noted that support self weights were not uniformly considered.

For some designs only a portion of the support weight was considered. Examples include conduit supports which consist of cantilevered tube steel sections where only the length to the conduit centerline was considered. Additionally, the brace weight for support type CSM-6b was not considered.

For other designs the support self weight was neglected such as CST-3 and CST-17 Unistrut supports are affected.

Status: Discussion with Gibbs & Hill is required. This item affects the design of anchor bolts. See cumulative effects, Review Issue 24. Also see Cable Tray Review Issue 6.

8. Torsion of Unistrut Members

References: 1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Cygna Study of Unistrut Torsional Capacity," 84056.040, dated January 18, 1985

2. Communications Report between R. Kissinger (TUGCO) and J. Russ (Cygna) dated 1/8/85

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3. Communications Report between S. McBee (TUGCO) and J. Russ (Cygna) dated 2/21/85

4. Communications Report between R. Miller (CCL), R. Kissinger and S. McBee (TUGCO), and J. Russ and N. Williams (Cygna) dated 2/25/85

5. Communications Report between R. Kissinger and S. McBee (TUGCO), R. Miller (CCL), and D. Leong, J. Russ, and N. Williams (Cygna) Dated 4/9/85. 1

6. Communications Report between R. Kissinger and S. McBee (TUGCO), P. Huang (Gibbs & Hill), R. Miller and R. Yow (CCL), and D. Leong and J. Russ (Cygna) dated 4/10/85.

Summary: Torsional loading of Unistrut members is not considered in the support designs. Unistrut does not support the use of members for torsional loading. Since analysis of asymmetric sections is difficult, testing of the members was proposed.

Three approaches may be used to provide qualification of asymmetric Unistrut sections by testing. The first approach provides parametric studies for the Unistrut members. The following variables should be included: member length, placement of load, and direction of load. This approach provides qualification of the asymmetric sections with respect to load-carrying capability of the section and performance of the spot welds.

The second approach provides qualification of the member by testing it in actual support configurations. This approach also assures load-transfer capability through the member end connections to the rest of the support. To provide the proper test scope, the supports should be loaded to maximize stress in the asymmetric members. A parametric study similar to the first approach should be used to provide consideration for all possible support configurations.

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The third approach provides qualification of an entire support configuration and thus implicit qualification of the asymmetric members. To provide qualification of a support configuration, the support geometry and load placement and magnitude must be chosen to maximize response of the weak link. If other supports are to be qualified by similarity with the tested configurations, the weak link of those supports must also be addressed by insuring that the supports are enveloped by the original test sample. 1

In selecting any of the three approaches for the member qualification, the objectives of the test program must be identified prior to preparation of a test procedure. Since the objectives of the three methods differ greatly, so do the testing procedures used to meet the objectives. The differences in the test procedures are reflected in the selection of loading cases, boundary conditions, instrumentation, and data reduction techniques. The test procedure must clearly specify the methods it will use to meet the test objective.

Status: TUGCO/Gibbs & Hill are evaluating the effects of torsion in Unistrut components by a support qualification test program (References 5 and 6). Cygna personnel visited the CCL test labs (Reference 4, 5 and 6) and provided the following comments on the test scope and procedures:

1. Enveloping of Conduit Supports:

   - The group of tested conduit supports is assumed to adequately provide an enveloping population to qualify all generic type supports at CPSES. Detailed documentation is required to assure that the selected supports envelop all other supports. The documentation should address the weak link of each enveloping support and how the tests correlate with the perceived weak link of each support qualified by comparison.

   - The conduit support test scope should include applicable concerns from the Review Issues List.

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- The effect of applicable generic and support-specific design changes should be addressed in the qualification effort.

2. Worst case support configuration for the tested support:

   - The chosen member lengths and load magnitudes and directions may not be the critical case. Cygna noted that the selected configurations may not adequately address torsional behavior of the generic support design or address the capability of the spot welds to resist tensile forces.

   - The choice of larger diameter conduits for some supports precludes testing of P2558 clamps, since C708-S clamps are required for large conduits.

3. Direction of loading to test weak link:

   - Clamp loadings should induce tensile forces in the clamp bolts. Many tests load the members in bearing instead of maximizing clamp load.

   - For composite Unistrut sections, the loading direction should be selected to provide tensile loads on spot welds to test the integrity of the composite section.

4. Test Procedures:

   - In the visit documented in Reference 4, Cygna noted that a yoke plate had impinged upon an outrigger, which imparted additional, unintended forces into the support. The effect of this additional load must be considered when reducing the test data.

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- In the visit to the test lab documented in Reference 5, Cygna noted two discrepancies in the test set-up. The hydraulic ram which applied the transverse and vertical load was attached in a manner such that longitudinal conduit displacement rotated the ram from the perpendicular. Due to this rotation, a force in the longitudinal conduit direction was imparted in a direction opposite to the load applied by the longitudinal ram. The impact of the effective reductions in the longitudinal and transverse forces should be addressed in the data reduction.

  Cygna noted that in a test of a conduit support using detail CSD-1a (Reference 5), the supporting wide flange beam to which the detail was attached via a strainsert bolt was not sufficiently stiffened to prevent a deflection in the flange due to a rotation in the connection detail. Technical justification should be given for the ability of the support member flanges to resist bending due to imparted connection moments without deflection. Otherwise, the effect of any flange deflections must be considered in the data reduction.

Gibbs & Hill is also reanalyzing some supports per AISI code provisions. Additional information is required by Cygna to evaluate the adequacy of those analyses.

9. Improper Use of Catalog Components

References:

1. Communications Report between P. Patel, et al. (Gibbs & Hill) and J. Russ, et al. (Cygna) dated 9/20/84
2. Communications Report between D. Kissinger (TUGCO) and N. Williams (Cygna) dated 10/11/84
3. Communications Report between E. Irish (Unistrut) and D. Leong and J. Russ (Cygna) dated 1/21/85

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4. Communications Report between E. Irish (Unistrut) and D. Leong and J. Russ (Cygna) dated 2/4/85

5. Gibbs & Hill Calculation 2323-SCS-153C, Sheet 1/37

6. Cygna Generic Conduit Support Review Checklists (not yet issued)

Summary:

A. In addition to Cygna's comments on the implicit increase in allowables for SSE loads (see Review Issue 1), Cygna has other concerns regarding the support designs using catalog components.

AISC-derived allowables are used in the design process. These values are generally conservative for bending, but are generally unconservative for axial allowables, as catalog allowables are based on the AISI Code which considers buckling of thin, open sections.

Examples of Cygna's concern are discussed below:

- CSM-6b: 20 ksi was used for Fa, the axial allowable. This value is equal to .6 Fy, where Fy = 33 ksi and was used for any member length which neglects slenderness effects. Catalog values range from 5.77 ksi for a brace length of 60" to 13.9 ksi for a 24" brace.

- CST-3: The design employed the AISC table of axial stress allowables for 36 ksi steel.

- CST-17: The design employed the AISC tables of axial stress allowables for 36 ksi steel. The table value was then reduced by a ratio of 33/36.

B. Use of components in ways not intended by the vendors.

Cygna concerns in this area are as follows:

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- Allowables are not listed for P1001C3 sections in the Unistrut catalog. Member properties are given for the X-Y axes instead of the principal axes. Discussions with Unistrut indicate that the uses of P1001C3 are unique with respect to load application and member restraint. Thus, no generic allowables can be provided. Unistrut places the burden on the designer to properly consider the capacity of the section for its intended use.

- The Unistrut catalog indicates that the intended use of P1325, P1331, P1332 brackets is for single members in a pinned connection. Gibbs & Hill uses two brackets on double members, which Cygna believes to be a moment resisting connection. Gibbs & Hill considers these connections pinned for some brackets in CSM-6b, CST-3, and CST-17 type supports. However, Unistrut does not provide allowables for this bracket configuration.

- Gibbs & Hill references Unistrut Test C-49 to obtain allowables for the double bracket connection in CST-3. This connection is subject to tensile and shear loads. The test provided data only on loading the bracket in tension. Gibbs & Hill compared the calculated tensile load to the allowable, ignoring the calculated shear.

- P1941 plate connectors are used to connect headers to outriggers in CA-1a and CA-2a supports. Gibbs & Hill calculations indicate that tightening the Unistrut bolts to the specified torque overstresses the plate and causes excessive bowing of the plate. Discussion with Unistrut indicates that these connectors are to be used to construct frames where the connected members are restrained at both ends. Clarification of this concern is required for CA-1a and CA-2a supports, since the member end restaint required by Unistrut has not been provided.

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In Revision 1 of Gibbs & Hill Drawing 2323-S-0010, Sheet CA-1a, Note 7, was added to provide P1064 plates if bending of the P1941 plates occurs. In Gibbs & Hill Calculation 2323-SCS-153C, Sheet 1/37, a discussion of field installation practice, documents that the P1064 plates do not reduce the bowing of the outriggers. Unistrut tests showed no bowing of the outriggers when the P1064 plates were used. Verification of the bolt torques used in the test set-up is required.

- C708-S clamps are not designed for three-directional loading. Allowables for tensile loading only are given in the Superstrut Catalog.

Status: TUGCO/Gibbs & Hill should provide technical justification for the above issues.

10. Anchor Bolts

References: 1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Cable Tray and Conduit Support Review Questions," 84056.015, dated August 6, 1984, question A2b regarding CSD-1a

Summary: Cygna has the following concerns regarding anchor bolt designs:

- A prying factor of 1.5 was used in most cases without justification. The Teledyne method predicts higher factors for CSM-18d and CSM-18f (rectangular plates).
- The AISC 8th Edition method was used to omit a prying factor for CSD-2, Detail 8 (U-clips).
- No prying factor was used for CST-17, Type 17 (box bracket). Additionally, since the anchor bolt passes through the member, bending of the bolt occurs. The anchor bolt design does not consider this additional load.

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- No prying factor was used for CSD-1, Detail 2 (Z-clips). The behavior of this detail is to be addressed in the Unistrut test program.

Status: TUGCO/Gibbs & Hill should provide technical justification of the above issues. Also see Cable Tray Review Issue 3 for related anchor bolt issues.

11. Longitudinal Loads on Transverse Supports

References:
1. Communications Report between E. Irish (Unistrut) and J. Russ (Cygna) dated 7/25/84
2. Cygna Generic Conduit Support Review Checklists (to be issued)

Summary: Some transverse supports may be on the same order of stiffness as long cantilever multi-directional supports. Since conduit clamps provide restraint in three-directions, longitudinal loads, which were not considered in the design, may be imparted to the supports.

Additionally, the displacements due to torsion of longitudinal support beam members may induce some longitudinal loads into transverse supports.

Status: Technical justification of the above assumption by Gibbs & Hill is required.

12. Hilti Kwik-Bolt Substitutions

References: None

Summary: Note 4 on Gibbs & Hill Drawing 2323-S-0910, Sheet G-4a, allows the substitution of all Hilti Kwik- and Super Kwik-bolts with those of a larger size. A reduction in the allowables for the larger bolts may be necessary since the actual spacing may be smaller than that required. Thus, a situation may occur where the replacement bolts have a lower capacity than the bolts in the original design.

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Examples of Cygna's concern are described below:

- CSM-18c: 1/2" Hilti Kwik-bolts at 5" spacing were used in the original design. If all 1/2" bolts are substituted with 3/4" or 1" bolts, the tensile allowable for the replacement bolts will be less than the design tensile allowable of 3012 lbs. (2750 lbs for 3/4" bolts and 2930 lbs. for 1" bolts).

- CSM-42 Type III: 1" Hilti Super Kwik-bolts at 7.5" spacing were used in the original design (allowable tension = 12452 lbs, allowable shear = 6884 lbs). If all 1" bolts are replaced by 1-1/4" bolts of equal embedment, the bolt capacity is significantly reduced (allowble tension = 6405 lbs, allowable shear = 6221 lbs).

Status: Technical justification by Gibbs & Hill is required for supports affected by this note.

13. Substitution of Smaller Conduits on CA-Type Supports

References: 1. Communications Report between S. McBee (TUGCO) and J. Russ (Cygna) dated 3/7/85

Summary: CA-type supports are designed using ZPA for large (> 2") diameter conduits while peak accelerations are used for small diameter conduits (<2"). For CA-type supports where capacities are tabulated on the drawings, small diameter conduits may be installed unless specifically prohibited on the drawings. Although the deadweight load of the small diameter conduits must be less than the capacity, the accelerated load of the small diameter conduits may exceed the equivalent accelerated load of the large diameter conduits considered in the original design.

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As an example, support type CA-15 was designed for two 3" conduits with a deadweight capacity of 156 lbs. However, five 1-1/2" conduits can be installed on a CA-15 support, giving higher accelerated loads than designed for. The rigid span loads for two 3" conduits are 343 lbs. and 109 lbs. for the vertical and horizontal directions respectively. The flexible span loads for five 1-1/2" conduits are 504 lbs. and 450 lbs. for the vertical and horizontal directions respectively.

This item possibly affects support types CA-6, CA-7, CA-12, CA-14 Series, and CA-16a.

Status: Discussion with TUGCO and Gibbs & Hill is required. TUGCO is investigating this item with respect to fire protected supports.

14. Use of CA-Type Supports in LS Spans

References:
1. Communications Report between M. Warner, et al. (TUGCO) and W. Horstman, et al. (Cygna) dated 2/20/85
2. Communications Report between S. McBee (TUGCO) and J. Russ (Cygna) dated 3/7/85

Summary: CA-type supports are used to support LA spans, which are limited to a 6' length. CST-type and CSM-type supports are used to support LS spans, which can be up to 12' for transverse spans and 24' for longitudinal spans. In field installations, when conduits run from walls to equipment in the middle of a room, a transition is made between LA spans and LS spans. Thus, CA type supports may support LS spans. The concerns are discussed below.

For large diameter conduits (>2"), ZPA was used to calculate the accelerated design load. For the CA-type support with an adjacent suspended support (CST- or CSM-type), the peak acceleration should be used to check support capacity, since rigidity of the transitional span can no longer be guaranteed. There is evidence that decreased support capacity is considered for the fire protected supports (see CP-EI-4.0-49), since support capacities are given for both LA spans

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and LS spans. For unprotected lines, there is no indication that this was considered.

Status: TUGCO is investigating the practice for fire protected supports.

15. Stresses in Cable Trays Due to Attached Conduit Supports

References:
1. Cygna Generic Conduit Support Review Checklists (to be issued)
2. Gibbs & Hill Calculation 2323-SCS-156C, Set 1, Sheets 101-104

Summary: This item applies to CSD-16 in the Cygna review scope and to any similar details. Cable tray spans are ostensibly designed to the capacity of the tray. The addition of these types of conduit supports to the tray rails adds loads above the calculated capacity. Therefore, a generic stress check for the trays is not possible, and all tray spans with these conduit supports should be individually checked. Since the design drawing does not preclude the use of this detail on fire protected trays, and since the conduit support designer, instead of a cable tray designer, is responsible for showing adequacy of the tray when using this attachment detail, a proper check must be made for all uses of this detail.

Status: Cygna has reviewed the Gibbs & Hill calculation for CSD-16. Cygna's comments require discussion with Gibbs & Hill.

16. Increases in Allowable Span Lengths

References:
1. Communications Report between P. Huang (Gibbs & Hill) and D. Leong and J. Russ (Cygna) dated 12/27/84
2. Gibbs & Hill Calculation 2323-SCS-189C, Set 1, Sheets 15-24

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3. Communications Report between R. Kissinger and S. McBee (TUGCO), P. Huang (Gibbs & Hill), R. Miller and R. Yow (CCL), and D. Leong and J. Russ (Cygna) dated 4/10/85. ⚠

Summary: In the revised Gibbs & Hill Drawing 2323-S-0910 package, LA span lengths were increased by a ratio of the refined to the unrefined spectra. Gibbs & Hill provided a calculation to show that the above changes are correct and that rigid spans remain rigid (diameters > 2"). This is adequate for support designs, since support loads are proportional to span lengths. However, an evaluation of the conduit stress is required, since conduit bending stress is proportional to the square of the span length.

Status: In Reference 3, Gibbs & Hill stated that the conduit spans discussed in this review issue are enveloped by the spans discussed in Review Issue 22. TUGCO is providing additional information to address Review Issue 22. If Review Issue 22 is resolved, Review Issue 16 is resolved by envelope. If Review Issue 22 is not resolved, technical justification for Review Issue 16 is required. ⚠

17. Substitution of Next Heavier Structural Member

References: None

Summary: This item refers to Note 5 on Gibbs & Hill Drawing 2323-S-0910, Sheet G-1a. Most supports are designed to the allowable loads for the Hilti Kwik-bolts. In light of the discussion in Review Issue 7, generic designs using structural steel are affected but are not checked.

Status: Discussion with Gibbs & Hill is required. See cumulative effects, Review Issue 24.

18. Clamp Usage

References: 1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Cable Tray and Conduit Support Review Questions" 84056.015, dated August 6, 1984, question A4

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2. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Conduit Support Walkdown Questions," 84056.020, dated August 13, 1984, question 3

3. Communications Report between E. Irish (Unistrut) and J. Russ (Cygna) dated 7/25/84

4. Communications Report between T. Keiss, et al. (TUGCO), B. Bhujang, et al. (Gibbs & Hill) and W. Horstman, et al. (Cygna) dated 10/9/84

5. Cygna Generic Conduit Support Review Checklists (to be issued)

Summary:

A. For small diameter conduits (<2"), clamps may be reamed to accommodate 3/8" Hilti-bolts. As a result, the minimum edge distance requirements are violated. Additionally, the washer for 3/8" Hilti Kwik-bolts will not fit on clamps for small diameter conduits (<2"). The washer is an integral part of the bolt, and justification for its omission is required.

B. In the Cygna walkdown, clamp distortion was noted for the following supports.

Support ID	Support Type
C12G93528-8	CSM-18f
C12002935-3	CA-5a
C12G03126-18	CSM-42
C12G02851-6	CA-5a

Status:

A. Cygna is reviewing calculations on clamp reaming provided by TUGCO. Further discussion is required on the subject of Hilti washers.

B. Discussion with TUGCO is required.

19. Documentation Deviations Between Inspection Reports, CMC's and IN-FP Drawings

References: 1. Communications Report between P. Patel (TUGCO) and D. Leong and J. Russ (Cygna) dated 2/18/85

CONDUIT SUPPORTS
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Summary: For each conduit line, an inspection is performed and documented on an inspection report (IR). All CMCs and applicable IN-FP drawings should be reflected on the IR.

Examples of Cygna's concerns are discussed below:

- Line C11003395, IRME-18120F, Support -1: On the IR, the support is listed as CSM-18f, Revision 4. On CMC 62903, the support is listed as CSM-18b, Revision 14. Based on the CMC information, the IR is in error.

- Line C12G-05087, IRME-16817F, Support -4: On the IR, the support is listed as CSM-18C, Revision 13. On CMC 62905, Revision 0, the support is listed as Revision 9. On CMC 62905, Revision 1, the support is listed as Revision 12.

- Line C12004695, IRME-16089F, IN-FP-216, and IN-FP-226: There are discrepancies between the IR and both IN-FP drawings for support types CA-1a and CA-2a. There is no structural difference in the supports, but a documentation inconsistency exists.

Status: This item is still under review. Additional issues will be noted as the review progresses.

20. Nelson Studs

References:

1. Communications Report between P. Huang and R. Sanders (Gibbs & Hill) and J. Russ (Cygna) dated 8/7/84

2. Gibbs & Hill Calculation 2323-SCS-156C, Set 1, Sheets 131-160

3. Gibbs & Hill Calculation 2323-SCS-109C, Set 1, Sheets 164-184

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Summary: The Nelson stud allowables used by Gibbs & Hill do not conform to those given by TRW/Nelson.

Gibbs & Hill calculations use the pretension force in the Nelson studs to resist applied conduit loads. The pretension force should consider the flexibility of the shim plate and clamp, as distortion and/or relaxation in these components will decrease the stud preload. Gibbs & Hill provided Cygna with a calculation to address shim plate stresses.

Filler plates with oversized or slotted holes allow the studs to be loaded at the clamp, thus applying a shear load eccentric to the stud weld. Transfer of side or longitudinal loads on the clamp is provided through shears and bending of the Nelson stud rather than pure shear as considered in the design.

Status:

A. Justification of allowables used for the Nelson studs is required.

B. Further evaluation of the actual preload and its effect on the stud capacity is required.

C. Evaluation of the Nelson studs for any effects due to bending is required.

D. Cygna has reviewed the shim plate calculation and requires technical justification of the following issues regarding the yield line analysis:

- The reason weld underrun was not included in the analysis.
- The assumed stress distribution in the fillet weld around the plate is unrealistic, as it assumes an infinite stress on the bottom of the plate. A more realistic stress distribution shows that the weld does not have sufficient capacity to allow the plate to yield. This should be considered in a revised yield line analysis.

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21. Conduit Fire Protection Configuration

References:
1. Communication Report between T. Keiss (TUGCO) and W. Horstman, et al. (Cygna) dated 10/16/84

Summary: Gibbs & Hill fire protection calculations consider a round configuration of Thermolag material around conduits. The Thermolag weight on the spans was calculated based on this configuration. The Cygna walkdown and discussions with TUGCO indicate that a square configuration was also used in the field installations. Documentation of the specific configuration installed was not maintained.

Status: Evaluation by Gibbs & Hill of the as-built configuration with respect to the design configuration is required to insure that the design adequately envelops the field condition. Preliminary evaluation by Cygna indicates that small unconservatisms exist for some cases. See Review Issue 24 for cumulative effects.

22. Span Increase for Fire Protected Spans

References:
1. Communications Report between T. Keiss (TUGCO) and W. Horstman, et al. (Cygna) dated 10/16/84
2. Communications Report between T. Keiss (TUGCO) and J. Russ and N. Williams (Cygna) dated 10/27/84
3. TUGCO Instruction CP-EI-4.0-49
4. Gibbs & Hill Drawing 2323-S-0910, LA Series
5. Gibbs & Hill Drawing 2323-S-0910, LS Series
6. Gibbs & Hill Calculation 2323-SCS-1017, Set 1
7. Communications Report between S. McBee (TUGCO) and D. Leong (Cygna) dated 4/16/85
8. Communications Report between S. McBee (TUGCO) and D. Leong (Cygna) dated 4/18/85

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Summary: The allowable spans for some fire protected conduit runs are longer than allowable spans for unprotected runs.

Status: Cygna has reviewed calculations provided by TUGCO for fire protected conduit spans. Since these spans are the largest allowable spans, the stress calculations envelop all other spans (e.g., LA spans, see Review Issue 16).

In the stress calculations for the fire protected spans, the material allowables vary with conduit size, according to test data obtained from the vendor. A limit of 33 ksi was imposed on the yield stress.

In Reference 7, Cygna asked TUGCO for justification for the material allowables used. In References 7 and 8, TUGCO indicated that documentation would be provided for conduit material properties at CPSES.

23. Grouted Penetration Loads

References: 1. Communications Report between R. Kissinger and S. McBee (TUGCO), P. Huang (Gibbs & Hill), R. Miller and R. Yow (CCL) and D. Leong and J. Russ (Cygna) dated 4/10/85.

Summary: For straight conduit runs embedded in walls and floors, longitudinal conduit supports are not required if there are no bends in the run. For very long conduit runs, the loads on the grouted penetrations may be large.

Status: Technical justification is required for the capability of grouted penetrations to resist longitudinal conduit loads for runs where no other longtidunal supports are considered. These justifications should, as a minimum, address the following:

- The capability of the grout to resist applied loads.
- The documentation and inspection of grouting to validate the analysis assumptions on the ability of penetrations to resist the applied loads.

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24. Cumulative Effect of Review Issues

References: None

Summary: Small unconservatisms may usually be neglected in design. Since most of the conduit supports are designed to maximum capacity, the cumulative effect of many unconservatisms may be significant. The following items may have cumulative effects on the conduit support designs:

- Combination of dead weight and earthquake loads (Review Issue 3).
- Support self weight (Review Issue 7).
- Substitution of heavier structural members (Review Issue 17).
- Variance in Thermolag cross-section (Review Issue 21).

Status: Discussion with Gibbs & Hill is required.

ELECTRICAL
(Power and I&C)
Review Items List

1. Instrumentation Pressure/Temperature Ratings

References:
1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), 84056.010, dated July 30, 1984
2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated August 11, 1984

Summary: Two instances were noted by Cygna where the pressure temperature ratings for instruments installed in the Component Cooling Water System (CCW) were lower than the maximum pressure or temperature of the system as indicated in the Gibbs & Hill analyses. The instruments in question were later shown to be qualified for the higher design conditions or protected by interlocks. Cygna reviewed a total of 24 CCW instruments and these were the only two pressure-temperature discrepancies noted.

Status: Gibbs & Hill/TUGCO should provide evidence that when design and operating data is revised, all existing system components are reviewed to ensure that they meet the new operating conditions. Statistically, two instances out of 20 may indicate the need for further review.

2. Cable Tray Thermolag Fire Protection

References:
1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), 84056.010, dated July 30, 1984
2. L.M. Popplewell (TUGCO) letter to N.H. Williams (Cygna) dated August 11, 1984
3. N.H. Williams (Cygna) letter to J.B. George (TUGCO), 84056.024, dated August 21, 1984
4. L.M. Popplewell (TUGCO) letter to N.H. Williams (Cygna) dated September 4, 1984
5. Communications Report between J. Van Amerongen (TUGCO) and R. Hess (Cygna), dated 9/11/84, 11:00 a.m.

ELECTRICAL
(Power and I&C)
Review Items List

Summary: During the Cygna walkdown of July 16-20, 1984, it was noted that cable tray section T130ACA43 was not covered with Thermolag fire protection material. Cygna reinspected the area in August/September and the proper material was installed. However, the documentation supplied by TUGCO for the removal and reinstallation of the fire lag insulation indicates that the work was completed and signed off on 7/14/84. This is prior to the Cygna walkdown. While the reinspection showed the tray to be properly covered, the documentation is not consistent with the noted sequence of events.

Status: Closed

3. Temperature Indicator X-TI-4837 Not Installed

References: 1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation WD-07-02

Summary: During the walkdown of the Spent Fuel Pool Cooling System, it was noted that a temperature indicator was not installed. Further investigation revealed that some instrumentation is not installed by construction in order to prevent it from being damaged by additional construction activities. When the system is turned over for operation, a set of instruments is provided for final installation.

Status: Closed.

4. Incorrect Cable Identification Number

References: 1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation WD-07-03

Summary: One of six cable identification tags checked during the walkdown had an incorrect unit identification number on the tag. An additional 32 safety related cable identification tags were checked and found to be correct. Since the only discrepancy was in the unit number, no safety impact was involved and the observation was closed as an isolated error.

Status: Closed.

MECHANICAL SYSTEMS
Review Items List

1. Component Cooling Water (CCW) System Maximum Temperature

References:

1. Cygna Phase 4 Final Report, TR-84056-01, Revision 0, Observation MS-01-01 (not yet issued)
2. N.H. Williams (Cygna) letter to J.B. George (TUGCO), 84056.010, dated July 30, 1984
3. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna), dated August 11, 1984
4. N.H. Williams (Cygna) letter to J.B. George (TUGCO), 84056.023, dated August 21, 1984
5. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna), dated April 11, 1984
6. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna), dated October 1, 1984

Summary: Cygna noted discrepancies between the Westinghouse stated maximum CCW system temperature of 120°F and (1) the CPSES FSAR; (2) Gibbs & Hill calculation 233-16; and (3) Gibbs & Hill calculation 229-14. These documents indicated maximums of 121.8°F, 135°F and 129.7°F, respectively. TUGCO provided documentation that showed the acceptability of the 135°F maximum temperature. Some of this documentation is dated as late as 9/28/84 indicating that TUGCO may not have been aware of the problem prior to the Cygna questions.

Status: Cygna Observation MS-01-01 was closed based on the documentation which was provided by TUGCO. However, Gibbs & Hill/TUGCO should demonstrate that when design and operating data is revised, all existing system components are reviewed to ensure that they meet the new operating conditions.

MECHANICAL SYSTEMS
Review Items List

2. CCW Surge Tank Isolation on High Radiation Signal

References:
1. Cygna Phase 4 Final Report, TR-84056-01, Revision 0, Observation MS-06-01 (not yet issued)
2. N.H. Williams (Cygna) letter to J.B. George (TUGCO), 84056.028, dated August 27, 1984
3. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated September 20, 1984

Summary: The Westinghouse functional design requirements document for the CCW system required that the surge tank be isolated by closing the vent valve on receipt of a high radiation signal. TUGCO/Gibbs & Hill removed this control function from the system radiation monitors to prevent spurious actuation caused by rising system temperature during accidents. Since the change did not address the radiation release effects of the vent remaining open, Cygna requested verification that the release would be acceptable. TUGCO performed a calculation which verified that the release was within the limits of 10 CFR 100. No generic review was conducted of other radiation monitor control function changes at CPSES.

Status: Cygna Observation MS-06-01 was closed based on the results of TUGCO calculation TNE-CA-094 dated September 19, 1984.

3. Class 5 Piping

References:
1. Cygna Phase 4 Final Report, TR-84056-01, Revision 0, Observation MS-02-01 (not yet issued)
2. N.H. Williams (Cygna) letter to J.B. George (TUGCO), 84056.010, dated July 30, 1984
3. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated August 11, 1984
4. N.H. Williams (Cygna) letter to J.B. George (TUGCO), 84056.023, dated August 21, 1984
5. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated September 11, 1984

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6. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated September 21, 1984

7. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated September 25, 1984

8. Communications Report between D. Wade (TUGCO) and R. Hess (Cygna) dated 9/5/84, 3:00 p.m.

9. N.H. Williams (Cygna) letter to V. Noonan (USNRC) "Open Items Associated with Walsh/Doyle Allegations," 84042.022, dated January 18, 1985

Summary: Per Gibbs & Hill, Class 5 piping is not seismically designed; it is only seismically supported to prevent it from falling on safety related equipment. TUGCO did provide documentation showing that the specific Class 5 CCW piping that was in Cygna's review scope was seismically analyzed and therefore, would remain functional as required. However, Cygna could not determine whether any similar circumstances exist in other piping systems where Class 5 piping may be required to remain functional during a seismic event.

Status: Observation MS-02-01 was closed for the CCW system based on the documentation and analyses provided. Gibbs & Hill/TUGCO should explain the use of Class 5 piping in areas where functionality is required following design basis events and demonstrate its acceptability. Cygna should check a sample of these systems to insure they meet their functional requirements. 1

4. Fire Doors

References:

1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), 84056.010, dated July 30, 1984

2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated August 11, 1984

3. N.H. Williams (Cygna) letter to J.B. George (TUGCO), 84056.023, dated August 21, 1984

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4. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated August 31, 1984

5. Communications Report between J. Van Amerongen (TUGCO) and R. Hess (Cygna), dated 9/11/84, 11:00 a.m.

6. Communications Report between Mark Wells (TUGCO) and R. Hess (Cygna) dated 9/13/84, 11:00 a.m.

Summary: Cygna noted that the double doors between the train A & B nuclear chillers did not have a U.L. fire rating label. TUGCO stated that this had been previously noted by them and that the proper door was being installed. TUGCO could not provide documentation of how the error was noted but did supply copies of a purchase order for the correct door. Subsequent reinspection by Cygna verified the proper door had been installed. TUGCO stated that an NCR or other paper work was not initiated since the door is not safety related. The door is required to meet Appendix R requirements.

Status: TUGCO should provide assurance that the as-built Appendix R modifications are in conformance with the Appendix R design requirements and specifications.

5. Single Failure - Reactor Coolant Pump Thermal Barrier

References:

1. Cygna Phase 4 Final Report, TR-84056-01, Revision 0, Observation MS-02-02 (not yet issued)

2. Cygna Phase 4 Final Report, TR-84056-01, Revision 0, Potential Finding PFR-01 (not yet issued)

3. N.H. Williams (Cygna) letter to J.B. George (TUGCO), 84056.010, dated July 30, 1984

4. Communications Report between D. Wade (TUGCO) and R. Hess (Cygna) dated 8/17/84, 8:30 a.m.

5. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated August 24, 1984

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6. Communications Report between D. Wade (TUGCO) and N. Williams (Cygna) dated 8/30/84, 3:30 p.m.

7. Communications Report between D. Wade (TUGCO) and R. Hess (Cygna) dated 9/5/84, 3:00 p.m.

8. D.H. Wade (TUGCO) letter to N.H. Williams (Cygna), CPPA-40961, dated September 18, 1984

9. D.H. Wade (TUGCO) letter to N.H. Williams (Cygna), CPPA-41237, dated October 3, 1984

10. N.H. Williams (Cygna) letter to S. Burwell (USNRC), 84056.032, dated October 9, 1984

11. Communications Report between D. Wade (TUGCO) and N. Williams (Cygna) dated 10/11/84, 5:00 p.m.

12. N.H. Williams (Cygna) letter to S. Burwell (USNRC), 84056.035, dated October 22, 1984

13. E.P. Rahe, Jr., (Westinghouse) letter to R.C. DeYoung (USNRC), NS-EPR-2938, dated July 13, 1984

14. T.R. Puryear (Westinghouse) letter to J.T. Merritt, Jr. (TUGCO), WPT-7436, dated July 23, 1984

Summary: Cygna expressed a concern that if the single temperature controlled isolation valve on the outlet of the reactor coolant pump thermal barrier should fail to close subsequent to a rupture of the thermal barrier, then low pressure portions of the CCW system would be over pressurized and reactor coolant could be released outside containment. Westinghouse also notified the NRC and TUGCO of a similar problem with CCW systems they designed. TUGCO informed Cygna that they were filing a 50.55E report with the NRC on this issue and that they would investigate the generic implications of this finding. Cygna submitted two letters on this subject to the NRC and TUGCO in accordance with our review procedures for a Definite Potential Finding. Cygna has not received any of the TUGCO documents which evaluate this issue nor has Cygna performed any additional investigation or review on this issue.

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Status: Observation MS-02-02 was upgraded to Potential Finding PFR-01. Subsequently, references 10 and 12 were sent to the NRC in accordance with Cygna's procedures for processing a Definite Potential Finding. TUGCO should provide evidence that other systems do not possess a similiar set of attributes which could potentially result in a common mode failure. TUGCO should provide Cygna with the 50.55E report to insure that the report addresses Cygna concerns. ⚠1

DESIGN CONTROL
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1. Review and Analysis of Cumulative Effects

References:

1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, all Sections
2. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, all Sections
3. N. H. Williams (Cygna) letter to V. Noonan (USNRC), "Open Items Associated with Walsh/Doyle Allegations," 84042.022, dated January 18, 1985
4. N. H. Williams (Cygna) letter to V. Noonan (USNRC), "Status of IAP Conclusions," 84056.050, dated January 25, 1985
5. All Communications Reports and correspondence written on all Phases of the Independent Assessment Program

Summary: Utilizing the data available from all four phases of the Cygna technical and design control reviews, a cumulative effects evaluation of all observations and potential finding reports is being performed. This review is also focusing on the cumulative effects of individually insignificant discrepancies. Any trends identified which indicate either strengths or weaknesses in the CPSES design/design control program are being evaluated.

Status: Cygna is in the process of extracting raw data from all phases of the IAP performed to date. The results of this review will be included in the Phase 4 Final Report.

2. Adequacy of the Design Process used on CPSES

References:

1. Memorandum and Order (Quality Assurance for Design), Texas Utilities Generating Company, et al., Comanche Peak Steam Electric Station Units 1 and 2, dated December 28, 1983

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2. CASE's Motion for Summary Disposition, "Allegations Concerning Quality Assurance Program for Design of Piping and Pipe Supports," dated July 3, 1984

3. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, all Sections

4. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, all Sections

5. N.H. Williams (Cygna) letter to V. Noonan (USNRC), "Status of IAP Conclusions," 84056.050, dated January 25, 1985

6. All Communications Reports and correspondence written on all Phases of the Independent Assessment Program

Summary: Based on the Phase 1 through 4 review scopes, Cygna is evaluating the adequacy of the process employed in the design of Comanche Peak Steam Electric Station. This review also includes an assessment of the resulting quality of the final design.

Status: This evaluation is ongoing in conjunction with the cumulative effects review. The results of this review will be included in the Phase 4 Final Report.

3. Qualification and Training of Design Engineers

References:

1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, all Sections

2. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, all Sections

3. N. H. Williams (Cygna) letter to V. Noonan (USNRC), "Status of IAP Conclusions," 84056.050, dated January 25, 1985

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4. All Communications Reports and correspondence written on all Phases of the Independent Assessment Program

Summary: The root cause of all discrepancies and observations is being assessed to determine whether or not a trend exists which indicates any weakness in the training/qualifications of the design engineers.

Status: This issue is being addressed in conjunction with the cumulative effects evaluation. The results of this review will be provided in the Phase 4 Final Report.

4. Control of Design Interfaces

References:
1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, all Sections
2. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, all Sections
3. N. H. Williams (Cygna) letter to V. Noonan (USNRC), "Status of IAP Conclusions," 84056.050, dated January 25, 1985
4. All Communications Reports and correspondence written on all Phases of the Independent Assessment Program

Summary: The adequacy of the interfaces will be assessed as a result of trending which is being performed on Phase 1 through 4 observations.

Status: This issue is being addressed in conjunction with the cumulative effects evaluation. The results of this review will be provided in the Phase 4 Final Report.

5. Adequacy of Procedures

References:
1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, all Sections

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2. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, all Sections

3. N. H. Williams (Cygna) letter to V. Noonan (USNRC), "Status of IAP Conclusions," 84056.050, dated January 25, 1985

4. All Communications Reports and correspondence written on all Phases of the Independent Assessment Program

Summary: The adequacy of and each organizations' compliance with the requisite CPSES project design related procedures is being reviewed as a result of the initial trending of observations in Phases 1 through 4.

Status: This issue is being addressed in conjunction with the cumulative effects evaluation. The results of this review will be provided in the Phase 4 Final Report.

6. Adequacy of Design Documentation

References:

1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, all Sections

2. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, all Sections

3. N. H. Williams (Cygna) letter to V. Noonan (USNRC), "Status of IAP Conclusions," 84056.050, dated January 25, 1985

4. All Communications Reports and correspondence written on all Phases of the Independent Assessment Program

Summary: The adequacy of design documentation is being evaluated as a result of the numerous undocumented assumptions and inadequate references which were identified during the IAP technical reviews.

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Status: This issue is being addressed in conjunction with the cumulative effects evaluation. The results of this review will be provided in the Phase 4 Final Report.

7. Corrective Action as it Pertains to Design Related Issues Identified to Date

Reference:
1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, all Sections
2. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, all Sections
3. N. H. Williams (Cygna) letter to V. Noonan (USNRC), "Status of IAP Conclusions," 84056.050, dated January 25, 1985
4. All Communications Reports and correspondence written on all Phases of the Independent Assessment Program

Summary: An assessment is being performed to determine whether or not the issues identified by Cygna on all phases of the IAP should have been detected by TUGCO through the corrective action system.

Status: This issue is being addressed in conjunction with the cumulative effects evaluation. The results of this review will be provided in the Phase 4 Final Report.

8. Document Control

References:
1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observations DC-01-01, DC-01-02 and DC-01-03
2. N.H. Williams (Cygna) letter to S. Burwell (USNRC) "DCC Satellite Review Results," 83090.013, dated June 30, 1984
3. N. H. Williams (Cygna) letter to V. Noonan (USNRC), "Status of IAP Conclusions," 84056.050, dated January 25, 1985

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Summary: Observations concerning the Document Control Center (DCC) and control of design documents were written in Phases 1 and 2. Reference 2 was issued to document the adequacy of current DCC practices. An assessment is still required to evaluate the effects of technical and design control deficiencies which could be attributed to inadequate controls in the DCC.

Status: This issue is being addressed in conjunction with the cumulative effects evaluation. The results of this review will be provided in the Phase 4 Final Report.

9. Design Change Tracking Group

References:
1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation DC-01-04
2. N.H. Williams (Cygna) letter to S. Burwell (USNRC) "DCTG Data Base Review Results," 83090.017, dated November 6, 1984

Summary: The Field Design Change and Review Status Log was reviewed and Observation DC-01-04 was initiated during Phases 1 and 2. The effects of inadequate controls on design changes are being reevaluated to determine whether or not there was any possible impact on the adequacy of the design.

Status: This issue is closed except for input to the cumulative effects review.

10. Gibbs & Hill Design Input References

References:
1. Cygna Phase 1 and 2 Final Report, TR-83090-01, Revision 0, Observation DC-02-01
2. N. H. Williams (Cygna) letter to V. Noonan (USNRC), "Status of IAP Conclusions," 84056.050, dated January 25, 1985

Summary: A Gibbs & Hill design specification required a different edition of ASME Section III than a computer code (ADLPIPE Version 2c) used for piping calculations.

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Status: This observation is considered closed except for input to the cumulative effects review.

11. Inspection Reports

References:
1. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation DC-01-01
2. N.H. Williams (Cygna) letter to V. Noonan (USNRC), "Status of IAP Conclusions," 84056.050, dated January 25, 1985

Summary: Three inspection reports had been filed in the permanent plant records vault prior to closure.

Status: This observation is closed except for input to the cumulative effects review.

12. TUGCO Audits

References:
1. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observations DC-01-02 and DC-01-03
2. N.H. Williams (Cygna) letter to V. Noonan (USNRC), "Status of IAP Conclusions," 84056.050, dated January 25, 1985

Summary: TUGCO Audit files did not contain corrective action responses for selected audit findings.

Status: These observations are closed except for input to the cumulative effects review.

13. Gibbs & Hill Internal Surveillances

References:
1. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation DC-02-01
2. N.H. Williams (Cygna) letter to V. Noonan (USNRC), "Status of IAP Conclusions," 84056.050, dated January 25, 1985

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Summary: Documentation which verified that surveillance activities had been performed for 1973 through 1977 was not immediately obtained.

Status: This observation is closed except for input to the cumulative effects review.

14. Gibbs & Hill Management Reviews

References:
1. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, observation DC-02-02
2. N.H. Williams (Cygna) letter to V. Noonan (USNRC), "Status of IAP Conclusions," 84056.050, dated January 25, 1985

Summary: Gibbs & Hill Management Review Evaluation Reports were not available for 1974 through 1976.

Status: This observation is closed except for input to the cumulative effects review.

15. Gibbs & Hill Audit Corrective Actions

References:
1. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation DC-02-03
2. N.H. Williams (Cygna) letter to V. Noonan (USNRC), "Status of IAP Conclusions," 84056.050, dated January 25, 1985

Summary: Gibbs & Hill had renumbered an audit finding and not closed the original finding.

Status: This is closed except for input to the cumulative effects review.

16. Evaluation of Gibbs & Hill Design Reviewers

References:
1. Cygna Phase 3 Final Report, TR-84042-01, Revision 1, Observation DC-02-04

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2. N.H. Williams (Cygna) letter to V. Noonan (USNRC), "Status of IAP Conclusions," 84056.050, dated January 25, 1985

Summary: Gibbs & Hill design reviewers were not evaluated on an annual basis as required.

Status: This observation is closed except for input to the cumulative effects review.

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2. The analysis assumed a single two-foot tray per beam and did not assess the impact of more realistic multiple tray loadings.

3. Eccentricities (reference Review Issue 10).

4. The assumption of tray attachment fixity to the support was not justified.

5. Selection of run configuration (reference Review Issue 11).

6. The base angle modeling assumed a simply supported beam for two bolt base connections.

7. Excitation in the longitudinal tray direction was not considered.

Status: To assure support acceptability Gibbs & Hill/TUGCO should justify the modeling assumptions, the applicability of the analysis results for global support qualification, and the use of working point deviations by QC. ⚠

13. Reduced Spectral Accelerations

References: 1. Gibbs & Hill calculations, "Analysis of Alternate Detail 1"

2. Gibbs & Hill Calculation Binder SCS-101C, Set 3, Sheet 247, Revision 9

3. Gibbs & Hill Calculation Binder SCS-215C, Set 4

Summary: For the qualification of the supports discussed below, Gibbs & Hill used reduced spectral accelerations based on a calculated support-tray system frequency

A. For the analysis of transverse supports, such as type A_4 which was used in analysis of Alternate Detail 1 (Reference 1), a reduced acceleration was used. This acceleration is based on a calculated frequency which is beyond the spectral peak. The study assumes a tray weight of 35 psf and tray spans of 8'-6". Use of this

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study's results will not be valid in installations where either of the above parameters have been exceeded without considering the effect on frequency.

B. Similarly, for longitudinal supports (e.g., type SP-7 with brace [Reference 3], L-A_1 [Reference 2], etc.) the frequency will decrease due to tray weights exceeding 35 psf or longitudinal spans exceeding 40'-0". In addition, the frequency calculations for support types L-A_4, L-B_4, etc., did not include the effect of the axial frequency of the tray.

Status: Additional discussion between Cygna and Gibbs & Hill is required.

14. Non-Conformance with AISC Specifications

References: 1. AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings, 7th Edition

Summary: Gibbs & Hill failed to properly consider the requirements of Reference 1 as discussed below.

A. Unbraced length for axial buckling:

1. Section 1.8.4 requires that $kl/r \leq 200$.

2. Examples where kl/r limitations were exceeded.

a. See Generic Item 4.

b. Detail SP-7 and associated supports are checked for buckling, assuming that the tray provides a pinned restraint at the tray attachment point; therefore, k = 1.0. However, since no restraint can be assumed, k = 2 and $kl/r > 257$ for a 12" tray.

B. Unbraced length for lateral torsinal buckling:

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1. Section 1.5.1.4.6a requires that Equation 1.5-7 be used to calculate the allowable bending stress for channels. In the denominator, "l" is the unbraced length of the compression flange.

2. Examples where the specifications were ignored or improperly applied.

   a. The working point analyses use 22 ksi for the allowable flexural stress without checking Equation 1.5-7. Since the frame heights are on the order of 144", an allowable flexural stress of 15 ksi is calculated by Equation 1.5.7.

   b. Detail SP-7 and similar supports consider "l" to be the distance to the tray centerline and not to the outside rail where the load is applied. Use of the larger distance will result in lower allowable bending stresses.

C. Reduction in section due to bolt holes in flanges per Section 1.10.1 (see Review Issue 9).

D. Lacing of double angle braces (see Review Issue 7).

E. Eccentric connections - Specification Section 1.15.2.

   1. This section requires that any axial members not meeting at a single working point be designed for the eccentricities.

   2. Examples of designs where this specification section applies are the gusset plates used for single angle braces, especially type SP-7 with brace.

Status: Technical justification for not complying with the Code should be provided by TUGCO/Gibbs & Hill.

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15. Member Substitution

References: 1. Communications Reports between R.M. Kissinger (TUGCO) and J. Russ (Cygna), dated 1/17/85, 8:15 a.m. and 3:45 p.m.

Summary: A. Note 9 on Gibbs & Hill Drawing 2323-S-0901, Revision 4, states:

> "Structural members shown on drawing numbers 2323-S-900 series may be substituted by one step heavier shape of the same size."

Cygna interprets this note as allowing craft to interchange structural shapes, e.g., an MC for a C or vice versa, as long as the substituted shape is heavier than, but of the same depth as the original members. This would allow the use of substitute sections which have lower section moduli. TUGCO has stated that they interpret this note as requiring the craft to stay with the same shape, i.e., a C section can only be substituted by a C section (Reference 1).

B. Within Cygna's walkdown scope, support number 6654 (see Review Issue 20) was reviewed and found to be an example of Cygna's concern as discussed above. The design required an MC6x12 and the installed member was a C6x13 which has a smaller section modulus ($S = 5.80$ in^3 for a C6x13 compared to $S = 6.24$ in^3 for an MC6x12). For the other supports listed in Review Issue 20, the required MC6x12's were substituted with C6x8.2's, a substitution not permitted by this note.

C. Cygna could not locate any documentation which informs engineering where such substitutions are made.

Status: TUGCO/Gibbs & Hill should provide justification of such substitutions and the requirements for documentation of the substitutions.

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16. Weld Size Requirements

References:

1. N.H. Williams (Cygna) letter to V. Noonan (USNRC), "Response to NRC Questions," 83090.023, dated March 8, 1985
2. Communications Report between Chang and Huang (Gibbs & Hill) and Horstman, Russ and Williams (Cygna) dated 10/27/84
3. Communications Report between Chang and Huang (Gibbs & Hill) and Horstman, Russ and Williams (Cygna) dated 11/13/84
4. Communications Report between Chang and Huang (Gibbs & Hill) and J. Russ (Cygna) dated 11/17/84
5. Communications Report between R. M. Kissinger (TUGCO) and J. Russ (Cygna), dated 11/30/84
6. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Cable Tray Support Review Questions," 84056.041, dated February 12, 1985

Summary: Cygna has discovered the following problems with the weld designs of cable tray supports.

A. The design drawings are missing the weld details as described in Reference 1, Attachment C.

B. Per discussions with Gibbs & Hill/TUGCO (References 2, 3, 4 and 5), Cygna has noted that the weld sizes shown on the fabrication drawings differ from those shown on the design drawings and those that were assumed in Gibbs & Hill calculations.

C. Eccentricities were not considered in weld connections.

1. Detail SP-7 with brace and similar connections require a partial penetration groove weld at the gusset plate/beam connection. The design calculations did not consider the eccentric load transfer from the brace member. The eccentricity of the brace loads results in a weld stress in excess of 400 ksi.

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2. Weld designs for base angle connections never considered the eccentricities of the applied loads from the connecting members.

D. The weld designs did not consider the thickness of the connected parts. Gibbs & Hill's weld designs assumed that the full weld throat would be developed without considering the thickness of the connected member.

E. Gibbs & Hill assumed an incorrect minimum weld length for the beam/hanger base angle connection.

1. Gibbs & Hill assumed a distance of l-k, where l = angle leg width and k = distance from back of angle leg to end of fillet.

2. Because of the radius of the curve at the angle toe, r (approximately equal to one-half the leg thickness), the actual weld length is l-k-r.

Status: Items A-D are open pending response to Reference 6. Item E requires discussion with TUGCO.

17. Embedded Plates Design

References:

1. N.H. Williams (Cygna) letter to J.B. George (TUGCO), "Cable Tray Support Review Questions," 84056.041, dated February 12, 1985, Attachment A, question 1

2. L.M. Poppelwell (TUGCO) letter to N.H. Williams (Cygna) dated April 19, 1984, page 11

3. Communications Report between Williams, Russ and Horstman (Cygna), Kissinger and Keiss (TUGCO) and Bhujang, Huang and Chang (Gibbs & Hill) dated 9/15/84

4. Communications Report between M. Warner (TUGCO) and N. Williams, J. Minichiello and J. Russ (Cygna) dated 2/27/85

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Summary: Cygna's review of cable tray attachments to embedded plates indicated that the allowables for the embedded plates may not have included the effects of prying action (Reference 1). Additionally, questions from Cygna's pipe support reviewers and cable tray reviewers on the stiffening requirements for embedded plate moment connections elicited conflicting responses from TUGCO personnel. One response indicated that attachments to embedded plates act as stiffeners for moment connections (Reference 2) while another indicated that any moment attachment must be stiffened or sufficiently analyzed (Reference 3).

Cygna has also noted that cable tray embedded plate designs were not within the tolerances of Gibbs & Hill Specification 2323-SS-30, "Structural Embedments" (Reference 1).

Cygna is also evaluating the lack of attributes for embedded plate inspections on the QC Inspection Report forms as well as the verification procedures for attachment proximity criteria (Reference 4).

Status: TUGCO/Gibbs & Hill should provide justification for the above items.

18. Tray Clamps

References: None

Summary: The cable trays have been assumed to provide bracing to the tray supports for the following modes of behavior:

- Buckling of the hanger members.
- Lateral torsional buckling of the beam members.
- Bracing of the support frame to prevent frame rotation which would result in anchor bolt overload.

Such bracing may occur only if the tray clamps provide suitable compatability conditions.

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Status: Cygna is currently evaluating the various clamp designs to establish their capability to provide sufficient load transfer.

19. Other Loads in the FSAR Combinations

References:
1. CPSES FSAR, Section 3.8.4.3.3
2. Gibbs & Hill Calculation Binder SCS-103C, Set 1, Sheets 14-19
3. Gibbs & Hill Calculation Binder SCS-103C, Set 2, Sheet 32

Summary: Cygna is concerned that all applicable loadings, as defined in Reference 1, are considered in the design of cable tray supports. Among these concerns are LOCA loads. Reference 2 provides the calculations for Detail "A" (Gibbs & Hill drawing 2323-E1-0500-01-S), which was originally designed for use in containment. Only dead weight and seismic loads were considered in this design. Similarly, Reference 3 is the design calculation for Detail "C" (Gibbs & Hill drawing 2323-E1-0500-04-S). This support was only evaluated for dead weight and seismic loads.

Status: Discussion with Gibbs & Hill/TUGCO is required to establish the exact criteria for not specifically evaluating other possible support loadings.

20. Differences Between the Installation and the Design/Construction Drawings without Appropriate Documentation

References:
1. Gibbs & Hill, Inc., support layout drawing 2323-E1-0713-01-S
2. Brown & Root, Inc., fabrication drawing FSE-00159
3. American Institute of Steel Construction, Inc., Manual of Steel Construction, 7th Edition
4. Gibbs & Hill support layout drawing 2323-E1-0601-01-S

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5. Gibbs & Hill support layout drawing 2323-E1-0700-01-S

6. Gibbs & Hill cable tray support design drawings 2323-S-0900 series

Summary: Cygna performed walkdown inspections on 49 of the 92 supports within the review scope. Certain discrepancies between the as-built support configurations and the design requirements were as noted below.

A. Support No. 481, Longitudinal Type A_4

Single angles were installed as braces in the longitudinal direction. A pair of angles is required by the design drawing. No change documentation was located.

B. Support No. 408, Type B_4

The lower corner of the frame is modified by CMC 9916, Revision 1, to avoid interference with the CCW heat exchanger. This change document shows that 4" channel sections are to be used for the prescribed modification. A 6" channel section is actually installed.

C. Support No. 649, Type A_1

This installation uses concrete anchorage "Alternate Detail 1" (Gibbs & Hill design drawing 2323-S-0903) which requires the use of an L6x6x3/4. Cygna's field inspection discovered that an L5x5x3/4 was installed. No existing documentation accounted for this discrepancy.

D. Support Nos. 722 and 2606, Detail "N", Drawing 2323-E1-0601-01-S

Cygna's field inspection found a working point violation on the brace attachment to the wall. Design drawing 2323-S-0929 Connection Detail "F" was used (2323-S-0903) which has a tolerance of $b/2 \pm 0.3b$ where $12" < b < 30"$. Cygna's field inspection results show the tolerance used was $b/2 - 0.5b$ (i.e., the brace was located in line with one bolt).

5/16/85

To: Document Control

From: S. B. Burwell x 27038

Subject: Cygna Review (Phase 4) Comanche Peak

Attached is the following document:
CYGNA letter to JW Beck from N. H. Williams dated April 23, 1985. Letter no. 84056.064 enclosing Template set of review issues ✓

Please distribute as follows:

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