ATTACHMENT 2

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)	)	

APPLICANTS' STATEMENT OF MATERIAL
FACTS RELATING TO RICHMOND INSERTS
AS TO WHICH THERE ARE NO MATERIAL ISSUES

1. CASE has raised six allegations concerning Richmond inserts. These allegations relate to (1) the factor of safety used for Richmond inserts, (2) testing of Richmond inserts, (3) the ability of Richmond inserts to resist axial torsion, (4) methods used to analyze connections, (5) bending moments in the bolts, and (6) sharing of shear loads. Affidavit of John C. Finneran, Jr., Robert C. Iotti and R. Peter Deubler, Regarding Design of Richmond Inserts and Their Application To Support Design ("Affidavit") at 2-3.

2. In the manufacturer's literature regarding Richmond inserts, based on testing, the manufacturer specified the ultimate loads associated with the various sized inserts. In addition, the manufacturer selected a factor of safety, and back-calculated the corresponding allowable loads, i.e., the ultimate load divided by the safety factor is equal to the allowable load. This factor of

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safety and corresponding recommended allowable loads specified by the manufacturer apply only to the Richmond insert itself and not to the threaded rod (sometimes used interchangeably with bolt) which may be procured separately. Allowables for the threaded rod are those set forth in appropriate Codes, e.g., for A-36 threaded rod the allowed load in shear is 17.7 kips. Id. at 4.

3. In its design calculations, Applicants used higher allowable loads for the inserts than specified by the manufacturer. Accordingly, if the ultimate loads recommended by this manufacturer were applicable to Applicants' use of the inserts at CPSES, it could be viewed that Applicants had reduced the factor of safety recommended by the manufacturer. Id.

4. The current allowable recommended loads for the inserts by the Richmond Screw Anchor Co. are based on tests conducted at the Polytechnic Institute of Brooklyn in 1957. Id. at 5.

5. Data from the manufacturer's tests reflect that failure in all shear tests and the 1-1/2 inch tension tests occurred due to failure of the anchor stud bolts, not failure of the inserts. Failure in the 1 inch tension test occurred due to failure of the insert by concrete cone pullout.

6. Failure of the insert can generally be equated with failure in the concrete resulting in a cone of concrete being pulled out ("concrete cone pullout".) Even if failure by internal damage of the insert occurs instead of concrete cone pullout, the load at which it occurs is essentially the same at which concrete cone pullout would occur. Id. at 5-6 and Attachment B.

7. Allowable loads and factors of safety concerning the threaded rods (bolts) used with the inserts are established by Code and adhered to by Applicants. Id. at 6-7.

8. The major factor affecting concrete cone pullout is the strength of the concrete in which the inserts are placed. Significantly, the manufacturer's tests were conducted with concrete which had a strength of between 2850 and 3220 psi (approximately 3000 psi). While the concrete at CPSES is designed for 4000 psi, it actually ranges from 4500 to above 5000 psi. Id. at 7.

9. From conservative calculations, the additional strength of the concrete of CPSES results in a much higher ultimate failure load of the insert than established by the manufacturer's tests. Accordingly, use of allowable loads higher than recommended by the manufacturer was justified based on the higher ultimate loads for the particular circumstances at CPSES, and the safety factor specified by the manufacturer would be essentially met. Id. at 7-11.

10. The low strength threaded rods/bolts, used in the vast majority of all Richmond inserts of concern, have lower allowable loads than the allowable loads for the Richmond inserts used in the CPSES design. Accordingly, for the allowable loads for pure tension or shear, the governing limits on design would not be the allowables for the inserts, but rather (in most cases) the allowable loads of the threaded rods. Id. at 10.

11. Shear tests were conducted at CPSES on 1-1/2 inch Richmond inserts in March 1983. The results of the tests indicated that the performance capabilities in shear of the Richmond inserts used at CPSES exceed the design allowables by a ratio in excess of 3.3 to 1. Because the tests did not go to failure, the actual ratio is higher and the results are conservative. Id. at 11-12.

12. Test results for the specimens with and without the 1 inch washer were comparable, indicating that the presence of the washer has little effect on the performance of the threaded connection/bolt or the Richmond insert. If any bending stress is introduced in the bolt as a result of the 1 inch thick washer, the tests results show that it is not significant. Id. at 12.

13. Applicants performed another series of tests in March and April, 1984. These tests were performed to determine the load carrying characteristics of 1-1/2 and 1 inch Richmond inserts (the inserts of concern) when subjected to tension only, shear only and combined shear and tension loadings. The test results confirm the judgment of Applicants that (1) shear and tensile ultimate capacities are nearly the same and (2) the actual factors of safety are in excess of 3.0 for shear, tension and combined shear-tension loadings. Id. at 13-16.

14. The concrete used in the tests was representative of concrete in the plant. 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. 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 at CPSES. Id. at 16-17.

15. To be very conservative, the tests conducted in March 1984 employed two layers of reinforcement rods rather than 4 layers used in the prior test and at CPSES. The capacities of the Richmonds were not impaired even with this reduced rebar. Id. at 17.

16. The difference in reinforcement in the concrete (a concern expressed by CASE) is not significant when compared to other factors. If rebar was a dominant factor, it would be evident from a comparison of the results of the March 1983 tests (using 4 layers of rebar) and the March 1984 tests (using 2 layers of rebar). However, a comparison of those results (including bolt deflections) indicates that the amount of rebar is not a significant factor. Id.

17. To study the validity of Applicants' use of its calculational methodology, Applicants performed detailed finite element analyses utilizing the STARDYNE computer program. The results of the analyses indicate that the formulas used by Applicants did not precisely model the resulting forces. The formulas used by Applicants to calculate axial torsion resulted in a calculated force that was low for all but six supports by as much as 18 percent (in six specific supports it was low by 33%). However, because of conservatism in the methodology and process used, in all cases allowables would not have been exceeded. Id. at 21-24.

18. In the process of performing the finite element analyses, regarding axial torsion, Applicants noted that when it was assumed that no clearance existed between the tube steel and the bolt, a shear couple is created which places the bolt in bending. The effect becomes pronounced when the bolt holes are offset to their largest values. To investigate the possible adverse effects on the connections, Applicants developed a screening criterion based on very conservative assumptions. The factors of safety inherent in the methods of calculation employed to establish the criterion are in excess of 10. Id. at 24-5.

19. The results of the evaluation of the conservative criterion, coupled with subsequent testing, reflected that with regard to this bending moment in the bolts, there is no safety concern with these connections. Id. at 27-30.

20. CASE agrees that the moment in the tube (M_y) about the axis of the bolt cannot develop. However, CASE states that the moment Mz (which would tend to produce prying action, if any), should either be considered whenever the moment which produced torsion (M_x) is considered, or both M_x and M_z should be released. CASE states further at VIII-6 that "the ability to rotate about the local Z axis is inhibited; therefore, prying (moment coupling) exists." Id. at 31-2.

21. For attachment assemblies under axial loads, that is, subjected to a pure M_z moment, a finite element analysis performed by Applicants demonstrates that the displacement of the tube due to bolt elongation (along the Y direction) is sufficient to cause

loss of contact with the washer. Thus, there is no prying action. For pure axial loads, i.e. loads applied to the tube steel between Richmond inserts in the Y direction, there is no prying action and the release of the moment about the Z axis is the correct way to model the joint. Id. at 33-4.

22. A parametric study of the loading was performed to analyze the effect of bending moment M_z on the prying action which occurs due to the torsional load. The results of the study reflect that no prying action will occur. Id. at 34-36, note 13.

23. Applicants have reanalyzed several support configurations selected at random assuming that all moments would be released, as CASE recommended. The results reflect that adequate margins exist, even assuming fully released moments. Id. at 39.

24. Bending of the bolt is not considered by the ASME Code, because in conventional bolt connections, bending is not significant. In reality, however, bending can occur. Id. at 40.

25. Applicants have conducted detailed analyses regarding the ability to resist axial torsion. The results of these analyses reflect that due to the conservatism of the calculational methodology, bending does not present a safety concern with these connections. Id. at 40-1.

26. The results of tests reinforce Applicants' conclusion that deflection of the supports at the design loads are very small regardless of whether the load is applied torsionally or as a shear, and that ample margin exists. Id. at 41-2.