UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

APPLICANTS' MOTION FOR SUMMARY
DISPOSITION OF CASE'S ALLEGATIONS
REGARDING CINCHING DOWN OF U-BOLTS

Pursuant to 10 C.F.R. § 2.749, Texas Utilities Electric Company, et al. ("Applicants") hereby move the Atomic Safety and Licensing Board ("Board") for summary disposition of the Citizens Association for Sound Energy's ("CASE") allegations regarding Cinching Down of U-bolts. As demonstrated in the accompanying affidavit of R.C. Iotti and J.C. Finneran, Jr. Regarding Cinching Down of U-Bolts ("Affidavit") (Attachment 1) and Statement of Material Facts (Attachment 2), there is no genuine issue of fact to be heard regarding this issue. Applicants urge the Board to so find, to conclude that Applicants are entitled to a favorable decision as a matter of law, and to dismiss this issue from this proceeding.

I. BACKGROUND

In August, 1982, intervenor CASE deposed Mr. Jack Doyle, a former employee of Applicants, with respect to certain allegations Mr. Doyle had regarding the design of pipe supports at Comanche Peak. Mr. Doyle's deposition was subsequently admitted into the record in this proceeding as his testimony (CASE Exhibit 669; Tr. 3631). One issue raised by Mr. Doyle concerned the impacts of cinching down of U-bolts. CASE Exhibit 669 at p. 201-202, 206-213. All parties presented testimony on this issue, e.g., CASE Exhibit 763 Item 11-14, Applicants Exhibit 142F at 5 and NRC Staff Exhibit 207 at 31-34.

Following litigation of the pipe support design allegations, each of the parties submitted proposed findings addressing, inter alia, allegations regarding cinching down of U-bolts. (See Applicants' Proposed Findings of Fact Concerning Pipe Support Design Questions (August 5, 1983) at 47-50; NRC Staff's Proposed Findings of Fact (August 30, 1983) at 53-56; CASE's Proposed Findings of Fact and Conclusions of Law (August 22, 1983), Section IV; and Applicants' Reply to CASE's Proposed Findings of Fact and Conclusions of Law (September 6, 1983) at 17-19).

In its Memorandum and Order of December 28, 1983 concerning design issues at 25-28 and 33-41, the Board stated that the record was not adequate to provide reasonable assurance that U-bolts would provide the appropriate clamping force to prevent instability without adversely impacting the piping system or the U-bolts. By Memorandum and Order of February 8, 1984 at 19-26, the Board reaffirmed its earlier decision.

This motion addresses CASE's concerns regarding the impact of cinching down of U-bolts, as set forth in its Proposed Findings of Fact at Section IV and summarized in the Board's December 28, 1983 and February 8, 1984 Orders. In responding to these concerns, Applicants provide the information which they committed to generate as part of Applicants' Plan to Respond to Memorandum and Order (Quality Assurance for Design) ("Applicants' Plan") at 5-6, items 3, 4 and 5 (February 3, 1984).

II. APPLICANTS' MOTION FOR SUMMARY DISPOSITION

A. General

Applicants have previously discussed the legal requirements applicable to motions for summary disposition in their "Motion for Summary Disposition of Certain CASE Allegations Regarding AWS and ASME Code Provisions Related to Welding," filed April 15, 1984 (at 5-8), incorporated herein by reference.

B. CASE's Allegations Regarding Cinching Down of U-bolts Should Be Summarily Dismissed

In Section IV of its Proposed Findings, CASE makes allegations regarding this issue which may be categorized into the following three basic areas:

1. The stability of cinched-down U-bolt clamping assemblies to include the maintenance of adequate clamping forces (see the December 28, 1983 Memorandum and Order at 27-28 and 33, and the February 8, 1984 Memorandum and Order at 20-23).

2. The impact of forces and stresses induced in the U-bolt itself (see December 28, 1983 Memorandum and Order at 33-5, and February 8, 1984 Memorandum and Order at 24-5).

3. The impact of forces and stresses induced in the pipe by the cinching down practice (see December 28, 1983 Memorandum and Order at 33-40, and February 8, 1984 Memorandum and Order at 25-6).

In responding to these concerns, Applicants committed to provide the following information (see Applicants' Plan to Respond to Memorandum and Order (Quality Assurance for Design) at 5-6 (items 3, 4 and 5)):

"3. Provide evidence that the use of U-bolt cinching is appropriate to eliminate potential local instability without introducing adverse effects in the piping and the U-bolt itself."

"4. Provide evidence that there are no adverse long-term effects from U-bolts caused by heat-up and cooldown and related friction on the pipe."

"5. Provide evidence of the acceptability of stresses on pipes caused by thermal expansion in local areas around cinched U-bolts."

While the primary method used to obtain this information is testing, Applicants recognized that testing could be performed on only a limited number of test specimens. Therefore, Applicants have also performed finite element analyses to obtain additional data. Affidavit at 3-4. The results of this analytical and testing program and associated evaluation are set forth in the attached Affidavit.[1]

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1 In addition, the Affidavit clears up two apparent misunderstandings that the Board exhibited in its December 28, 1983 Memorandum and Order regarding (1) the use of U-bolts in the plant (Affidavit at 4-5) and (2) the use of SA-307 and SA-36 material as friction type connections loaded in shear (Id. at 5-8).

As set forth more fully below, none of CASE's four concerns raises an issue that reflects a breakdown in Applicants' Quality Assurance ("QA") Program or a safety concern in the plant. Accordingly, no genuine issue of material fact exists with respect to these allegations, and the Board should find that the Applicants are entitled to judgment as a matter of law.

1. The Testing Program

In that the tests (and corresponding finite element analyses) rely on assumptions regarding the torque applied to U-bolts in the plant, to assure that the tests and analyses accurately represent plant conditions, Applicants conducted a survey of the torque on a representative sample of cinched down U-bolts (see Affidavit at 9-12). From the data, Applicants established that to bound field conditions for 4, 10 and 32 inch pipe, tests should be conducted with preload (torque on bolts) varying from 5 to 60 ft-lbs., 10 to 100 ft-lbs., and 20 to 240 ft-lbs., respectively. Id. at 10. In all cases, the likelihood of exceeding these values in the field is very remote. Id. at 11-12.

Applicants' testing program consisted of seven distinct tests. The objectives and results of the seven tests are summarized below:

a. Torque versus Preload Test (Affidavit at 12-14.)

The objectives of this test were two fold, *viz.*, (1) to establish the relationship between torque applied to a U-bolt nut and the resulting tension in the U-bolt as a function of pipe size, and (2) to determine the strain in a pipe as a function of preload on the associated U-bolt.

The results of the torque versus preload test indicate that for the range of values of concern, a linear relationship of t = KTD exists between the torque imparted to a U-bolt nut and the tension developed in the U-bolt, where t is the applied torque, D is the bolt diameter, T is the tension in the bolt and K is a constant that varies between 0.25 and 0.35. Also, the test reflected that maximum pipe strains (and stresses) caused by preload of the U-bolt are generally found in the circumferential direction, are compressive in nature, and occur generally below the cross piece.

b. Friction Test (*Id.* at 14-18.)

The objective of this test was to determine the force on a U-bolt which is needed to cause slippage between the U-bolt/cross piece assembly and the pipe.

The friction test produced two results, *viz.*, (1) the force required to cause slippage between the U-bolt support assembly and the pipe in the plane of the U-bolt (*i.e.*, the force that produces rotation about the pipe axis), and (2) the coefficient of friction which exists for the U-bolt/cross piece assembly.

c. Load Distribution/Strain Measurement Test (Id. at 18-21.)

The objective of this test was to determine the stiffness of the U-bolt assembly, and accordingly, whether thermal expansion and mechanical loads are directly additive to the preload. Applicants had maintained that while expansion loads are additive to preload, total mechanical loads are not directly additive. The results of this test reflect that the mechanical external loads are not directly additive to preload.

d. Thermal Cycling/Thermal Gradient Test (Id. at 21-25.)

The objectives of this test were twofold, *viz.*, (1) to determine the additional load (and resulting stresses) on a support and pipe caused by differential thermal expansion of the pipe with respect to the U-bolt, and (2) to assess the relaxation of the U-bolt preload caused by long-term temperature cycling in order to determine whether material relaxation effects would reduce the preload to the extent that slipping of the U-bolt/cross piece can occur.

This test provided the thermal load data for use in the finite element analyses. Further, the results of the test reflect that (1) the maximum relaxation of each specimen can be predicted with reasonable assurance, and (2) where there are stresses above approximately 1/2 yield, thermal relaxation will occur rapidly until the stress reaches about 1/2 yield (sufficient to retain an adequate clamping force) and then will stabilize.

e. Creep Test (*Id*. at 25-26.)

The objective of this test was to determine whether long-term temperature exposure could result in material relaxation so that preload would be decreased or lost. The results clearly reflect that after the initial relaxation achieved during thermal cycling, no further relaxation occurs, and at temperatures of concern creep is not a problem.

f. Accelerated Vibration Test (*Id*. at 26-31.)

The objective of this test was to determine whether normal vibration levels in the plant could cause material relaxation, and consequently, loss of preload. In order to simulate 40 years of accumulative effects of piping vibration, this test was run as an accelerated vibration test utilizing vibratory forces varying in frequency from 5 to 200 Hz at an amplitude equal to the maximum expected OBE force for the pipe tested (4000 lbs.) as well as at lower forces (1000-1500 lbs.). The time duration of this test combined with the amplitude of the vibratory (sinusoidal) force resulted in an overall energy input into the test specimen exceeding by orders of magnitude the energy that would be induced by an earthquake (both operating basis and design basis earthquakes). This test simulates conditions far more severe than expected in the plant for normal vibration levels.

The results of the test reflect that after an initial repositioning of the assembly, which reduces the preload a relatively small amount, no further decrease in preload was observed, indicating that the vibration per se had no effect on relaxation.

g. Seismic Test (Id. at 31-34.)

The objective of this test (an auxiliary test to the accelerated vibration test, noted above) was to test the effect on the U-bolt assembly of the peak force for the safe shutdown earthquake, 7000 lbs. Although due to mechanical failure of the test equipment the test was not capable of being totally completed, the results of those portions completed supported determinations in previous tests.

2. Finite Element Analyses

Each U-bolt assembly tested was modeled with a finite element analysis utilizing MSC NASTRAN Version 63. Id. at 42. This computer code was chosen because it is universally recognized and accepted by industry as having the capability of providing analytical solutions that accurately characterize the local stress, gap, friction effects, and plastic material behavior (if any) that are important for assessing the pipe and U-bolt assembly stress, and the support stability. Id. at 42-43.

The objectives of the finite element analysis program were (1) to determine if the pipe would slip, creating an unstable support condition when the hanger support was subjected to the preload, thermal, pressure and mechanical loads that would be expected in the Comanche Peak hanger assemblies; and (2) to calculate pipe and pipe support stresses that could be expected to be experienced by the Comanche Peak U-bolt support assemblies and assess their significance. Id. at 44-45.

The results of the analyses reflect that (1) the U-bolt assemblies would behave stably at and even below the low preload values evaluated in the analyses (below those values generally expected in the field) (Id. at 45-46); (2) maximum stress in the U-bolt as a result of the worst case load combination evaluated compared favorably with test results and demonstrated that stresses in the U-bolts will not cause any adverse impact (Id. at 46-47); and (3) stresses in piping due to preload values expected in the field in conjunction with other loads imposed will not result in any adverse impact. Id. at 47-49.

3. Stability of U-bolt Assemblies

From the testing and finite element analyses, the U-bolt/cross piece assembly can perform effectively as a clamp provided that sufficient preload is established in the U-bolt. Id. at 34, 50 and 71-73. (It should be noted that a clamp also requires preloading.) Further, if the preload level were insufficient, but present in some amount, the U-bolt support would vibrate, but still be capable of supporting the necessary loads, thus behaving "stably." Id. at 34 and 74-75. The results of the finite element analyses support the conclusions of the testing in this regard. Id. at 45-46 and 74-75.

To provide further assurance of acceptable preload values, Applicants will conduct a 100 percent inspection of all cinched down U-bolts on struts or snubbers (a total of 380). Id. at 34. At the time of the inspections, to remove questions regarding stability, Applicants will assure that each such U-bolt is torqued to a level at which the assembly will be stable in the absolute truest sense, i.e., no rotation, and axial movement, if any, is toward the strut. Id. As previously noted, the results of the tests conducted for vibration, seismic response, creep and thermal cycling confirm the capability to maintain the stability of the assembly when preloaded to observed values.

4. Stresses in the U-bolt

From the results of tests, stresses produced in the U-bolts at CPSES would not adversely impact the U-bolts' capability to function. Id. at 36-42, and 50. High stresses in the U-bolts occur only if large preload values are applied (i.e., near the maximum used in the tests) to small diameter U-bolts. Id. Large preload values are generally not present in the plant supports, nor are they needed to assure stability of the supports under seismic excitation. Id. at 40-41. In those instances where high preload torques may be initially present, the characteristic relaxation behavior of the material employed (A-36) will reduce the preload value, and hence, the stresses in the U-bolt, to acceptable levels. Id. Moreover, tests have demonstrated that there is adequate margin between yield and failure of the U-bolts. Id. For instance, these tests showed that for the 1/2-inch U-bolt employed for the 4-inch specimen, the margin is about 2 to 1. Id. The finite element analyses in essence confirmed the results of testing. Id. at 46-47.

To allevaite any concern regarding stress in the U-bolts from preload values exceeding those analyzed, as previously noted, Applicants have committed to a 100 percent inspection program of torques of cinched down U-bolts. Id. at 75.

5. Stresses in the Pipe

Testing reflects that the maximum torques to the U-bolt pipe assembiles can potentially result in high but acceptable local pipe stresses. Id. at 35 and 50. The finite element analyses confirm that piping strasses resulting from U-bolt assemblies and associated loading will not adversely impact plant safety. Id. at 47-50.

6. ASME Code Provisions

While the ASME Code does not provide any direct quantitative guidance regarding local stresses induced by external attachments such as U-bolt clamp assemblies, the acceptance criteria established and met by Applicants in this regard conform with the intent of the ASME Code. Id. at 50-73.

IV. CONCLUSION

For the reasons set forth above, Applicants request that the Board grant Applicants' motion for summary disposition.

Respectfully submitted,

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