July 1, 1985

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket Nos. 50-445 OL and 50-446
TEXAS UTILITIES ELECTRIC COMPANY, ET AL.	)	
	)	(Application for Operating Licenses)
(Comanche Peak Steam Electric Station, Units 1 and 2)	)	

APPLICANTS' THIRD PARTIAL RESPONSE TO CASE'S FIFTH SET OF INTERROGATORIES RE: CREDIBILITY

I. INTRODUCTION

Pursuant to 10 C.F.R. §§2.740b and 2.741, Applicants hereby provide their third partial response to CASE's Fifth Set of Interrogatories and Requests to Produce Re: Credibility, filed March 4, 1985.[1] Applicants' response is governed further by the Board's February 15, 1985, Memorandum (Motion for Protective Order), wherein the Board granted, in part, Applicants' motions for protective orders by restricting Applicants' obligation to

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1/ Applicants and CASE agreed to an extension of time to respond to these discovery requests. The Board accepted this agreement and requested that Applicants document its acquiescence in the first set of partial answers.

respond to CASE's discovery requests regarding credibility[2] "to discovery related to the validity or reliability of tests and samples" (Memorandum at 1). Accordingly, Applicants respond only to those requests which are within the scope of the authorized discovery.[3]

II. APPLICANTS' RESPONSE TO CASE'S INTERROGATORIES RE: CREDIBILITY

Regarding Axial Restraints:

Where an affidavit is referenced, it is the Affidavit of Robert C. Iotti and John C. Finneran, Jr. Regarding Consideration of Force Distribution in Axial Restraints, which was attached to Applicants' 7/9/84 Motion for Summary Disposition Regarding Allegations Concerning Consideration of Force Distribution in Axial Restraints.

Q5. Affidavit at page 4, last paragraph continuing on page 5: Applicants state:

> "In order to assess the effect on piping stresses from modelling the rotational constraints, Gibbs & Hill performed a (sic) reanalyses of several stress problems for lines ranging in size from 4" to the 32". Table 1 (attached) shows a comparison of the results obtained for the pipe stresses under the two different modelling assumptions . . ."

a. Only two (not several) stress problems were listed in Table 1.

2/ These discovery requests were authorized by the Board in its December 18, 1984, Memorandum (Reopening Discovery; Misleading Statements).

3/ Applicants have also agreed to respond to other requests that are "ripe" for discovery, i.e., the subject matter of the interrogatories is likely to remain the subject of litigation. (See Applicants' June 7, 1985, Report Regarding Status of Replies To CASE Interrogatories.) Responses to those requests will be transmitted.

(1) Were the results shown for the two stress problems which were listed in Table 1 representative of the results for the stress problems which were not included in Table 1?

(2) If the answer to (1) above is no, how do the results differ? Give specific details.

(3) Provide a detailed breakdown like that shown in Table 1 for the rest of the stress problems (other than the two shown in Table 1) which were reanalyzed.

(4) What were the allowables for the different loading conditions for Equation 9 and Equation 10 as shown in Table 1?

Response:

Question 5.a.(1): As stated in the Affidavit, page 4, last paragraph, and first line on page 5, Table 1 shows results obtained for the 32" main steam line only (Stress Problem 1-1 and 1-4). Applicants did not state or imply that Table 1 includes results from several stress problems. In any event, the Affidavit already provides the answer to CASE's question, where it is stated (at 5):

> "Analyses of the other lines indicate identical results with respect to pipe stresses. Thus, these analyses demonstrate that excluding the rotational constraint of the trapeze supports has virtually no effect on the pipe stresses."

Further, CASE should note that the discussion in the Affidavit of interest here (bottom of page 4 and top of page 5) concerns only pipe stresses. Thus, the results shown from the two stress problems listed in Table 1 are representative of the results obtained for the other stress problems -- insofar as pipe stresses are concerned.

Question 5.a.(2): Not applicable.

Question 5.a.(3): A breakdown like that shown in Table 1 of the Affidavit for the rest of the stress problems which were reanalyzed is provided as Table 5-a-3, below.

Question 5.a(4): The allowables for the different loading conditions for Equation 9 and Equation 10 are those directly specified by the ASME Code for service level B (Equation 9 upset) and service level C (Equation 9 emergency) (see, e.g., ASME Code Section NC-3651).

TABLE 5-a-3

MAXIMUM PIPE STRESS COMPARISON

Prob. No.	Pipe Size (Thickness)	Node No.	Eq. 9 Upset (Trapeze)	Eq. 9 Upset	Eq. 9 Emer. (Trapeze)	Eq. 9 Emer.	Eq. 10 (Trapeze)
1-61C	24.0 (.375)	353	16884	17002	18587	18842	22384
		385	6624	6613	6031	6120	5758
		399	5777	5937	5549	5750	9652
		332	3639	3637	3724	3714	8614
1-29C	6.625 (.280)	63	3566	3566	3893	3893	18780
		107	3300	3300	3552	3552	1706
		101	7648	7648	8528	8528	8404
		1361	7120	7120	7927	7927	1442
155	6.625 (.432)	402	5547	5550	5934	5980	25565
		363	6567	6792	6958	7266	5686
		1376	6021	6554	6322	7049	17322
		381	4851	4961	4927	5077	22983
1-178A	12.0 (.375)	147	5619	5939	6374	6756	18270
		138	10543	11166	11900	12666	15627
		1193	7843	7840	8251	8248	4451
		197	3208	3241	3603	3636	20620
1-23B	32.0 (1.265)	1002	5297	5362	6236	6353	11839
	8.625 (.5)	1007	8103	8138	9436	9241	6993
	8.625 (.322)	6	8429	8420	8578	8563	4572
	32.0	2803	8464	8454	8605	8588	3698
1-66B	24.0 (.375)	1694	13007	13007	15249	15249	13547
		1572	8349	8353	9641	9659	24317
		597	9117	9117	9704	9704	4033
		1194	7543	7543	8607	8607	16373
2-63B	20.0 (.375)	814	4400	4194	4754	4497	562
	16.0 (.375)	809	2326	2335	2513	2521	2280
		806	3811	3913	4959	4759	12694
	10.75 (.365)	852	2716	2711	3130	3132	14485

1-61A	10.75 (.365)	128	8487	8494	11384	11391	701
		141	2797	2827	3146	3188	1098
	24.0 (.375)	105	3337	3438	3612	3721	1474
		22	2983	2977	3037	3028	877
1-76B	4.5 (.337)	211	5458	5864	5896	6347	4937
		222	5973	6150	6447	6696	12866
		246	6877	8241	7262	8669	2832
		212	5855	8561	6421	8935	1100
1-23A	8.625 (.332)	2349	2460	2361	2752	2540	4004
	8.625 (.5)	2347	7867	7613	9004	8577	6515
	32.0 (1.265)	185	8616	8605	8920	8900	2408
		1830	8224	8220	8308	8301	3002
1-23D	8.625 (.5)	1587	7573	7467	8543	8333	6289
		1583	10079	9750	12146	11492	19541
	32.0 (1.265)	3166	8879	8871	9142	9129	622
		4803	8472	8462	8715	8698	3709
1-70	8.625 (.322)	1235	5351	5297	5646	5580	1380
		2235	5613	5566	5985	5929	1461
	10.78 (.365)	1266	5397	5391	5537	5529	2517
		1270	5680	5698	5907	5929	5521
1-24	24.0 (.375)	104	6300	6412	7047	7176	3374
		904	5070	5705	5483	5552	280
		707	6143	5899	6835	6539	830
		136	5207	5176	5564	5535	1615

<u>Regarding Generic Stiffnesses</u>:

Where an affidavit is referenced, it is the Affidavit of R.C. Iotti and John C. Finneran, Jr. Regarding Use of Generic Stiffnesses Instead of Actual Stiffnesses in Piping Analyses, which was attached to Applicants' 5/21/84 Motion for Summary Disposition Regarding Use of Generic Stiffnesses Instead of Actual Stiffnesses in Piping Analysis.

Q12. Affidavit at page 5, A5:

a. What was the rationale for using only the actual stiffness values transmitted by NPSI?

b. What was the criteria for the sample selected?

c. Were the effects of base plate bending taken into account?

If the answer is yes, give specific details.
If the answer is no, what was the rationale for not taking it into account?

d. Were the effects of Richmond insert movement taken into account?

If the answer is yes, give specific details.
If the answer is no, what was the rationale for not taking it into account?

e. Provide any and all documentation for your answers to a., b., c., and d. preceding.

Response:

Question 12.a.: The actual stiffness values from NPSI were used because they were already available at the time Applicants were preparing their motion. The original request for the sample was prompted by Gibbs & Hill's desire in 1979 to determine whether stiffness values of NPSI-designed supports and the G&H generic stiffness values used in piping design were comparable. Gibbs & hill also sought to determine whether minimum stiffness values should be set for rigid struts and snubbers to assure that the resulting stiffness of the overall support would not deviate unacceptably from the assumed generic one.

Thus, the sample performed by NPSI is relevant to the issue of whether the deflection guideline of 1/16" maximum deflection under the service level B condition, excluding base plate and standard component deflection, provides reasonable assurance that the resulting support stiffness will be reasonably represented by the generic stiffness employed in design. For results of this inquiry, refer to the response to item e.

Question 12.b.: Based on discussions with NPSI, the sample was selected from Class 1 supports spanning pipe sizes most typically used in the NPSI effort on the date in which the sample was taken. Class 1 supports were chosen because actual stiffnesses had already been computed.

Question 12.c.: Based on discussions with NPSI, base plate bending was not always taken into account. Base plate flexibility (sic plate bending) was not taken into account in those supports the stiffness of which had been calculated prior to the promulgation of I&E Bulletin 79-02, because industry practice at that time was to neglect it. After the Bulletin was issued, subsequent stiffness calculations took into account base plate flexibility. This doesn't mean that the flexibility of the plate was always included in the stiffness because, for certain configurations of supports, analyses indicated that it could be neglected.

Question 12.d.: Richmond insert movement was not taken into account. At that point in time it was believed that the contribution from tne flexibility of the Richmond inserts was negligible. In the March 1984 series of tests, minimum stiffness of individual inserts of different size were determined to vary between 3×10^5 lb/in to 3×10^6 lb/in depending on size of the insert and whether the insert is loaded in shear or tension. The average stiffnesses of the inserts are higher by about a factor of two and there are a minimum of two inserts per support acting in parallel. Thus, the average stiffness of the inserts in the

support will be over 10^6 lb/in. For those supports listed in Table 12-e, inclusion of Richmond insert flexibility could produce softer stiffnesses ranging from a factor of 1.04 to 2.

Question 12.e.: The results of the NPSI sample are shown in Table 12-e. The letter transmitting these results will also be forwarded, as Exhibit 12.1. The table has been prepared because the attached letter provides no direct comparison between actual and generic stiffness.

Table 12-e

COMPARISON OF ACTUAL AND GENERIC STIFFNESS

Stiffness (lb/in x 10^6)

Generic	Actual	Generic	Actual	Generic	Actual
1.0	0.758	1.0	0.313	0.2	0.172
0.3	0.211	1.0	0.182	0.2	0.079
1.0	0.197	1.0	0.106	0.2	0.268
0.3	0.166	1.0	0.197	0.2	0.047
0.3	0.943	1.0	0.105	0.2	0.077
1.0	1.375	1.0	0.63	0.2	0.077
0.3	0.18	1.0	0.197	0.2	0.39
0.3	0.205	1.0	0.209	0.2	0.091
0.3	0.214	0.2	0.026	0.2	0.356
0.3	0.165	0.2	0.026	0.2	0.026
0.3	0.943	0.2	0.026	0.2	0.273
1.0	0.313	0.2	0.365	0.2	0.0213
1.0	0.295	0.2	0.08	0.2	0.076
1.0	0.276	0.2	0.075	0.2	0.355
1.0	0.182	0.2	0.156	0.2	0.090
1.0	0.239	0.2	0.142	0.2	0.073
0.3	0.101	0.2	0.09	0.2	0.067
0.3	0.204	0.2	0.084	0.2	0.232
0.3	0.164	0.2	0.074	0.2	0.073
0.3	0.172	0.2	0.074	0.2	0.077

Q13. Affidavit at page 4, A6., continuing on page 5:

a. What was Applicants' rationale for limiting their analyses to worst case supports which had been identified by CASE witness Jack Doyle?

b. Were the "four actual supports" which were tested also selected from those which had been identified by Mr. Doyle?

c. Were the four supports which were tested part of the "sixteen worst case supports" identified by Mr. Doyle?"

d. What assurance is there that the sixteen worst case supports identified by Mr. Doyle are representative of the worst case supports throughout Unit 1? throughout common? throughout Unit 2? throughout Unit 1, common, and Unit 2 (i.e., the entire plant)?

e. Please define "reasonably well?" How much difference would have been required for Applicants to conclude that

the base plate flexibility is a major factor in stiffness calculations?

f. What criteria was utilized to determine what constituted "reasonably well?"

g. In Attachment 1, under the Calculated Stiffness column, the value shown for support CC-2-011-001-A63R begins with "?". Is this a typographical error? What should the number be?

h. What was the rationale for testing only four supports?

i. Provide any and all documentation for your answer to a. through h. preceding.

j. Was more than one test performed or is expected to be performed?

(1) If the answer is yes, answer the following questions:

(i) How many additional tests were performed? How many additional tests are expected to be performed?

(ii) What was the reason additional test(s) were/are expected to be performed?

(iii) Have Applicants supplemented their Motion for Summary Disposition with the information that additional test(s) were/are being performed? If not, why not?

k. Provide any and all documentation (including the test and test results and all documentation relating to them) regarding each test which was performed. Also provide any and all such documentation regarding each test which is expected to be performed or is currently being performed?

Response:

Question 13.a.: Mr. Doyle had made specific allegations about supports regarding the 1/16 inch deflective criteria. He alleged that actual deflection would be more than 1/16 inch. It seemed reasonable to analyze for stiffness the worst case supports of those identified by Mr. Doyle.

Question 13.b.: No.

Question 13.c.: No.

Question 13.d.: Applicants did not claim that the worst case supports Mr. Doyle identified are representative of any grouping of supports. We only stated that they were the worst cases from those identified by Mr. Doyle to support his allegations.

Question 13.e.: For purposes of support stiffness, "reasonbly well" would mean that calculated stiffness and actual stiffness were within an order of magnitude of one another. This is based on the inherent inaccuracies in trying to actually calculate stiffnesses, the play that would exist in support components, and the amount that stiffness can actually vary before its effect on computer analyses would be significant.

Question 13.f.: There was no written criteria, but the criteria referenced in answer e. above is what was applied.

Question 13.g.: The "?" should be an "8."

Question 13.h.: Applicants actually tested five supports (see response to Questions 13.j. and k.). The rationale for testing only these supports was that there was enough variation in these five configurations to provide a reasonable comparison between calculated and tested stiffnesses.

Question 13.i.: The only documentation would be that related to Question 13.h., which is included in the response to Questions 13.j. and k.

<u>Question 13.j. and k.</u>: On May 9, 1984, we tested five supports, as shown on Exhibit 13.2. The results of these tests were included in Applicants' affidavit concerning generic stiffnesses, filed on May 21, 1984. The results from those tests for support CC-2-011-702-A63R were not included in the affidavit because they did not seem reasonable. We instructed that the test for this support be rerun, but did not receive the results in time to include in our May 21, 1984, affidavit. (This support test was not included in our July 16, 1984 (Exhibit 13.1) response to the NRC, only because it had not been included in our original affidavit.) The test for this support was rerun, as indicated on the drawing in Exhibit 13.3. All of the above tests were run at the level B loads for each support, and they were all run with one load with the deflection measured at that load. We suspected that these values were questionable because of the initial play that may exist in some supports. We later reran all five tests on May 30, 1984. We ran these tests for a series of loads as indicated in Exhibit 13.4. These test results were the ones included in our response to the NRC (Exhibit 13.1, referenced above).

With regard to future testing, Applicants currently do not know what testing may be done, if any, in our current efforts with Stone & Webster Engineering Corporation.

Q14. Affidavit at page 5, A7., continuing on page 6:

a. What was the rationale for reanalyzing only three piping systems initially?

b. What criteria were utilized to determine which three piping systems were reanalyzed?

c. Were the effects of mass participation (as discussed by Cygna) included in the reanalyses?

d. If the answer to c. preceding is no, why not?

e. How did/will the inclusion of the effects of mass participation (as discussed by Cygna) affect the result of any reanalyses?

f. Provide any and all documentation for your answer to a. through e. preceding.

Response:

Question 14.a.: The rationale for initially reanalyzing three piping systems was that three piping systems had been analyzed originally to develop responses for the SIT. In fact, two of the three problems chosen for reanalysis were the same as those analyzed for the SIT, the only difference being that the reanalysis was performed for full SSE conditions while the analysis for the SIT had employed 1/2 SSE (OBE) conditions. Those problems related to piping of 6 and 32 inches. The third analyzed problem departed from that analyzed for the SIT, so as to provide results for a pipe of intermediate size. Problem AB-1-032 is for a 16-inch line, while the original problem run for the SIT (AB-1-062D) was for a 10-inch line.

Question 14.b.: Applicants utilized the following criteria for selection of the three piping systems which were initially analyzed:

(i) SIT had previously concluded that no adverse effect would occur as a result of employing generic stiffnesses on the basis that no

overstressing (with respect to ASME Code) had resulted from the OBE analyses of the three stress problems. (See Affidavit of W. P. Chen Regarding Open Items Concerning Walsh/Doyle Concerns, at 26-27 (filed October 14, 1983).)

(ii) Two of the three SIT problems employed essentially the same generic stiffnesses, i.e., the 6" line (1-66C) and 10" line (1-62D). We wanted to also include a problem of an intermediate pipe size with different generic stiffness.

(iii) The SIT analyses had been done for OBE and we wanted to assure ourselves that the SSE condition would also support a similar conclusion.

Question 14.c.-e.: The answers to these questions were provided previously in our April 25, 1985, first partial response.

Question 14.f.: There is no separate documentation for the referenced answers.

Regarding Richmond Inserts:

Where an affidavit is referenced, it is the 6/1/84 Affidavit of John C. Finneran, Jr., Robert C. Iotti and R. Peter Deubler Regarding Design of Richmond Inserts and Their Application to Support Design, which is Attachment 1 to Applicants' Motion for Summary Disposition Regarding Design of Richmond Inserts and Their Application to Support Design.

Q16. Affidavit at page 7, first full paragraph, and page 11, continuing on page 12:

a. On page 7, Applicants state:

> "While the concrete at CPSES is designed for 4000 psi, it actually ranges from 4500 to above 5000 psi."

And on page 11, last paragraph, Applicants state:

> "All [of the nine specimens which were tested] utilized 1-1/2 inch type EC-6W inserts in concrete representative of the strength and reinforcement found at CPSES. For the test the concrete strength was approximately 4600 psi."

(1) Provide any and all documentation that all concrete at CPSES is designed for 4000 psi.

(2) Isn't it a fact that some of the concrete at CPSES was designed for 2500 psi?

(3) What determined the use of 4000 psi or 2500 psi concrete at CPSES (i.e., was it according to whether or not: the concrete was in a safety-related area; the concrete was for a certain specified use, such as for the base mat, or for a wall; the concrete was for use inside the containment, etc.); or some other criteria was used (if so, give specific details).

(4) Provide any and all documentation regarding the criteria for determining whether concrete at CPSES was to have been designed for 4000 psi or for 2500 psi, and (if different) regarding the criteria for determining whether the concrete which was actually used at CPSES.

(5) Who (names, titles, organizations) made the determination as to which concrete was to be designed for 4000 psi and which for 2500 psi?

(6) What was the age of the concrete utilized in the test at the time it was tested?

How does this compare with the age of the concrete which Applicants allege actually ranges from 4500 to above 5000 psi?

(7) Isn't it a fact that the strength of concrete increased with age?

(8) Was the approximately 4600 psi concrete utilized in the test based on a field cured specimen or a lab cured specimen?

(9) Is the concrete at CPSES which Applicants allege actually ranges from 4500 to above 5000 psi based on field cured specimens or lab cured specimens?

(10) Isn't it a fact that lab cured specimens normally test out at higher psi values than field cured specimens?

(11) Did the tests on the Richmonds take into account the possibility that inserts might be embedded in concrete which was less than 4600 psi (for instance, the stated design strength of 4000 psi, or 2500 psi)?

(i) If not, why not?

(ii) If so, provide any and all documentation regarding such tests.

(12) Was a criteria on maximum shear deflection considered in the test(s)?

(13) Was a cyclic load test considered using the current allowable?

(i) If not, why not?

(ii) If so, provide any and all documentation regarding this.

(14) Why were only 9 specimens tested?

(15) (i) What was the yield strength of the tube steel and rods?

(ii) Was the yield strength of the materials considered to be variable?

(iii) If not, why not?

(16) Provide the test data report(s) for the A-490 bolts, SA-36 threaded rods, and tube steel materials which were utilized in the test(s).

(17) Provide any and all documentation that the 4600 psi concrete utilized in the test was representative of concrete at Comanche Peak.

(18) Provide any and all documentation for your answers to (2), (3), (5) through (10), (12), (14), and (15) preceding.

Response:

Question 16.a.(1): The Gibbs & Hill, Inc. Specification for Concrete, 2323-SS-9, provides that Class A concrete shall be utilized in all structures, unless otherwise indicated in the specification and on the engineering drawings. Class A concrete, as well as Classes B, D, E and F have minimum design strengths of 4000 psi at 28 days. The applicable portion of the Gibbs & Hill specification referenced above is being provided in Exhibit 16.2.

Question 16.a.(2): Yes. The Gibbs & Hill specification also provides that concrete Classes C and G shall have minimum design strengths of 2500 psi and 3000 psi at 28 days, respectively. These classes of concrete are to used only as indicated on engineering drawings. An example of a drawing utilizing different classes of concrete will be provided in Exhibit 16.3.

Questions 16.a.(3), (4): See responses to Questions 16.a.(1) and (2).

Question 16.a.(5): Gibbs & Hill, Inc., the architect/engineer, determines which class of concrete is to be used in different applications.

Question 16.a.(6): The age of the concrete utilized in the test at the time the concrete was tested was 28 days old. This is the same time increment at which all other concretes are tested. The industry standard for specifying strengths of concrete for comparison to design strength is 28 days, as defined in the ACI Code.

Question 16.a.(7): Generally, the strength of concrete increases with age due to the continued cement hydration process.

Question 16.a.(8): The approximately 4600 psi indicated was the approximate average of the field cured cylinders (4610 psi). Laboratory-cured cylinder average strengths for the subject concrete test block was 5590 psi at 28 days.

Question 16.a.(9): The average concrete strength of the structural concrete at CPSES is based on laboratory cylinders, in accordance with the ACI Code.

Question 16.a.(10): Generally, laboratory-cured cylinders will provide higher strengths than field-cured cylinders. Field-cured cylinder strengths are used to monitor the adequacy of the curing and protection of the actual concrete in the structure.

Question 16.a.(11): Yes. By applying a factor of safety to the test results variations in concrete strengths are accounted for. CASE should note that inserts embedded in 2500 psi concrete, if any, would not be used for safety-related supports and, thus, are not relevant.

Question 16.a.(12): Load application on each test specimen was halted before failure occurred, but was considered high enough for comparison with the design load values.

Question 16.a.(13): No. The factor of safety as applied to the test results compensates for any cyclic loading induced by postulated load combinations. Cyclic loads from these combinations are of low frequency and very few cycles.

Question 16.a.(14): The test program was to provide additional data on the performance of Richmond Inserts when loaded in shear. Generally, the tests were performed in accordance with ASME-488-76, with the exception that each test lot was to consist of three test specimens instead of five as outlined in the ASTM. This testing program description was provided to the NRC via TXX-3636, dated 3/25/83, which is being provided as Exhibit 16.4.

Question 16.a.(15): The objective to the test program was to demonstrate the maximum shear strength capability of the Richmond Insert. Due to the test apparatus capacity, the ultimate shear strength of the Richmond Insert was not achieved. It was demonstrated, however, that the Richmond Insert was capable of withstanding at least three times the design allowables for shear loading used in the design at CPSES. In any event, the objective of the test was not to test the steel bolting material performance characteristics. These can be predicted based on conventional steel design criteria and techniques. For this reason, the tests did not focus on yield strength of the bolting material.

Question 16.a.(16): Material strength of bolting and steel is not relevant. See response to 16.a.(15). Because the test was to assess the insert capability there was no reason to maintain test data reports for the specific bolts used in the test. Nevertheless, examples of test data reports are provided for A490 and A36 steels in Exhibit 16.1.

<u>Question 16.a.(17)</u>: Test data for concrete strength was taken from a random time period during high volume concrete placement in the power block areas. Test data collected was for cons. utive batching for Class A type concrete. (<u>See also</u> response to Question 18.d.2.)

<u>Question 16.a.(18)</u>: Applicants will provide the applicable portions of standards and other documents referenced in our responses. In addition, Exhibit 16.2 provides documentation of the concrete strength at CPSES, and it is clear that the test block strength is representative of the concrete at CPSES. The data provided refers to mixes 131 and 132 which are the most commonly used concrete mixes in category I structures. (<u>See also</u> response to Question 18.d.2.).

Q17. Affidavit at pages 13 and 14, regarding additional tests done in March and April, 1984.

a. (1) What was the age of the concrete utilized in the test at the time it was tested?

How does this compare with the age of the concrete which Applicants allege actually ranges from 4500 to above 5000 psi?

(2) Was the concrete in excess of 4900 psi utilized in the tests based on a field cured specimen or a lab cured specimen?

(3) Did the tests on the Richmonds take into account the possibility that inserts might be embedded in concrete which was less than 4900 psi (for instance, the stated design strength of 4000 psi, or 2500 psi)?

(i) If not, why not?

(ii) If so, provide any and all documentation regarding such tests.

(4) Was a criteria on maximum shear deflection considered in the test(s)?

(5) Was a cyclic load test considered using the current allowable?

(i) If not, why not?

(ii) If so, provide any and all documentation regarding this.

(6) Why were only 30 specimens tested?

(7) (i) What was the yield strength of the tube steel and rods?

(ii) Was the yield strength of the materials considered to be variable?

(iii) If not, why not?

(8) Provide the test data report(s) for the A-490 bolts, SA-36 threaded rods, and tube steel materials which were utilized in the test(s).

(9) Provide any and all documentation that the concrete with an average compressive strength in excess of 4900 psi which was utilized in the test was representative of concrete at Comanche Peak.

(10) What was the rationale for utilizing concrete with a concrete strength of approximately 4600 psi for the earlier tests, but utilizing concrete with an average compressive strength in excess of 4900 psi for the later tests?

(11) Provide any and all documentation of your answers to (1) through (7) and (10) preceding.

Response:

Question 17.a.(1): See response to Question 16.a.(6).

Question 17.a.(2): The specified value of 4900 psi was based on field-cured cylinders. The laboratory-cured strengths averaged 5460 psi.

Question 17.a.(3): See response Question 16.a.(11).

Question 17.a.(4): These tests were performed to ultimate load carrying capability, unless the test apparatus prevented this load from being achieved.

Question 17.a.(5): See response to Question 16.a.(13).

Question 17.a.(6): The test was performed per ASTM I488-76. This ASTM provides the number of test specimens to be tested.

Question 17.a.(7): The object of the test was to demonstrate the strength capabilities of the Richmond Inserts when loaded in tension, shear and combined shear and tension.

Bolt and steel performance can be predicted based on conventional steel design criteria and techniques. Thus, these characteristics were not evaluated separately in the tests.

Question 17.a.(8): Material strengths of the bolting material and steel is not relevant. See response to subpart (7) and responses to Question 16.a.(15) and (16).

Question 17.a.(9): See response to Question 16.a.(17).

Question 17.a.(10): These strengths are the strengths of the specific test blocks and represent the strength scatter that is associated with the variability of heterogeneous material.

Question 17.a.(11): Applicants will provide documentation referenced above which has not previously been provided.

Q18. Affidavit at page 16, last paragraph on page, continuing on page 17:

a. (1) Isn't it a fact that in some instances reinforcing steel was left out of concrete pours at Comanche Peak?

(2) If the answer is yes, provide a summary of each such instance. Identify each as to where the instance occurred (for instance, Unit 1

containment, Unit containment, etc.) and provide all other relevant details (such as elevation, how and why the omission occurred, who was responsible for the omission's having occurred, whether or not the area is safety-related, etc.).

(3) If the answer is yes, provide any and all documentation regarding <u>each</u> such instance.

b. Were any Richmond Inserts installed in any area where reinforcing steel was left out?

(1) Provide any and all documentation for your answer.

(2) If the answer is yes, provide a summary of how many inserts are installed in <u>each</u> location where reinforcing steel was left out. Provide all other relevant details and any and all documentation for your answer.

c. Were any tests performed with <u>no</u> reinforcing steel in the concrete?

(1) If not, why not?

(2) If the answer is yes, provide a summary of all results.

(3) If the answer is yes, provide any and all documentation regarding such test(s).

d. Applicants stated:

> "Applicants have conducted a review of a representative sample of test reports of concrete used at CPSES to assure that such concrete is essentially the same as that used in the tests."

(1) Who (names, titles, organizations) conducted the review?

(2) Provide any and all documentation that the sample reviewed was representative of the concrete used at CPSES.

(3) Please qualify what is meant by the phrase "essentially the same" as it is used in the above-quoted sentence.

(4) What was the result of Applicants' review?

e. Applicants state:

"In addition, Applicants have reviewed NCRs regarding concrete at CPSES to provide additional assurance that the concrete used in these tests was representative of that used in CPSES. From our review, we conclude that test conditions are representative of conditions at CPSES."

(1) Who (names, titles, organizations) reviewed the NCR's?

(2) Did their review include any of the NCR's discussed in Attachment D to CASE's Answer to Applicants' Motion for Summary Disposition Regarding Richmond Inserts (sent under cover letter dated 1/12/84)?

   (i) Provide any and all documentation for your answer.

   (ii) If the answer is yes, specify which of those NCR's were reviewed.

(3) List each and every NCR reviewed by Applicants.

(4) Provide copies of each of the NCR's reviewed by Applicants (original and all revisions and all attachments), as well as any additional documents related to such NCR.

(5) For each of the NCR's listed in (3) preceding, provide the following information:

   (i) In dispositioning the NCR, was the Swiss hammer test or equivalent used?

   (ii) If the answer to (i) above is yes, what was the basis for accepting the results?

   (iii) If the answer to (i) is yes, how was the Swiss hammer (or equivalent) calibrated?

   (iv) If the answer to (i) is yes, who (names, titles, organizations) performed the Swiss hammer (or equivalent) tests?

   (v) If the answer to (i) is yes, who (names, titles, organizations) interpreted the results of the Swiss hammer (or equivalent) tests?

   (vi) Was each and every concrete pour listed on the NCR retested?

(a) Provide any and all documentation for your answer.

(b) If the answer is no, why not?

(c) If the answer is yes, what was the result of each retesting?

Provide any and all documentation for your answer.

(d) If the answer is no, were any pours dispositioned "use as is", although the strength was below the design strength?

Provide any and all documentation for your answer.

(6) Provide any and all documentation that the NCR's reviewed by Applicants "provide additional assurance that the concrete used in these tests was representative of that used as CPSES".

(7) Who (names, titles, organizations) decided which NCR's would be reviewed?

(8) What criteria was utilized to decide which NCR's would be reviewed?

(9) Provide any and all documentation that the NCR's reviewed contained information on concrete pours which are representative of the concrete used at CPSES.

(10) Provide a listing of all designations for concrete pours which indicates which building and unit is designated by the numbering system; also indicate whether or not each such pour is safety-related (the type of listing we are looking for is something like: 101- at the beginning of the concrete pour number is the designation for Unit 1 containment, which is safety-related; 201- at the beginning of the concrete pour number is the designation for Unit 2 containment, which is safety-related; etc.). Also include an explanation of what the rest of the numbers in concrete pour number designates.

Response:

Question 18.a.(1): There have been some instances where reinforcing steel has been left out of concrete pours at CPSES.

Question 18.a.(2): A summary of instances of rebar omission is provided as Exhibit 18.1. This exhibit lists where the rebar was omitted, i.e., building, elevation, how the omission was disposed of, and the NCR number which pertains to each particular instance. In all of these instances the area is safety-related. "Responsibility" for the omission is not relevant.

Question 18.a.(3): The NCR's listed in Exhibit 18.1 will be forwarded separately as Exhibit 18.2.

Question 18.b.: Applicants are aware of Richmond inserts being installed where some reinforcing material (either steel or ties) has been omitted. We are presently reviewing those areas where the rebar omission was dispositioned "use as is" to ascertain the extent of Richmond Inserts present in those areas. Applicants note that although some reinforcing material may have been omitted, this does not mean that all reinforcement is missing.

Question 18.b.(1): Documentation of our answer will be provided as Exhibit 18.3. This exhibit shows the areas covered by NCR's C-267, C-669, C-763, C-806, C-809, C-815, C-1155, C-1275, C-1653, and C-82-1079.

Question 18.b.(2): No.

Question 18.c.: No tests on Richmond Inserts have been performed by Applicants with unreinforced concrete. The tests performed by the Richmond Screw Anchor Co. at the Polytechnic Institute of Brooklyn in 1957 were done in concrete test blocks with moderate surface reinforcement.

Question 18.c.(1): There were no tests performed by Applicants on unreinforced concrete because Richmond Inserts at CPSES were not intended to be utilized as safety-related supports in areas where the concrete is not reinforced. As noted above, disposition in accordance with normal non-conformance procedures is required if such use occurs.

Question 18.c.(2), (3): Not applicable.

Question 18.d.(1): Mr. Richard Kissinger of TUGCO, who at that time was the Project Civil Engineer, and Mr. John Eichler of Gibbs & Hill conducted the review.

Question 18.d.(2): The test reports which were reviewed are those of laboratory cured cylinders for concrete mixes of Class A concrete, which is used in Category I structures. The most commonly used mixes are Mix ID 131 and 132, Class A Regular. Mix 132 is what was employed in the tests. Applicants also reviewed mixes 128 and 129 which are used in areas of extreme rebar congestion. The review consisted of taking samples of 30 consecutive tests for each mix to determine the average strength and its standard deviation. The 30 consecutive tests were chosen amongst the most recent tests which are included in the design data presented as Exhibit 16.2 (Exhibit 16.2 shows the test data for Mix ID 131 and 132).

Question 18.d.(3): No two concretes are exactly alike because concrete is a non-homogeneous mixture with aggregate size, water and cement admixture which varies within specified limits. The variability in the concrete is clear from the reports provided in Exhibit 16.2.

Question 18.d.(4): The results of the review were that the concrete used in the test blocks was "essentially the same" (i.e., being of the same mix design and similar compressive strength) as used in the plant.

Question 18.e.(1): Mr. Richard Kissinger also reviewed the NCR's.

Question 18.e.(2): The review of the NCR's was conducted to determine the frequency with which laboratory cured cylinders violated minimum compressive strength requirements. No particular attention would have been paid to CASE's Attachment D NCR's (or DDR's and CAR's), because each of those was written to document violations of criteria for acceptance of field curing practices and or water metering, violations not relevant to this inquiry.

Question 18.e.(3): The list of NCR's which were reviewed will be forwarded as Exhibit 18.4. Applicants are presently gathering that material. These are the NCR's pertaining to the strength failure of the laboratory cured cylinder.

Question 18.e.(4): Copies of each of the NCR's included in the list referenced in (3) above will be provided as Exhibit 18.4.

Question 18.e.(5)(i): The disposition of each NCR is given in the NCR package itself. Swiss hammer tests would be used to disposition deviations due to field curing practices and not laboratory curing practices. Swiss hammer tests are not relevant to the NCR's that were reviewed.

Question 18.e.(5)(ii)-(v): No.

<u>Question 18.e.(5)(vi)</u>: Applicants are gathering this information.

<u>Question 18.e.(6),(8)</u>: The criterion utilized to decide which NCR's should be reviewed was that the NCR's should deal with understrength, laboratory-cured cylinder tests. The objective of the criterion was to determine the frequency of the test failures. If the failures are few, then the mix design data provided in Exhibit 16.2 can be relied on to be truly representative of the concrete at CPSES. Thus, the NCR review was intended to provide the assurance that the design mix data that was used to determine the test block concrete mix was representative of the concrete at CPSES. In this sense the NCR's reviewed by Applicants' "provide additional assurance that the concrete used in the tests is representative of that used at CPSES."

<u>Question 18.e.(7)</u>: Mr. Richard Kissinger determined which NCR's should be reviewed.

<u>Question 18.e.(8)</u>: See answer to e.(3) above.

<u>Question 18.e.(9)</u>: Such documentation is contained in the NCR's.

<u>Question 18.e.(10)</u>: The listing of all designations for concrete pours is provided as Exhibit 18.3.

Q20. Affidavit at page 23, last paragraph, continuing on page 24:

a. How was the sample selected which is shown in Table 1?

b. What is the source of the sample of 90%?

c. What criteria is there which would require the inclined bolt or offset bolt to be shown on the drawing?

d. What criteria was there to determine whether a support "may be primarily loaded in torsion or shear"?

e. What was the rationale for including only supports which "may be primarily loaded in torsion or shear"?

f. Why wasn't consideration also given to those supports which had primarily tension and were close to allowables but the additional stresses were not accounted for?

g. Provide any and all documentation that the supports listed in Table 1 are representative of what actually exists at Comanche Peak.

h. Provide any and all documentation for your answers to a. through f. preceding.

Response:

Question 20.a.: There are two sources for the supports in Table 1. Most of the supports are the result of a drawing review conducted on site in which we identified supports which utilized a single tube attachment loaded in torsion or shear. In addition supports were added to Table 1 by NPSI. These supports had been identified in a previous review of 60 supports for the SIT (see Affidavit at pages 40 and 41).

Question 20.b.: The 90% is not a sample. It is a statement of fact. Only 10% of the supports listed in Table 1 have significant eccentricities. CASE can verify this for themselves by totalling the eccentricity columns of Table 1 and noting that only 13 or 14 instances have significant eccentricities out of 157 supports (in excess of 3/8" for 4 x 4 TS and 1" for other TS sizes).

Question 20.c.: There are two mechanisms to bring an inclined bolt to engineering's attention: (1) an NCR might be

generated by QC inspectors because, for instance, the bolted parts do not have a proper fit, and (2) craft may be unable to install the tube steel due to an inclined bolt and would return the package to appropriate personnel for resolution. Either of these mechanisms may result in the inclination being shown on the drawing.

Question 20.d.: For the majority of the supports in Table 1, i.e., single tubes, no criteria was necessary because it is an easy matter to determine whether it is loaded in shear or torsion.

Question 20.e.: Bending of the bolt is caused by shear or torsion. We evaluated the supports where these loads are the primary loads.

Question 20.f.: The impact of original modelling of the torsional resistance of the assembly is most pronounced for configurations where shear and/or direct torsion are large or dominant. Supports which are primarily loaded in tension, particularly if close to allowables, would have small or negligible shear contribution.

This is best illustrated by the following example which utilizes the method of analyses used in original design and then compares these results with what one would have concluded using the method described in the Affidavit. Consider, for instance, a 4 x 4 x 3/8 tube steel which is loaded as shown in the sketch, and that the bolts are subjected primarily to tension. Assume that the bolt material is A36 and that the bolt is 1-1/2" in

diameter. The tension in the bolt is the external tension load plus the incremental tension resulting from coupling out any torsion or bending resulting from shear. By the initial design method (see Attachment D to the Affidavit) the incremental tension value was derived by assuming that the torsion or bolt bending would be reacted by a couple acting through an arm length equal to the distance from the bolt centerline to the centroid of the concrete compression block assumed to extend from the neutral axis to the edge of the washer. By the simplest revised evaluation method, the arm length is reduced to the distance from the bolt centerline to the tangent point of tube steel and washer. More accurately, the torsion and shear are resolved in both increased tension (but lower than computed by the simplest revised evaluation method) and a bending moment carried by the bolt. We shall refer to the original method of design as method 1, the second method which is the same as the original method but with the use of the actual arm length as method 2, and finally to the most precise method as method 3. Table 1 below illustrates why shear loads would have to be small in order for supports which are primarily loaded in tension and are close to allowable values to be acceptable by the original method of design (method 2). This table takes the example tube steel and shows how tension and shear contributions to interaction ratios close to allowables vary as a function of externally applied tension and shear load ratios.

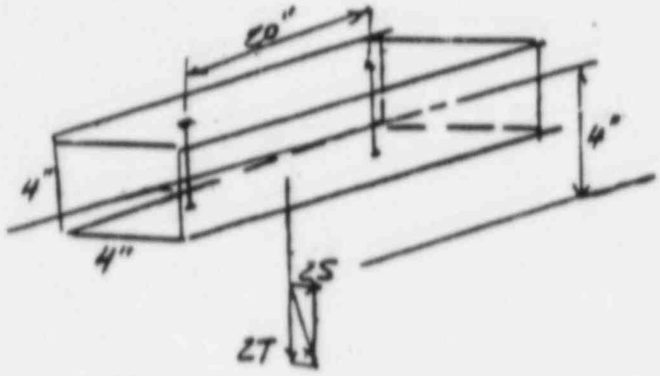

TABLE 1

External T	External S	$\frac{S}{T}$x(100%)	Total T	$\left(\frac{T}{To}\right)^2$	$\left(\frac{S}{So}\right)^2$	I.R	Comments
18000	1800	10	25841	.84	.010	.85	
18000	900	5	21920	.60	.003	.60	
18000	2700	15	29761	1.13	N/A	1.13	Not acceptable as designed
18000	2250	12.5	27801	.972	.016	.988	
15000	1500	10	21534	.760	.0073	.767	
15000	3000	20	28068	.991	.029	1.02	Not acceptable as designed
15000	2250	15	24801	.773	.016	.789	
12000	3600	30	27680	.963	.042	1.004	Not acceptable as designed
22500	900	4	26205	.864	.003	.867	

It is clear from the table that for the support to be primarily loaded in tension and be close to the allowables, but be acceptable, the external tension must be high and shear must be limited to about 12 percent of the tension. Higher shears coupled with high tensions would have resulted in unacceptable designs.

Table 2 shows how the interaction ratio would change for those cases of high tension and high interaction ratios when method 2 is applied. It also shows, by contrast, how the interaction ratio would change for those supports which are primarily loaded in torsion/shear, i.e., those examined by Applicants in the Affidavit.

TABLE 2

External T	External S	Total T	Original IR (Method 1)	IR (Method 2)	% Change
18000	1800	28080	.85	1.001	17.7
22500	900	27540	.867	.955	10.2
9000	3600	29160	.861	1.111	29.0
3000	3600	23080	.546	.709	29.8
0	3600	20160	.378	.552	46.0

It is evident that the higher the shear/torsion the higher is the percentage change in interaction ratio, and the larger is the possible impact of underestimating the torsional resistance of the Richmond. By the more accurate method of considering that a

fraction of torsion or shear goes directly into bolt bending, the correctness of selecting supports primarily loaded in torsion or/and shear is even more evident.

Table 3 examines the same cases as Table 2 but employs the interaction formula given in page 27 of the Affidavit. The computation of the interaction ratio for Table 3 is performed as described in pages 25 through 27 of Applicants' Affidavit.

TABLE 3

Ext. T	Ext. S	Total T	Orig IR	New IR	OK/Not OK
18000	1800	24209	.85	1.535	OK
22500	900	25605	.867	1.22	OK
9000	3600	21418	.861	2.17	Not OK
3000	3600	15418	.546	1.89	Not OK
0	3600	12418	.378	1.74	OK

Table 3 illustrates that acceptable loading conditions which had relatively high shear and torsion are no longer acceptable, whereas those characterized by high tension but relatively low shear are acceptable. This confirms that shear and torsion are the most significant parameters and demonstrates that Applicants' decision to examine those supports having high shear and/or torsion was correct.

Question 20.g.: These supports are the actual supports primarily loaded in torsion or shear. There is no sample involved and, thus, no question of representativeness.

Question 20.h.: Table 1 is a compilation of the documentation for the response to Question 20.a. There is no separate documentation for the responses to Questions 20.b.-f.

Please note that we have generated and provided the tables in response to Question 20 as examples. These numbers have not been independently verified. We do intend to have the numbers checked and will apprise all parties if any errors are identified.

Q24. Affidavit at page 39, second paragraph:

a. What was the basis of the sample?

b. Provide any and all documentation that this sample is representative of the rest of the plant.

c. Provide any and all documentation for each of your answers to a. preceding.

Response:

Question 24.a.: The basis for the sample was to select several supports with varying configurations which could be used to determine the effect of releasing the Mx moment on deflections, member stresses and anchor bolt interactions. The supports were selected by reviewing many frame type supports with Richmond Inserts. We identified several frames with various configurations which we believe are typical of supports in the plant.

Question 24.b.: There is no separate documentation.

Question 24.c.: See answer to a. and b.

Q26. Affidavit at page 10, continuing on page 11:

a. Provide the tests which Applicants commissioned ITT Grinnel to carry out on U-bolt capability to carry both normal and lateral loads; also provide any and all documentation regarding such tests.

b. Provide the tests which NPSI had run in 1975 on the lateral load capability of U-bolts.

Response:

Question 26.a. and b.: Although Applicants' affidavit called Attachment 1 and Attachment 2 the "results" of the ITT Grinnell and NPSI testing, Attachments 1 and 2 were the actual

complete test reports. There is no better information that we could supply. Applicants have not summarized the test data, but have already supplied the complete test reports. In addition, we are supplying the purchase order documentation related to the ITT U-bolt testing as Exhibit 26.1. The NPSI testing was not originally performed for Applicants and, thus, we do not have additional backup material for those tests.

Respectfully submitted

William A Horin / DAR

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Counsel for Applicants

July 1, 1985

State of TEXAS
County of SOMERVELL

John C. Finneran, Jr., being first duly sworn deposes and says:

That he is the pipe Support Engineer, Pipe Support Engineering Group for Comanche Peak Steam Electric Station and knows the contents of the foregoing Applicants' Third Partial Response to CASE's Fifth Set of Interrogatories RE: Credibility; that the same is true of his own knowledge except as to matters therein stated on information and belief, and as to that he believes them to be true.

John C. Finneran Jr.

John C. Finneran. Jr.

Robert C. Iotti, being first duly sworn deposes and says:

That he is Vice President of Advanced Technology for Ebasco Services, Inc. and knows the contents of the foregoing Applicants' Third Partial Response to CASE's Fifth Set of Intergoratories Re: Credibility; Requests; that the same is true of his own knowledge and belief, and as that he believes them to be true.

Robert C. Iotti

Robert C. Iotti

State of TEXAS
County of SOMERVELL

Subscribed and sworn to before me this 28th day of June, 1985.

Bill J. Hodges

Notary Public
MY COMMISSION EXPIRES MARCH 28, 1988

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket Nos. 50-445 and 50-446
TEXAS UTILITIES ELECTRIC COMPANY, ET AL.	)	
	)	
	)	(Application for Operating Licenses)
(Comanche Peak Steam Electric Station, Units 1 and 2)	)	
	)	

CERTIFICATE OF SERVICE

I hereby certify that copies of "Applicants' Third Partial Response to CASE's Fifth Set of Interrogatories Re: Credibility" in the above-captioned matter was served upon the following persons by express mail (*) or deposit in the United States mail, first class, postage prepaid, this 1st day of July, or by hand delivery (**) on the 2nd day of July, 1985.

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