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CYGNA
ENERGY SERVICES
2121 N. California Blvd., Suite 390, Walnut Creek, CA 94596 415/934-5733

March 3, 1988
84056.140

Mrs. Juanita Ellis
President, CASE
1426 S. Polk
Dallas, TX 75224

Subject: *Communications Report Transmittal No. 44*
Independent Assessment Program - All Phases
Comanche Peak Steam Electric Station
TU Electric
Job No. 84056

Dear Mrs. Ellis:

Enclosed please find communications reports associated with the conduit audits. A list of the enclosed communications reports appears in Attachment 1.

If you have any questions or desire to discuss any of these documents, please do not hesitate to call.

Very truly yours,

for

N. H. Williams
Project Manager

NHW/amh
Attachments

cc: Mr. J. Redding (TU Electric)
Mr. W. Counsil (TU Electric)
Mr. L. Nace (TU Electric)
Mr. J. Muffett (TU Electric)
Mr. D. Pigott (Orrick, Herrington & Sutcliffe)
Mr. C. Grimes (USNRC)
Ms. A. Vietti-Cook (USNRC)
Mr. C. Chiou (Ebasco)
Mr. F. Hettinger (Ebasco)

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ATTACHMENT 1

List of Enclosed Communications Reports

DATE	TIME
07/20/87	8:30 a.m.
08/10/87	5:30 p.m.
08/11/87	2:30 p.m.
08/11/87	4:00 p.m.
08/11/87	4:30 p.m.
08/14/87	1:30 p.m.
09/02/87	11:45 a.m.
09/03/87	10:15 a.m.
09/04/87	10:00 a.m.
09/04/87	12:30 p.m.
09/04/87	1:00 p.m.
09/04/87	1:10 p.m.
09/04/87	2:15 p.m.
09/15/87	10:30 a.m.
09/21/87	9:30 a.m.
09/21/87	2:30 p.m.
09/22/87	11:20 a.m.
09/23/87	9:45 a.m.
09/23/87	10:00 a.m.
09/23/87	11:45 a.m.
09/24/87	10:45 a.m.
09/24/87	3:45 p.m.
09/25/87	11:45 a.m.
10/01/87	9:25 a.m.
10/14/87	8:00 a.m.

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	07/20/87
Subject:	Conduit Audit Overview Ebasco Audit	Time:	8:30 a.m.
		Place:	Ebasco (N.Y.)
Participants:	H.S. Yu, R. Alexandru,	of	Ebasco
	H. Ghandi, K.T. Wu, C.Y. Chiou (part-time)		Ebasco
	J. Russ, B. Atalay, B. Shakibnia		Cygna

Item	Comments	Required Action By

Cygna spoke to Ebasco regarding the scope of the first Cygna audit of conduit support design review activities. Cygna stated that they would attempt to discuss the issues listed below:

1. Consideration of topping in anchor bolt embedment lengths.
2. Disposition of tube steel supports where the substitution is not acceptable by analysis.
3. Evaluation of grouted penetrations.
4. Evaluation of systems with non-rigid CA type supports.
5. Anchor bolt separation violation evaluations.
6. Review of SDARs on fire protection and conduit material properties.
7. Other anchor bolt considerations.
8. Hidden attributes.
9. Testing of supports, clamps, and systems.
10. Systems concept calculations.

Signed: J. R. Russ for N. H. Williams

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Item	Comments	Required Action By

11. Thermal studies.

12. Nelson studs.

13. Support CSD-166.

14. Bolt hole study.

Ebasco stated that the Ebasco site group was performing design review activities related to fire protection, clamp testing, testing of Unistrut supports and the bolt hole studies. The Ebasco New York group was performing work in the areas of generic support type evaluation, isometric as-built evaluations as requested by site, thermal effects on conduit systems, and studies on member substitutions.

Cygna requested the calculations on the thermal studies and on the grouted penetration evaluations. Ebasco stated that Mr. Ghandi was responsible for the thermal evaluations.

Ebasco provided Cygna with a description which listed the purposes for the various conduit clamp test programs. The clamp tests performed by CCL were for clamp capacity. The ANCO clamp tests were also to test clamp capacity. The CCL tests were viewed as being conservative with respect to the number of cycles considered, load direction and shape of the input. The ANCO tests showed that the capacities for C-708-S clamps were similar to P2558 clamps; whereas, the CCL tests showed that C-708-S clamps had significantly reduced capacities when compared to P2558 clamps. The Ebasco test specification for the ANCO tests is SAG-CP.26.

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.	84056
		Date:	08/10/87
Subject:	Conduit Audit	Time:	5:30 p.m.
		Place:	Ebasco
Participants:	H.S. Yu	of	Ebasco
	D.K. Leong		Cygna

Item	Comments	Required Action By
	Cygna requested and received the computer output binder for Calculation SPAN-1115, Safeguards Building, Elevation 896'-6" for use during the audit.	
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Signed: J. D. Russ for N. H. Williams

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Communications Report

Company:	CFS	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	8/11/87
Subject:	Conduit Audit	Time:	2:30 p.m.
		Place:	Ebasco (NY)
Participants:	H.S. Yu	of	Ebasco
	D.K. Leong, B. Shakibnia		Cygna

Item	Comments	Required Action By
	Cygna asked Ebasco whether methods similar to the support load factors would be used to evaluate the spans in the iso verification effort. Ebasco stated that if the original S-0910 spans were overstressed in the span verification effort, their length would be reduced. The revised lengths would then be incorporated in the new S-0910 package. Cygna stated that the volume of span calculations was overwhelming and asked whether there was a summary document which presented an overview of the models and their results. Ebasco stated that Calculation SPAN-1033 may provide some guidance in that area. Cygna noted that there were references to S-0910 sheets in the span calculations; however, the referenced sheets no longer exist in the new S-0910 package. Ebasco stated that the calculations referred to the old Gibbs & Hill S-0910 package and that the pertinent sheets were attached to the backs of the calculations. Cygna requested and received Calculations SPAN-1110 and SPAN-1111 for use during the review. \TUE\081187-B.CON	

Signed: J. R. Rees for N. H. Williams

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Mr. B. Atalay
Ms. D. Leong
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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	8/11/87
Subject:	Conduit Support Design Review Ebasco Audit - Thermal Analysis	Time:	4:00 p.m.
		Place:	New York, NY
Participants:	H. Ghandi	of	Ebasco
	B. Atalay		Cygna

Item	Comments	Required Action By
	References: 1. Cygna Communications Report dated July 20-July 23, 1987 8:00-5:30	
1.	Cygna and Ebasco discussed some of the thermal analysis issues identified during the Ebasco audit of July 20 - July 23, 1987. (Reference 1.)	
	a. With regards to Item 1a[1] Cygna asked if there was any other 10.24 sec. period (other than the first 10.24 sec.) for which the temperature differential exceeds 59°F. Ebasco will provide a response.	
	Cygna also asked if the accident thermal analyses were being conducted twice: with and without the seismic loads. Ebasco confirmed that the two analyses were being performed.	
	b. With reference to Item 4a, Cygna asked if the concerns regarding the clamp and anchor bolt displacement acceptance criteria for thermal accident loads had been addressed. Ebasco stated that they were currently developing and revising this acceptance criteria.	

1 All items are listed in Reference 1 to this communications report.

Signed: J. P. Rice for N. H. Williams

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c. With reference to Item 6a, Ebasco said that page 11 of Calculation Book 81, Revision 1, had been revised since the last Cygna audit to remove the reference to S_1 = 171 in. Analyses with S_1 = 190 in. have been included in the calculation and are now being used.

d. With reference to Item 8a, Ebasco confirmed that P-2558 clamps are not used with 3" diameter and larger conduits.

e. With reference to Item 8b, Ebasco stated that Calculation Book 82 and Calculation Book 81 contain computer analyses for generating thermal load versus stiffness relationships.

f. With reference to Item 8e, Cygna requested confirmation of the Ebasco statement that larger stiffnesses result in smaller seismic loads. Ebasco said all conduit supports were subject to a minimum frequency requirement, and because of this requirement, seismic loads are obtained from the descending portions of the floor response spectra. Therefore, the larger stiffnesses result in smaller seismic loads.

2. Cygna noted that seismic analyses were being conducted by Ebasco's thermal analysis group (in Calculation Book 87, Volumes 1 and 2, for example), and expressed concern that these seismic analyses, or the results thereof, may not be in accordance with those performed by the Ebasco "support design" group. Cygna asked for a demonstration of the correlation between the seismic analyses performed by the two Ebasco groups.

3. Cygna and Ebasco discussed the Cygna questions shown in Section 6 of the Enclosure of Cygna Letter No. 84056.110.

a. In response to Cygna question (a) on page 5 of the enclosure, Ebasco said that the thermal expansion points are shown in electrical drawing E1-1701-01.

b. In response to Cygna question (b) on page 5 of the enclosure, Ebasco said that the ambient temperature was 70°F and thermal differentials are based on the ambient temperature.

c. In response to Cygna questions (c) and (g) on page 5 of the enclosure, Ebasco said that SAG.CP21 has been revised since Cygna's original review to remove the erroneous references to Figs. 1 and 2, and quantities # s and # eg.

d. In response to Cygna question (d) on page 5 of the enclosure, Ebasco said that the procedure involved no deviation from

Item	Comments	Required Action By

experimental data and experimental data was merely being digitized.

e. In response to Cygna question (e) on page 5 of the enclosure, Ebasco said that in the sample analyses (contained in the Calculation Book 92), all stiffnesses for the three directions were modelled as nonlinear springs.

f. In response to Cygna question (f) on page 5 of the enclosure, Ebasco said that thermal accident loading of both surface mounted conduits and suspended conduits was being addressed in steps 2a and 2b, respectively, of Section 2.0 of Appendix b of SAG-CP21.

g. See paragraph (c) above.

h. In response to Cygna question (h) on page 5 of the enclosure, Ebasco said that more detail of junction box thermal analyses could be found in Calculation Books Thermal 1750 and 1751, for example.

4. Cygna asked how thermal analyses of CSM and CA series were being performed. Among those "other" supports are Unistrut and fire protection type supports. Ebasco responded that, per Section 1.0 of SAG-CP10, the Unistrut support design verification was being addressed through tests by the site office of Ebasco. Cygna asked how tests could address thermal loads and stated they would investigate this concern during a future site audit.

5. Cygna asked how the variation of support capacities and span allowables throughout the life of the project were being handled by the thermal analysis group. The thermal analysis uses support capacities and span allowables as input to their analyses. These capacities and allowables change from time to time and, in fact, such a change is presently taking place to account for the "CQC effect", i.e, the load factors introduced in SAG.CP25. Cygna asked how the thermal analysis results would be affected due to these variations. Ebasco said they would prepare a response to address these concerns.

6. Cygna noted that rigid conduit systems, such as the LA series seismically designed to the ZPA may have sufficient design margin to accommodate the additional thermal loads. Ebasco said that, due to this same concern, the LA series drawings were voided per Ebasco memorandum SAG.TUG1.8859, dated August 10, 1987.

7. Cygna asked for a correlation of the conclusions of Calculations Ther 1761 for Unit 1 and Calculation Book 86 for Unit 2, both of

Item	Comments	Required Action By
	which address the effect of multi-run conduit on a single support. Ebasco will address this request.	

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	8/11/87
Subject:	Conduit Audit	Time:	4:30 p.m.
		Place:	Ebasco (NY)
Participants:	H.S. Yu	of	Ebasco
	D.K. Leong		Cygna

Item	Comments	Required Action By
	Cygna requested and received Calculation SPAN-1116 and the computer output binder to Calculation SAPN-1128 at Elevation 852'-6" for use during the audit. \TUE\081187-A.CON	

Signed: J. P. Rees for N. H. Williams

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	8/14/87
Subject:	Conduit Audit Span Studies	Time:	1:30 p.m.
		Place:	New York, NY
Participants:	R. Alexandru, E. Bovera, K.T. Wu, H.S. Yu	of	Ebasco
	D.K. Leong, B. Shakibnia		Cygna

Item	Comments	Required Action By

Cygna began by stating that the volume of calculations in support of the span verification effort was overwhelming: calculations and computer output binders were generated for practically every building and system configuration; within each calculation, analyses were performed for different conduit sizes and building elevations, with results for both span stress and equivalent acceleration for support design.

The review of the calculations was time-consuming and difficult to accomplish without a summary overview of the study. Cygna asked Ebasco if such a summary could be prepared to aid in completion of the audit. Cygna requested that the following information be included in the summary:

For each analysis model, building and elevation:

- Which conduit sizes were analyzed and why they were chosen.
- Which modal combination method was used: Reg. Guide 1.92 or CQC.
- What the results were for each case (i.e., were the spans acceptable, was span reduction required, or was a support load factor required?).
- What conclusions were drawn for the cases not analyzed (i.e., for different elevations or conduit sizes).

Signed: J. P. Reen for N. H. Williams

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Ebasco stated that a summary of what was analyzed would be easy to provide; however, they were not sure a summary of results could be easily accomplished. However, they agreed to try to put the summary together.

Cygna then proceeded to discuss findings of the audit of the span calculations.

Target System Frequency

Cygna stated that it is their understanding that minimum target frequencies are chosen for each building and floor elevation. This target frequency corresponds to the highest frequency corresponding to the left side of the peaks of the three floor spectra. Minimum support frequencies are chosen to meet the system minimum frequency.

Cygna noted that, in some cases, the first mode frequency is below the target frequency. For example, in Calculation SPAN-1115, Safeguards 8996'-6", the target system frequency is 14.8 Hz. The actual system fundamental frequencies range from 10.81 to 14.54 Hz. None of the systems meet the target frequency. Cygna asked what the effect of slightly higher system frequency would be, such that the target frequency is met; would the response increase?

Clamp Evaluations

Cygna noted that the clamp evaluations in the span calculations only address clamps connected using Hilti anchors and Nelson studs. Cygna asked how Unistrut connections are to be evaluated. Ebasco replied that all clamps would be evaluated in the iso verification effort. The results in the span calculations are not used.

Calculation SPAN-1035

Cygna noted that Calculations SPAN-1115 and -1116 show that some S9 span stresses exceed the allowables, and the span lengths must be reduced. The calculations reference an evaluation of revised span lengths in Calculation SPAN-1035; however, the current calculation log shows that this calculation no longer exists. Cygna asked whether the calculation would be generated, or if not, where the reduced span evaluations were.

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Determination of Critical Models

In Calculation SPAN-1128 (double bends in the Auxiliary Building), Attachment F determines that the analysis model with BC is to be used for the analysis of the 3/4" conduit because the BC model gives a lower frequency. The calculation in Attachment F determines an equivalent span length for the BC in order to compare it with the span length in the model without the BC. The equivalent span length is incorrect and underpredicts the frequency of the span with the BC. The conclusion that the BC model is critical is, therefore, incorrect. In fact, Calculation SPAN-1115 shows that the BC model has a higher frequency than the model without BC for the 3/4" conduit.

Also in Calculation SPAN-1128, a 4" conduit is analyzed with results extended to a 5" conduit. Calculation SPAN-1116 showed that the 5" conduit has a lower frequency; therefore, keeping with the assumption that the system with the lower frequency is critical, the 5" conduit should have been analyzed. Cygna also pointed out that the lower frequency was critical for equivalent support accelerations, but they were not the sole contributor for conduit stress. Cygna determined that conduit stress was proportional to the unit weight, square of the length, and inverse of the section modulus. Therefore, the 5" conduit was also slightly more critical for conduit stress considering these parameters.

Development of Load Factors

Attachment H to Calculation SPAN-1001 develops the load factors to correct the support loads where the actual accelerations from the span evaluations exceed the approximate design accelerations. Page 7 of 8 of the attachment contains a manipulation of variables to prove that load factor #3 in SAG.CP20 is conservative with respect to the actual load factor. Cygna noted that there appeared to be an error in the calculation. Ebasco stated that it was not an error and that they would provide an evaluation to demonstrate that the equations were correct.

Span Stress Allowables

In the latest revision of SAG.CP10, the yield stress for the conduits is 25 ksi. In all the span calculations, the conduit allowables are derived using yield stress values which range up to 30 ksi. Cygna asked whether the span calculations would be corrected to reflect the revised yield stress. Ebasco stated that a generic calculation would be generated to cover all cases. They explained that the

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stress calculations were performed considering a conservative section modulus through a threaded cross-section. Removing this and other conservatisms, the adequacy of the current S-0910 spans would be shown.

Extension of Results to Other Systems

Cygna noted that the span analyses were performed for certain critical conduit sizes, buildings, and elevations. If those analyses show the critical systems to be adequate, other conduits can be qualified by envelope or similarity. However, if either the spans are overstressed or the actual support accelerations exceed the design acceleration, adequacy of the other conduits cannot be guaranteed. Cygna asked how the results of the analyses are extended to the other conduit sizes, buildings and elevations.

Spans With Unsupported Junction Boxes

Cygna noted that the span analyses did not consider systems with unsupported junction boxes, although the weight of the junction boxes are greater than that of the BCs or LBDs. Ebasco replied that spans with unsupported junction boxes are considered in the junction box analyses.

Systems With Unequal Spans

Cygna reviewed Calculation SPAN-1192, which validates unequal span cases for straight runs. The calculation also states that the results apply to the other configurations such as single bends, double bends, etc. Additionally, the analyses covered only two elevations in the Safeguards Building. Cygna asked Ebasco to justify the assertion that the analyses cover all possible configurations in all other buildings and elevations. Ebasco will revise the calculation to provide the justification.

Reduction of Spans

Calculation SPAN-1195 performs analyses of systems with LBDs. Cygna noted that the calculation reduced spans using the inverse of the square root of the stress ratio, whereas the reduction for spans with lumped weights should be done using the inverse of the stress ratio, according to SAG.CP10. Ebasco stated that the factor used in the calculation was correct, because the span that was being

Item	Comments	Required Action By

reduced was not the span containing the LBD, but was an adjacent straight span.

Cygna noted that this analysis was an example of why a summary of results was necessary. The summary would help to identify critical configurations. Since the final span lengths and support accelerations are determined by enveloping all results, it is important to identify which configurations are critical in order to judge the adequacy of the cases analyzed without a review of all calculations.

Consideration of CQC Results

Cygna noted that in Calculation SPAN-1122, most of the cases were originally run with the CQC modal combination. Only the cases with critical stress ratios were rerun using Reg Guide 1.92 modal combination. Cygna asked Ebasco how this was justified. Ebasco explained that they expect the same systems which were critical with the CQC modal combination to be critical with the Reg Guide 1.92 modal combination; therefore, only those cases were analyzed.

Ebasco asked Cygna what their plans were for the next conduit audit. They stated that the NRC would be performing audits in the NY office and that it would be more convenient to schedule the next NY conduit audit around the NRC's schedule. The NRC will audit the cable tray work during the last week in August and will audit the conduit work during the first week in September.

Cygna replied that they would probably perform audits at the site in the next one to two weeks to get a better overview of the entire project and how the studies performed in Ebasco's New York office fit into the final package. Additionally, Cygna needs to discuss conduit support and clamp testing, which is headed up by the site organization. Ebasco asked Cygna to please inform them when that site audit is scheduled, as they would like to send a representative to participate in the discussions. Cygna agreed to coordinate all audits through Scott Harrison at TU Electric.

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	9/2/87
Subject:	Conduit Support Audits Interface Between Site and NY	Time:	11:45 a.m.
		Place:	CPSES Site
Participants:	C.Y. Chiou	of	Ebasco
	D. Leong, J. Russ		Cygna

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Cygna and Ebasco discussed the division of responsibilities between the Ebasco site and New York conduit organizations and the interface between the two groups. Each major task was discussed:

Walkdowns

A 100% as-built walkdown is being performed. The site organization is responsible for all work.

Span Verification

All evaluations are being performed in New York to revise the S-0910 package; however all drawings are issued by the site organization.

Iso Verification

Each conduit line is being requalified. Most of the work is being done on site; however, the New York organization provides additional manpower as required.

Criteria

The New York organization is responsible for issuing criteria.

Testing

The Unistrut support and clamp tests were performed by CCL

Signed: J. R. Russ for N. H. Williams

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and administered by the site organization. A general study for cast-in-place conduits is being handled by the New York organization.

Thermal Studies

Mr. Chiou stated that New York is responsible for all thermal studies. Cygna noted that they were told that the site gave direction for the study. Mr. Chiou reiterated that all thermal studies are being performed in New York under Mr. H. Ghandi, who previously reported to Mr. Chiou when he was in the New York office. Mr. Ghandi now reports to Mr. K.T. Wu. Mr. Chiou stated that his responsibility with respect to the thermal studies is to interface with the third party, screen their comments, decide what action is needed to provide response, and communicate to the New York organization those needs.

Mr. Chiou stated that the New York office is basically a satellite office and that the center of activities is the site organization. All New York activities are under site direction. Cygna asked what role "Atlanta" has in the project. Mr. Chiou stated that "Atlanta" was Ebasco's Atlanta office and that they were in a role similar to that of a subcontractor or consultant to the New York office. Currently, Atlanta's involvement was limited to performing thermal analyses for junction boxes and their supports. All work is transmitted back to New York when completed.

Cygna mentioned that they were told that the charter of the thermal group in New York was to perform thermal evaluations for tube steel supports only, and that the Unistrut support were being evaluated by the site organization. Mr. Chiou stated that that was incorrect. He stated that they believed that the Unistrut supports were more flexible than the tube steel supports. He had recently contacted Mr. Ghandi to ask whether the present thermal study could also cover the Unistrut supports. Mr. Ghandi is presently evaluating that postulation.

In summary, Mr. Chiou listed all activities in which the New York organization was involved:

- o Criteria development
- o Generic studies
- o Analyses in support of the S-0910 package
- o Resolution of Cygna issues
- o Resolution of third party issues
- o Junction boxes
- o Iso verification

Item	Comments	Required Action By
	Mr. Chiou also mentioned that there were three criteria documents which would be revised by the site in the near future. This includes one Unit 1 procedure, SAG.CP25, which was originally written by Mr. Chiou and would be revised and issued by him. The other two are Unit 2 criteria: CP.SG02 and CP.SG03. All other criteria and procedures are issued by the New York organization.	

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No:	84056
		Date:	9/03/87
Subject:	Conduit Support Design Review Ebasco Audit-Conduit Clamp Testing	Time:	10:15 a.m.
		Place:	CPSES Site
Participants:	B. Atalay, D.K. Leong	of	Cygna
	C.Y. Chiou		Ebasco
	F. Thomas		Corporate Consulting & Development Co. Ltd (CCL)

Item	Comments	Required Action By

REFERENCES:

1. Letter from N. Williams (Cygna) to W. Counsil (TU Electric), Cygna Letter No. 84056.110, dated March 18, 1987.

2. "Conduit Clamp Test Report Phase I," CCL Report No. A-699-85, dated December 17, 1985.

3. "Conduit Clamp Test Report Phase II," CCL Report No. A-702-86, dated April 7, 1986.

1. Cygna, Ebasco and CCL discussed the Cygna questions appearing under Item 18 of the Enclosure (Reference 1). Questions A and B of Item 18 of Reference 1 had previously been answered by Ebasco, and the answers to Questions C and D had been deferred (see "Transcripts of the Conduit and Conduit Supports Design Verification Meeting" held at the CPSES Site, April 21, 1987). The Ebasco and CCL responses to Cygna Questions C and D are as follows:

   C. Clamp distortion was considered in the tests by varying bolt spacing. Bolt spacing was varied by ± 1/4 in. in Phase 1, and by - 1/8 in. in Phase 2 for "small" clamps, i.e., clamps for conduit 1-1/2 in. diameter and smaller. (See References 2 and 3, respectively.)

Signed: J. P. Duran for W. H. Williams

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Cygna asked why a +1/8 in. bolt spacing variation was not considered in Phase II, especially since Conclusion 8 on page 4 of Reference 3 implies that a larger bolt spacing results in smaller allowable vertical clamp loads. CCL responded that clamps had large vertical capacities, and qualification in the vertical direction was not a problem. CCL added that Conclusion 8 did not really pertain to the effect of clamp distortion (installed bolt spacing), but merely addressed the effect of designed bolt spacing in undistorted clamps.

CCL added that C-708N-U and C-708-U clamps were not tested in Phase II since Phase 1 demonstrated that these clamps were at least as strong as P2558 clamps. CCL added that, due to the equivalent clamp behavior, the SAG.CP10 clamp allowable tables are based on bolt diameter but not on clamp type; i.e., C-708N-U or C-708-U or P2558.

Cygna said that the Phase 1 tests do not include tests that would allow a direct comparison between C-708 and P2558 clamp types. Ebasco and CCL were asked to demonstrate the assertion that C-708 clamps are as strong as P2558 clamps. Ebasco and CCL will attempt this demonstration.

D. i. The first bullet of Question D of Item 18 of Reference 1 is basically a request for clarification on Cygna's part. Ebasco and CCL basically confirmed Cygna's understanding. Ebasco and CCL explained that, with possible exceptions, the clamp tests generally exhibited the following categories of load-displacement curves:

- o Category 1 curves under axial conduit loads;
- o Category 2 curves under vertical conduit loads; and,
- o Category 3 curves under transverse conduit loads.

For a description of the categories of load-displacement curves see pages 16 and 17 of Reference 2.

D. ii. In response to the second bullet of Question D of Item 18 of Reference 1, Ebasco and CCL said that the term "factor of safety" as described on page 26 of Reference 3, and elsewhere in References 2 and 3, was a misnomer. This situation is, in fact, addressed in the footnote on page 26 of Reference 3. The term's use as a safety factor is not strictly true. The quantities 3 and 4 on page 17 of Reference 2 are merely the quantities that

ultimate static capacities were divided by to arrive at the target loads to be applied in the cyclic tests.

Cygna then asked for the safety margins of the allowable clamp capacities given SAG.CP10. Ebasco stated that no consideration was given to the phenomenon of safety factors in developing the clamp allowables in SAG.CP10. Ebasco, however, felt that due to the stringent acceptance criteria implicit in the tests (see D.iii below), the clamp allowables had implicit factors of safety, even though they had not been quantified. Ebasco stated that they were in the process of formalizing their position on the factor of safety issue, and they would, if need be, revise the clamp allowables in SAG.CP10 such that the allowables are in accordance with the developed position. The tentative Ebasco position on the factor of safety issue is based on the observed test behavior, and is as follows:

- For clamps with Nelson studs, a linear interaction ratio with factors of safety equal to 2 and 3, for OBE and SSE, respectively, will be required.

- For clamps with Hiltis, the analysis of support and conformance with 2323-SS-30 means that such supports have factors of safety of 4 and 5, for OBE and SSE, respectively.

- The above do not consider the interaction with the axial direction; in the axial direction, a factor of safety equal to the ratio of static clamp failure load to applied cyclic load exists.

Ebasco's final response regarding factors of safety will be available in the near future.

D. iii. In response to the third bullet of Question D of Item 18 of Reference 1, Ebasco stated that, based on the SRP, only 200 cycles of strong motion input in tests were required, but the clamps were subjected to a higher number of cycles (up to 2439 cycles). This should eliminate all concerns regarding the number of cycles that have to be applied. Ebasco added that, in all tests that form the basis of the clamp allowables, no "failure" was observed.

Cygna asked what constituted "failure"; i.e., what were the failure criteria? CCL said that a limiting value of slip in the axial direction, or structural failure (bolt

Item	Comments	Required Action By

breakage, pull-out, etc.) constituted "failure." CCL did not remember what the limiting value of slip was (the tentative recollection being 1/4 in. or 1/2 in.), but said they would provide this value.

D. iv. In response to the fourth bullet of Question D of Item 18 of Reference 1, Ebasco and CCL said that the values appearing in Table 7.1 of Reference 2 were inconsequential, and added that this was stated as such on page 18 of Reference 2.

D. v. In response to the fifth bullet of Question D of Item 18 of Reference 1, CCL said that the first 1000 to 2000 conduit support as-built drawings were sent to them. Those support drawings were reviewed and a best effort was made to ensure that all variations would be covered by the tests. Furthermore, the response behavior is governed by the clamp bolt size and type but not by the clamp type. The iso verification effort will reveal if there are any clamp types present that have not been covered by the tests.

CCL said that new P2558 clamps had to be distorted so that they could be installed on existing stud plates in the field, and added that a test was added to the test program to study this specific configuration.

D. vi. Cygna, Ebasco and CCL noted that the discussion of the sixth bullet of Question D of Item 18 of Reference 1 had already been held in sufficient detail under Item D.ii., above.

2. Cygna, Ebasco and CCL then discussed the following issues resulting from Cygna's review of References 2 and 3.

A. Cygna asked for a clarification of footnote No. (2) appearing on page 20 of Reference 2. CCL stated that, for the clamp sizes and types for which the footnote is applicable, they ran out of clamps to test and, therefore, did not have three samples pass at this load level.

B. Cygna noted that Paragraph 3.3.2 of SAG.CP21 references a CCL Letter (dated June 11, 1986) and quotes clamp stiffnesses which are substantially different than the clamp stiffnesses reported in Tables 6.5 through 6.7 of Reference 3. Cygna asked what the substance of the subject letter was, and further, asked for a reconciliation of the different clamp stiffnesses.

Item	Comments	Required Action By

Cygna also noted that Tables 6.5 through 6.7 of Reference 3 are for P2558 type clamps. Cygna asked if tables similar to Tables 6.5 through 6.7 were generated for C-708 type clamps and how the stiffness of C-708S type clamps given in SAG.CP21, Paragraphs 3.3.2 were derived. Ebasco will provide the requested clarifications.

C. Cygna noted that the load-displacement curves on which the clamp stiffnesses are based are highly nonlinear. Cygna further noted that they did not see a record of the stiffness calculations although References 2 and 3 described the general method of the calculations. Ebasco/CCL will provide a sample stiffness calculation so that Cygna can review the procedure.

D. Cygna noted that "minimum" and "average" clamp stiffnesses were being tabulated in Tables 6.1-6.2 and 6.3-6.4, respectively, and asked why the "minimum" and "average" clamp stiffnesses were being mixed in arriving at the proposed clamp stiffnesses shown in Tables 6.5 through 6.7 of Reference 3. CCL said that the data was being interpreted in this fashion due to presence of testing anomalies. CCL will present a more formal response.

E. The last pages of Appendices C-1 through C29 of Reference 2 are the only records of the results of the clamp cyclic tests. These test results are interpreted by CCL and clamp allowable loads, such as those shown in Table 10.10 of Reference 2, are derived. The method of this data interpretation is not clear, and Cygna asked for a clarification. CCL said that samples of the same clamp/conduit configuration were tested. Out of the number of samples tested, CCL picked the minimum envelope of the three highest successes, success as defined in response to Item 1.D.iii, above. For example, let five samples of a configuration have the following test loads and results:

Sample No.	Cyclic Loads Applied Longit.	Transv.	Vert.	Pass/Fail
1.	L_1	T_1	V_1	Pass
2.	L_2	T_2	V_2	Pass
3.	L_3	T_3	V_3	Pass
4.	L_4	T_4	V_4	Pass
5.	L_5	T_5	V_5	Fail

If samples 1, 2 and 3 had the highest three passing loads (out of Samples 1, 2, 3 and 4) then the clamp allowables would be:

Item	Comments	Required Action By

Allowable L = Min. $\{L_1, L_2, L_3\}$,
Allowable T = Min. $\{T_1, T_2, T_3\}$, and
Allowable V = Min. $\{V_1, V_2, V_3\}$.

Cygna pointed out exceptions to the above description; namely, the applied loads and proposed allowables for test configurations C-1-02 and C-3-05 did not agree with the above description. CCL said that they would repeat the allowable loads determination portion of the cyclic tests results evaluation, and assure that the above acceptance criteria are satisfied.

F. Cygna asked why some of the load versus displacement diagrams exhibit anomalous behavior. For example:

i. On page 38 of Appendix C-2 of Reference 2, the loads had to be increased to maintain a constant displacement.

ii. On pages 6 and 43 of Appendix C-26 of Reference 2, the applied loads and resulting slips were in opposite directions.

CCL attributed these to anomalous tested behavior.

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	9/4/87
Subject:	Conduit Support Audits Torsional Capacity	Time:	10:00 a.m.
		Place:	CPSES Site
Participants:	C.Y. Chiou	of	Ebasco
	D. Leong		Cygna

Item	Comments	Required Action By
	Cygna reviewed CPE-TD-EB-060, Revision 1, "Conduit Design Adequacy Program" and noted that the document mentioned procedure SAG.CP14 in regards to the determination of torsional capacity by test. Cygna asked whether tests which determine torsional capacities of clamps were being performed. Ebasco replied that tests of that nature were not being performed; SAG.CP14 refers to tests being conducted for the torsional capacities of epoxied coupling joints for cantilevered conduit segments. Cygna requested and received SAG.CP14 for review during the audit. \TUE\090487-E.CON	

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Communications Report

Company:	CES	[X] Telecon	[ ] Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	9/4/87
Subject:	Conduit Support Walkdowns	Time:	12:30 p.m.
		Place:	Walnut Creek
Participants:	R. Beam	of	Ebasco
	J. Russ		Cygna

Item	Comments	Required Action By

Reference: Communications Report between J. Aaen, R. Beam (Ebasco) and J. Russ (Cygna) dated September 2, 1987, 9:00 a.m.

Ebasco telephoned to provide Cygna with the information promised during the discussion documented in the referenced communications report. Two Interim Change Notices (ICNs) have been issued against revision 2 to CPE-EB-FVM-CS-033. The changes to the procedure from the ICNs are as follows:

ICN	CHANGE
1	Correction of typographical errors
2	Removed requirement for the verification of the anchor spacing to adjacent supports and removed deficiency requirement 13.1.K, "No washer under clamp bolt."

Ebasco provided the responses to the questions on topics found under the following sections of the walkdown procedure.

Section 7.5 - Historical FVM-CS-010

Ebasco stated that walkdown packages were generated under the requirements of procedure FVM-CS-010. These packages have an inventory sheet which serves as an index. If a document is removed from these FVM-CS-010 packages, a "Field Verification Package

Signed: J. P. Russ for N. H. Williams

Page 1 of 2

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Inventory Supplement" must be inserted into the old walkdown package to indicate where that document now resides.

Section 8.2 - Isometric Drawing and Support Verification

Sub-section C

Ebasco stated that this section will be removed by an ICN.

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	9/4/87
Subject:	Conduit Support Design Review Ebasco Audit Conduit Clamp Testing	Time:	1:00 p.m.
		Place:	CPSES Site
Participants:	B. Atalay	of	Cygna
	C.Y. Chiou		Ebasco

Item	Comments	Required Action By

REFERENCES

1. "Conduit Clamp Test Report Phase I," CCL Report No. A-699-85, dated December 17, 1985.

2. "Conduit Clamp Test Report Phase II," CCL Report No. A-702-86, dated April 7, 1986.

Based on their review of the CCL clamp testing program, Cygna had the following questions. These questions are in addition to those listed in Cygna Communication Report dated September 3, 1987, 10:15 a.m.

1. Please clarify which is the correct entry for the "3 in. conduit with Hilti bolts" entry of Table 10.3 of Reference 1. Is clamp type C-708-S or C-708N-U? Why is no ultimate transverse load entered in the table?

2. Why are clamp allowable loads different in Tables 5.1, 7.2 and 10.10 of Reference 1? According to Cygna's understanding, Table 5.1 of Reference 1 gives the target cyclic loads. Does Table 7.2 contain the applied (target) loads as its title suggests or the achieved allowable loads? Table 10.10 appears to be an interpreted ("smoothened") version of Table 7.2, yet there are substantial differences in the entries of the two tables for certain tests. For example, compare the results of tests C-5-06 and C-5-10 in Table 7.2 and 10.10 and reconcile.

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3. In Table 7.1 of Reference 2, clamp allowable loads for 4 the in. clamp size which was not tested are obtained by interpolation. The interpolations performed do not seem accurate or justifiable.

4. Results are reported in Tables 4.1 and 4.2 of Reference 2 for test configurations which are not among the configurations shown as tested in Tables 3.3 through 3.5. For example, in Table 4.1, results are reported for 3 in. P2558 clamps with Nelson studs and a 1 in. thick filler plate. According to Tables 3.3 through 3.5, no such tests were conducted. Please reconcile.

5. Cygna noted that the clamp allowable loads given in Tables 7.1 through 7.12 of Reference 2 (and Tables 1.1 through 1.9 of SAG.CP10) did not show a reasonable trend. For example, in Table 7.3 of Reference 2 (and Table 1.6 of SAG.CP10) the allowable load of 3736 lbs. violates the expected trends. Ebasco said that they were aware of such anomalies, and they would address such situations when they revise the clamp allowables.

6. Cygna asked why the following CCL results and clamp allowable loads have not been incorporated into the design criteria document SAG.CP10:

Clamp/Configuration	CCL Results in Reference 2
P2558 A (Abrasive)	Tables 7.1 through 7.9
Nelson studs with 4 filler plates, 1 to 2 in. thick	Tables 7.10 through 7.12

In partial response, Ebasco stated thaat P2558A type clamps have not been encountered in the design verification effort.

Ebasco will respond to Cygna questions 1, 2, 3, 4 and 6 above.

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	09/04/87
Subject:	Conduit Support Design Review Ebasco Audit	Time:	1:10 p.m.
		Place:	CPSES Site, TX
Participants:	T. Kuo	of	Ebasco
	B. Shakibnia, D. Leong		Cygna

Item	Comments	Required Action By

REFERENCE LIST

1. Seismic Qualification Test Report for Conduit Support Systems for CPSES, by CCL. Report No. A-678-85, October 9, 1985.

During the review of Calculation LIS-602C, Revision 1, Cygna noted that when calculating the natural frequencies of CA-type and JA-type supports, Gibbs & Hill used the displacements from the CCL test results (Reference 1) in conjunction with the loads based on the tributary weight of 6-foot conduit spans. Cygna believes that for frequency calculations, the test displacements should be used in conjunction with the test loads. Therefore, the frequency calculations for CA-type and JA-type supports should be revised and appropriate test displacements and loads should be used.

Ebasco stated that they agreed with Cygna's comment and the frequency calculation for CA-type and JA-type supports will be revised using test displacements in conjunction with test loads. Ebasco also stated that due to failures of rigid conduit supports (CA and JA types) noted in the conduit thermal analyses, there will not be any LA-span series. All CA-type or JA-type supports must now meet the minimum support frequencies required for LS-type supports.

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP PHASE 4	Job No.:	84056
		Date:	9/4/87
Subject:	Conduit Support Design Review- Conduit Clamp Dynamic Tests by Anco	Time:	2:15 pm
		Place:	CPSES Site
Participants:	B. Atalay, D.K. Leong	of	Cygna
	L. Natzic		TU Electric

Item	Comments	Required Action By

REFERENCES

1. "Specification for Dynamic Test of Conduit Clamp for CPSES Units NO. 1 and 2", Ebasco Services Inc., SAG.CP-26, Rev. 1, dated April 10, 1987.

2. "Test Procedure for Conduit Dynamic Tests", Anco Document No. A-000189, Rev. 0, dated April 1987.

Cygna noted that there were a number of differences between the Ebasco test specification and the Anco Test Plan regarding the test parameters. The number of tests, for example, appears as 23 and 17 in References 1 and 2, respectively; i.e., six tests with Hilti bolts are not included in the test plan (Reference 2), although such tests are specified in Reference 1. Additional discrepancies between the Test Specification (Reference 1) and the Test Plan (Reference 2) follow:

	Test Specification (Reference 1)	Test Plan (Reference 2)
Bolt Spacing	Std. ± 1/4 in.	Std. 1/8 in.
Filler Plate Thickness	3/16 in. to 2in.	1/4 in.
C-708U Clamps	Yes	None
No. of Bolts	2 and 4	2

Signed: J. D. Reece for N. H. Williams

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	TU Electric said that the Test Plan (Reference 2) had an amendment, and that the amendment may address some of the above-noted discrepancies. The amended test plan will be provided for Cygna's review.	

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	9/15/87
Subject:	Conduit Support Audits	Time:	10:30 a.m.
		Place:	Walnut Creek
Participants:	H. Gandhi, H. S. Yu	of	Ebasco
	D. Leong		Cygna

Item	Comments	Required Action By

Reference: 1. Communications Report between R. Alexandru (Ebasco) and D. Leong (Cygna), dated August 14, 1987, 10:30 a.m.

2. Communications Report between R. Alexandru et al (Ebasco) and D. Leong et al (Cygna), dated August 14, 1987, 1:30 p.m.

Cygna asked Ebasco for the status of two summary documents which had been requested in References 1 and 2. In regards to the span verification program, a separate calculation book is being generated to provide a summary of all analyses which have been done for the span verification effort. Justification will be provided for the choice of conduit sizes and spectra used for the evaluation.

Cygna asked whether a summary of the results was also being generated. Ebasco replied that, currently, a summary of the resulting design "g" values was contained in Calculation Book SJPAN-1009. The results of the CQC reanalyses are also contained in a separate calculation book. Ebasco stated that they were currently compiling a summary of span reduction results.

Cygna asked when the summary would be available for review. Ebasco stated that they believed it would be completed by the next week. Cygna stated that they would be continuing with audits in New York that week.

Signed: N. H. Williams

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Item	Comments	Required Action By

In regard to the thermal studies, Ebasco stated that their position paper on thermal effects (Appendix 10) was being updated to provided more explanation and details. Cygna stated that they wanted to have a summary put together providing explanation of which calculations were applicable, what the intent of each calculation was, and how the calculations fit together to provide a cohesive argument. Ebasco stated that they would try to provide the summary for next week's audit.

Ebasco stated that some of the thermal calculations had been revised to address some of Cygna's comments and that the revisions did not have a significant effect on the results. They are prepared to respond to most of the outstanding issues and to provide an overview of the ongoing work for the Unistrut supports.

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	9/21/87
Subject:	Conduit Audit - Document Request	Time:	9:30 a.m.
		Place:	New York, NY
Participants:	K.T. Wu	of	Ebasco
	J. Russ		Cygna

Item	Comments	Required Action By
	Cygna requested and received the latest revisions of the following documents for use during the audit:	
1.	Criteria A. SAG.CP-10 B. SAG.CP-17 C. SAG.CP-25	
2.	Drawings A. 2323-S-0910 B. 2323-S2-0910	
3.	Specifications A. AISC Specifications, 7th edition	
4.	Calculations A. Book 92, Volumes 1, 2 and 3 B. SUPT-0247 C. SPAN-1189 D. SPAN-1191 E. BOOK 44	

Signed: J. P. Russ for N. H. Wilcox

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Item	Comments	Required Action By
5.	Miscellaneous A. List of junction box analyses.	

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	9/21/87
Subject:	Conduit Audit - Drawing Interpretation	Time:	2:30 p.m.
		Place:	New York, NY
Participants:	H.S. Yu	of	Ebasco
	J. Russ		Cygna

Item	Comments	Required Action By
	Cygna spoke to Ebasco about several requirements listed on the following drawing sheets from drawing package 2323-S-0910. Ebasco provided to several of the questions immediately or shortly thereafter.	
	Drawing Package 2323-S-0910 Sheet CSD-5b-I, revision 3	
1.	What is the maximum tube steel size that can be used?	
	Ebasco will provide a response.	
	Drawing Package 2323-S-0910 Sheet CSD-14b-I-A, revision CP-01	
2.	Is Case III shown on this drawing sheet only for a TS6x6?	
	No. The detail for Case III may be used with any tube steel size allowed in the drawing package.	
3.	In section C-C, which depicts an alternative connection, what size tube steel is this limited to? Cygna's copy has this section obscured by a DCC stamp.	
	Ebasco will provide a response.	
4.	What were the original requirements for the use of Case III?	
	There were no requirements. This is indicated by reviewing Sheet CSD-14b-I from the Gibbs & Hill drawing package 2323-S-0910.	

Signed: J. P. Russ for N. H. Williams

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	Cygna requested and received, for use during the audit, a copy of Ebasco Calculation Book SUPT-1001.	

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	9/22/87
Subject:	Conduit Audit - Document Request	Time:	11:20 a.m.
		Place:	New York, NY
Participants:	K.T. Wu	of	Ebasco
	J. Russ		Cygna

Item	Comments	Required Action By
	Cygna requested and received the latest revisions of the following documents for use during the audit:	
1.	Criteria	
	a. SAG.CP-2	
2.	Calculations	
	Three volumes of computer output for Book 2 of the accident thermal analysis. The requested output is for the time history analysis of the seismic and thermal analysis.	
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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No:	84056
		Date:	9/23/87
Subject:	Conduit Audit - Document Request	Time:	9:45 a.m.
		Place:	New York, NY
Participants:	H.S. Yu	of	Ebasco
	J. Russ		Cygna

Item	Comments	Required Action By
	Cygna requested and received for use during the audit Ebasco Calculation Book SUPT-0246, Revision 0, dated March 10, 1987. \TUE\092387-E.CON	

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.	84056
		Date:	09/23/87
Subject:	Conduit Support Design Review Ebasco Audit	Time:	10:00 a.m.
		Place:	New York, NY
Participants:	C.A. Liu	of	Ebasco
	B. Shakibnia, J. Russ		Cygna

Item	Comments	Required Action By

The following discussion occurred after Cygna's review of Ebasco Calculation SUPT-0247, Revision 0.

1. Cygna asked Ebasco to explain the significance of mass transformation factor for frequency, "C", and the load transformation factor for stress, "u".

   Ebasco stated that the factors "C" and "u" were used to determine the equivalent concentrated mass of a uniformly distributed load on a cantilevered beam which would result in the same frequency and stress values, respectively.

2. Cygna asked Ebasco how the interaction ratios were calculated for weld, base plate, and member strength, and whether these interaction ratios were based on the SRSS of the seismic responses in the three directions.

   Ebasco stated that the minimum of the four capacities of the base plate, weld, member strength, and frequency requirements was selected as the support capacity. Then the interaction ratios for weld, base plate, and member strength were calculated by dividing the minimum member strength capacities by the corresponding weld, base plate, or member strength capacity. Ebasco also stated that these interaction ratios were based on the SRSS of the seismic responses in the three directions.

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No:	84056
		Date:	09/23/87
Subject:	Conduit Support Design Review Ebasco Audit	Time:	10:00 a.m.
		Place:	New York, NY
Participants:	C.A. Liu	of	Ebasco
	B. Shakibnia, J. Russ		Cygna

Item	Comments	Required Action By

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1. Cygna asked Ebasco to explain the significance of mass transformation factor for frequency, "C", and the load transformation factor for stress, "u".

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Item	Comments	Required Action By
	3. The stress ratio (new/old) is determined by dividing the conduit weight plus the equivalent concentrated weight of the new heavier tube stee) by the conduit weight plus the equivalent concentrated weight of the old tuble steel. This method of the stress ratio calculation assumes that the change in stress is linearly proportional to the change in the member weight plus conduit weight. This assumption may be true if all the masses were concentrated at one point. However, when the member weight is distributed and conduit weight is concentrated (actual case), the stress is calculated based on the dead loads and seismic loads in 3 directions using SRSS method. Therefore, it can be concluded that the change in the stress is not linearly proportional to the change in member weight plus conduit weight. Ebasco stated that they agree with the fact that the change in stress is not linearly proportional to the change in member weight plus conduit weight. However, it would be conservative to compare the calculated stress ratio by the inverse of the original interaction ratio. Cygna stated that they would discuss the issue internally. 4. Cygna asked Ebasco why the frequency ratios (new/old) were not calculated for all the possible cantilever lengths. Ebasco stated that the frequency ratios were calculated for those lengths where the support capacities were controlled by the minimum support frequency requirements. 5. Cygna asked Ebasco whether all the L-shaped supports have the same leg size. Ebasco stated that the supports have the same leg size in the generic calculations. TUE\092387-D.CON	

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	9/23/87
Subject:	Conduit Audit - Document Request	Time:	11:45 a.m.
		Place:	New York, NY
Participants:	K.T. Wu	of	Ebasco
	J. Russ		Cygna

Item	Comments	Required Action By
	Cygna requested and received for use during the audit the NASTRAN output associated with Ebasco Calculation Book 44. \TUE\092387-F.CON	

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No:	84056
		Date:	09/24/87
Subject:	Conduit Audit- CSD-16	Time:	10:45 a.m.
		Place:	New York, NY
Participants:	H.S. Yu	of	Ebasco
	J. Russ		Cygna

Item	Comments	Required Action By
	Cygna had completed its review of the qualification calculation for Sheet CSD-16, revision CP-01 of drawing package 2323-S-0910. This calculation is on page 29 of 511 of Ebasco Calculation Book SPAN-1191 and is dated October 3, 1986.	
	Cygna noted that they were aware that a walkdown was planned to identify attachments to cable trays. Following the identification of any such attachments, the responsible cable tray contractor would evaluate the stresses in the cable tray, while Ebasco would be responsible for any conduits within their scope that are attached to the trays.	
	Cygna noted that the drawing and the design verification calculation do not address the configurations recorded by Cygna during their walkdowns. Those configurations included an attachment plate, a 12-16 inch length of rigid conduit with some flex conduit attached at the end. Ebasco stated that the drawing and the calculation reflect only the allowed configurations. If Cygna noted some other configuration, that particular support would be termed a modified support and subjected to an individual calculation.	
	Cygna noted some specific concerns on the calculation. These are as follows:	
1.	The bolt properties used by the analyst considered the gross area of the bolt. The bolts used in the installation would be threaded as close to their head as possible. Therefore, the net section properties should be used.	

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Item	Comments	Required Action By
2.	The analyst did not check the shear in the bolts.	
3.	The analyst based his acceptance on low loads applied to the bolts or alternately acceptable welds. Given the types of inputs available to the analyst at the time (design G's), Cygna disagreed with this conclusion. The cable tray would provide additional amplification of the input floor motion which was not considered anywhere in the calculation. Ebasco stated that they would provide a response to Cygna's concerns.	

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	9/24/98
Subject:	Conduit Audit - Nelson Stud Clamps	Time:	3:45 p.m.
		Place:	Ebasco (NY)
Participants:	R. Bovera, H. S. Yu	of	Ebasco
	J. Russ		Cygna

Item	Comments	Required Action By
	Cygna had partially reviewed Ebasco Calculation Book 44 which contained the evaluation of the CSD series set of drawing details on clamps with Nelson studs, shim plates and filler plates. Cygna discussed the following topics with Ebasco:	
	1. Friction Resistance for Conduit Slippage	
	Cygna asked why longitudinal (slip thru) and transverse (slip along) conduit loads were not considered in the analysis. Ebasco replied that the friction force was taken at the interface between the conduit and the filler plate surface. This assumption was made since the clamp/Nelson stud/conduit assembly was analogous to a friction connection as specified by AISC. Additionally, for transverse loads to be continually applied to the conduit clamp as Cygna suggested they should be, Ebasco stated that the conduit must continually slip in the direction of load to keep contact with a continuously deforming clamp.	
	2. Statement on Undercut	
	In section 1.2 of the calculation, Cygna noted the use of the word undercut for the word underrun. Ebasco noted Cygna's concern but stated that note requires the engineer to allow for the possibility of underrun.	

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Item	Comments	Required Action By

3. Edge Distances

In the calculation of edge distances, Cygna asked why Ebasco did not consider the requirements for increased edge distance when using a component with oversize bolt holes. Ebasco stated that the calculation was merely to point out that edge distance violations did exist even without the increased edge distance requirements, and there was a need to address the problem.

4. Seismic Loads in Non-linear Analyses

Cygna asked why seismic loads were not included in the non-linear analyses for the Nelson stud clamps. Ebasco replied that the ductility was very low and that the loads could have been doubled and still have met the criteria.

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	9/25/87
Subject:	Conduit Support Design Review Ebasco Audit	Time:	11:45 a.m.
		Place:	New York, NY
Participants:	H.S. Yu	of	Ebasco
	B. Shakibnia		Cygna

Item	Comments	Required Action By
	After review of Ebasco Calculation SPAN-1189, Revision 1, Cygna raised the following questions:	
1.	What is the significance of the capacity calculated by Gibbs & Hill shown on sheet 29?	
	Ebasco stated that if a support capacity was calculated that was larger than shown on the original S-0910 documents, the Gibbs & Hill value was maintained as the support capacity.	
2.	On Sheet 31, why was support JS-31a listed as acceptable when the table on the previous page listed the support as not satisfying the frequency requirements?	
	Ebasco stated that support JS-31a was designed for the envelope of all building accelerations. In the table on the previous sheet, the ratios of new to old weight (W(new)/W(old)) were compared to the minimum allowable values. Hence, for this support the ratio was compared to the actual allowable at the elevation but with maximum accelerations.	
3.	Why is the moment ratio (M(new)/M(old)) controlled by the stress requirements of support CSM.18f - type 17d, shown on sheet 35?	
	Ebasco stated that the moment ratio calculation had numerical errors. However, these errors would not effect the rest of the calculation.	

Signed: J. P. Rice for N. H. Williams

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Item	Comments	Required Action By
	Ebasco also stated that the SAG CP.25 would be revised to reflect that a reduction in support capacity equal to 40% of the increased member weight (after substitution) is required for support CSM-18f, type 17d.	

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Communications Report

Company:	CES	[X] Telecon	[ ] Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	10/1/87
Subject:	Conduit Support Review Status	Time:	9:25 a.m.
		Place:	Walnut Creek
Participants:	S. Harrison, L. Natzic	of	TU Electric
	D. Leong, J. Russ		Cygna

Item	Comments	Required Action By

Cygna provided TU Electric with a status of the current work required to close out all conduit support Review Issues. Cygna noted that most of the outstanding Ebasco responses were in the areas of thermal analysis and testing. Another area requiring significant effort is the span verification program. Cygna stated that they would mention which Review Issues could be closed either by procedural adequacy or transfer to the design control area.

Cygna stated that their review to date had noted significant changes in criteria, technical approaches, and input to the design verification program. Since a great deal of work has already been completed and since many of the studies are interdependent, Cygna is concerned that, at present, there are no procedures in place to direct the engineers to review and incorporate the changes as necessary to the existing work. TU Electric stated that Ebasco is developing a "PI-11 type" document (referring to Impell's cable tray final closeout procedure) to specify what changes are required. The document is currently in draft form and will provide guidance to backfit generic calculations and reconcile any deviations from generic calculations.

Cygna then listed the status and action items for each of the conduit support Review Issues:

Issue 1. Governing Load Case For Design

Cygna is basing the dispositioning of this issue on the outcome of the discussions on allowables for the cable tray hanger scope. Of

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Item	Comments	Required Action By

particular concern are the allowables for single angle design and the 2/3 F_{cr} buckling limit. Cygna is basically looking for consistency between the cable tray and conduit groups.

Issue 2. Dynamic Amplification Factors

Ebasco is currently preparing a summary document to describe and justify the analyses that were performed in the span verification study and to describe the results of the study and how they were used to validate the conclusions.

Additionally, Cygna had several specific questions on the span verification study. Ebasco is responding to those questions.

Cygna had questions on the proof provided for the load factor applied to account for the effects of CQC. Ebasco must provide the required calculation to clarify the load factor derivation.

Cygna had noted that configurations with unsupported junction boxes were not included in the span verification scope. Ebasco had stated that the unsupported junction boxes were addressed in the junction box verification. Cygna will review the junction box calculations to assure this.

Ebasco is revising SAG.CP25 to specify guidelines for adequate mass point spacing to capture response up to a frequency of 33 Hz. Cygna will review SAG.CP25 when it is available to ensure that the specified spacing is adequate.

Issue 3. Combination of Deadweight and Seismic Responses

Cygna must review the Ebasco STRUDL skeleton to ensure that the deadweight and seismic responses are properly combined. A similar check was performed for the cable tray hanger scope; the methods used there were acceptable. TU Electric stated that the skeleton would be provided for Cygna's review at the next audit.

Issue 4. Measurement of Embedment From Top of Topping

Cygna will review Ebasco's procedures to consider anchors in topping when they are revised to incorporate the requirements of DBD-CS-015.

Cygna also noted that, in previous conversations with Ebasco it appeared that Ebasco thought that the purpose of DBD-CS-015 was just to specify spacing and edge distance requirements. TU acknowledged that DBD-CS-015 was a much broader document and agreed to verify Ebasco's understanding of its implementation.

Item	Comments	Required Action By

Issue 5. Bolt Hole Tolerance and Edge Distance Violation

Cygna stated that they had received the responses on the bolt hole study for cable trays and would review it for applicability to conduit supports. TU Electric stated that, in addition, a special document pertaining to conduits was available. This will be provided to Cygna at their next audit.

Issue 6. FSAR Load Combinations

In the area of the thermal operating and accident evaluations, Cygna had a number of questions presented in five communications reports. Ebasco is currently preparing responses to those questions.

Additionally, Ebasco is to provide a conduit stress check for the normal operating condition.

Ebasco had not completed the criteria and analyses for the junction box accident load case. TU Electric believes that they are completed and will be ready for Cygna's review at the next audit.

Issue 7. Support Self Weight

Ebasco has committed to include the support self weight in the design verification scope. This is documented in SAG.CP10. In the course of auditing the iso verification process, Cygna will verify that this is being accomplished correctly.

Issue 8. Torsion of Unistrut Members

Cygna had a number of concerns regarding Ebasco's implementation of the Unistrut support test data to obtain capacities for the S-0910 supports. Among those concerns were:

* Determination of support frequency using test loads.
* Use of test loads in calculations to determine the final support capacities.
* Applicability of test configurations to all installations on the S-0910 drawing.
* Justification that the worst case configurations were tested. Cygna noted that the test configurations had been chosen prior to Ebasco's involvement. Cygna also mentioned that they had been unsuccessful in pursuing discussions regarding selection of the worst case test configurations with Gibbs & Hill. TU

Item	Comments	Required Action By

Electric stated that they would provide a response justifying the choice of test configurations.

* Adequacy of anchor bolts, primarily in the CA-1a type supports and other supports adjacent to these supports. Ebasco provided a calculation demonstrating that adjacent supports with Hilti anchors having spacing violations with CA-1a outrigger Hilti anchors will not be subject to decreased capacity. Ebasco must reconcile all criteria and methods with DBD-CS-015.

* Additionally, there were specific questions and concerns regarding capacity calculations for Unistrut supports. Ebasco must provide response to these questions.

Issue 9. Improper Use of Catalog Components

This issue is covered under issues 8 and 18.

Issue 10. Anchor Bolts

Ebasco must incorporate the requirements of DBD-CS-015 in their criteria, procedures and calculations.

Issue 11. Longitudinal Loads on Transverse Supports

Cygna acknowledged that generic transverse supports have been voided and that all transverse supports will be deleted or upgraded/qualified to provide three-dimensional restraint. TU Electric will provide a list which dispositions all existing transverse supports. Cygna stated that they would review selected supports for conformance to AISI requirements.

Issue 12. Hilti Kwik-Bolt Substitutions

Cygna noted that the walkdown effort documents as-built information on the support anchors and that the iso verification process considers anchor substitutions where required. However, Cygna has not been provided with Ebasco's inaccessible attribute procedure. TU Electric stated that there is a document addressing inaccessible attributes which specifies worst case assumptions to be taken if as-built information is not available. This document will be made available to Cygna at the next audit.

Issue 13. Substitution of Smaller Conduits on CA-Type Supports

Cygna understands that capacities on the S-0910 drawings will be given in total weight rather than numbers of conduits which can be installed on the support. Additionally, Cygna understands that

Item	Comments	Required Action By

LA-Spans will no longer be evaluated using design "g" values. Cygna will review the S-0910 drawings and calculations to assure this is true.

Issue 14. Use of CA-Type Supports in LS Spans

Cygna will review the revised SAG.CP25 when it is available. The revised document will provide additional guidance regarding response spectrum analysis methods.

Issue 15. Stresses in Cable Trays Due to Attached Conduit Supports

Cygna had questions regarding the Ebasco calculations which had been performed for the generic CSD-16 support detail. Ebasco must provide responses to those questions.

TU Electric will provide the walkdown procedures for attachments to cable trays. This will be available for Cygna's review in Impell's Walnut Creek office.

Issue 16. Increases in Allowable Span Lengths

This issue is closed, as the spans in the S-0910 package are being reverified. Span reverification is covered under Review Issue 2.

Issue 17. Substitution of Next Heavier Structural Member

Ebasco must provide responses to Cygna's questions on the generic calculations addressing tube steel substitutions.

Issue 18. Clamp Usage

Cygna had numerous questions and comments on the CCL test program. CCL and Ebasco are to respond to those questions and comments.

TU Electric must provide the ANCO test report for Cygna's review when it is available. TU Electric stated that Revision 0 of the test report had been issued; however, TU Electric had numerous comments which required iteration on the text. They stated that a version may be available in the next week for review.

Issue 19. Documentation Deviations Between Inspection Reports, CMCs and IN-FP Drawings

Cygna is to review the inaccessible attribute procedures with respect to the existing documentation. See Review Issue 12.

Item	Comments	Required Action By

Issue 20. Nelson Studs

Cygna must complete their review of the CSD details using Nelson studs.

Issue 21. Conduit Fire Protection Calculations

Ebasco is updating SAG.CP25 for additional guidance for performing RSM analyses in the iso verification scope, which includes evaluation of fire protected systems.

Issue 22. Span Increase For Fire Protected Spans

TU Electric will provide a copy of SDAR-CP-85-19 and its resolution in the reading room at Impell's Walnut Creek office. This SDAR refers to conduit material properties. Also see Review Issue 21.

Issue 23. Grouted Penetrations

Both Ebasco and Cygna are to investigate the applicability of bond stress formulas to conduits larger than #18 bars.

Issue 24. Rigidity of CA-Type Supports

Ebasco must address Cygna's concerns regarding the frequency of Unistrut supports calculated from test data (see Review Issue 8.) For other CA-type supports which were not tested, Cygna will audit selected calculations for frequency calculations.

Issue 25. Enveloping Configurations For Design

Ebasco must update Calculation Book 44.

Cygna will review any STARDYNE analyses performed to verify if shear center offsets were considered in calculating the torsional moment on support members.

Issue 26. Design Drawing Discrepancies

There are no outstanding questions.

Issue 27. Walkdown Discrepancies

Cygna will discuss their walkdown questions with Ebasco's design verification group.

Ebasco will provide the procedures specifying how Richmond Inserts

Item	Comments	Required Action By

which are installed at an angle to the perpendicular are handled in the design verification process.

Issue 28. Systems Concept

Cygna is discussing the review findings internally and will discuss any outstanding concerns with Ebasco at the next audit.

Issue 29. Cumulative Effect of Review Issues

There are no questions.

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Communications Report

Company:	CES	☐ Telecon	☒ Conference Report
Project:	TU Electric CPSES IAP Phase 4	Job No.:	84056
		Date:	10/14/87
Subject:	Thermal Analyses	Time:	8:00 a.m.
		Place:	Walnut Creek
Participants:	H. Ghandi	of	Ebasco
	J. Russ		Cygna

Item	Comments	Required Action By
	Ebasco called to discuss Cygna's concerns regarding the thermal analyses for the normal load combination. It was Ebasco's impression that all Cygna concerns had been addressed during the last audit. Cygna responded that their concerns were raised after the last audit and were discussed with TU Electric during a conference call on the status of the conduit review. (See Cygna Communication Report dated October 1, 1987, 9:25 a.m.) Ebosco stated that the noted concerns were addressed in a calculation book. Cygna replied that calculation book will be reviewed during the next audit. \TUE\101487-E.CON	

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