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Ref: 10CFR50.90

CPSES-200203192
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File # 236

August 29, 2002

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES)
DOCKET NOS. 50-445 AND 50-446
REQUEST FOR ADDITIONAL INFORMATION REGARDING LICENSE AMENDMENT REQUEST (LAR) 01-012
STEAM GENERATOR TUBE REPAIR USING LEAK TIGHT SLEEVES

REF: 1) TXU Energy Letter, logged TXX-01086, from Mr. C. Lance Terry to the NRC dated October 23, 2001

2) TXU Energy Letter, logged TXX-02107, from Mr. C. Lance Terry to the NRC dated July 23, 2002

Gentlemen:

In Reference 1, TXU Generating Company LP (TXU Energy) submitted proposed changes to the Technical Specifications associated with steam generator (SG) repair using leak tight sleeves at CPSES Unit 1 (License Amendment Request LAR 01-012). Reference 2 provided additional information regarding the subject License Amendment Request as requested by the NRC staff. After review of the proposed submittals, the NRC staff requested additional information. The information requested, as we understand it, and TXU Energy's responses are provided in the attachment to this letter.

The requested change in the Technical Specifications, as provided in Attachment 2, provides a proposed revised Technical Specification page 5.0-16 to supplement LAR-01-012, Reference 1. The safety analysis for proposed changes of LAR 01-012 and

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the determination that the changes in LAR 01-012 do not involve a significant hazard consideration remain valid with the revised Technical Specification page 5.0-16 change provided in this letter. If you have any questions please contact Obaid Bhatty at (254) 897-5839.

I state under penalty of perjury that the foregoing is true and correct.

Executed on July 23, 2002.

Sincerely,

TXU Generation Company LP

By: TXU Generation Management Company LLC,
Its General Partner

C. L. Terry
Senior Vice President and Principal Nuclear Officer

By: Roger D. Walker
Roger D. Walker
Regulatory Affairs Manager

JDS/js
Attachments

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Response to NRC Questions Concerning Hydraulic Equivalency for Leak-Tight Sleeves

Nuclear Regulation Commission (NRC) staff had reviewed results of hydraulic equivalency for leak-tight sleeves. The NRC staff has previously reviewed the laser-welded sleeves, and has compared the leak-tight sleeves against the laser-welded sleeves, and raised some questions. The NRC staff's questions and TXU Energy's responses are as follows:

1. The entrance region of the laser sleeves appears to be expanded within the tube whereas the leak-tight sleeves appears to include a short unexpanded region. Is this correct? What loss coefficients were used? How do these coefficients compare with those from a traditional reference such as Crane Technical Paper 410?

The entrance region for the laser sleeves is indeed expanded while the entrance region of the leak-tight sleeves is not.

Loss coefficients used for calculation are determined from the following correlation for sudden contraction.

$$K = 0.5\left[1-\left(\frac{D_{small}}{D_{large}}\right)^2\right] \tag{1-1}$$

This correlation is used for both the laser sleeves and the leak-tight sleeves. Note that, for the entrance region, D_{small} is the inside diameter of the sleeve (expanded or un-expanded), and D_{large} is the inside diameter of the tube.

Table 1-1 tabulates results of loss coefficients as calculated by the correlation and the Crane Paper 410. As shown, the correlation will yield a higher coefficient than the Crane Paper 410.

Table 1-1 Comparison of sudden contraction loss coefficient between correlation and Crane 410

D_{small}/D_{large}	By correlation	By Crane 410
0.5	0.38	0.33
0.6	0.32	0.28
0.7	0.26	0.22
0.8	0.18	0.13
0.9	0.10	0.04

It is concluded that the correlation yields a conservative calculation of hydraulic equivalency when compared to the Crane 410.

2. A range of expansion/contraction multiplier is identified for "gradual" diameter changes in the leak-tight sleeve analyses. What values were actually used and what is the justification for those values? How do the coefficients compare with those from a traditional reference such as Crane Technical Paper 410?

   The loss coefficient for the gradual contraction is calculated by the following correlation.

$$K = 0.5\left[1-\left(\frac{D_{small}}{D_{large}}\right)^2\right](14.87\tan^3\alpha - 18.9\tan^2\alpha + 9.048\tan\alpha - 0.7287)\left[1-\left(\frac{D_{small}}{D_{large}}\right)^2\right] \quad (2\text{-}1)$$

   The loss coefficient for the gradual expansion is calculated by the following correlation.

$$K = \left[1-\left(\frac{D_{small}}{D_{large}}\right)^2\right](14.87\tan^3\alpha - 18.9\tan^2\alpha + 9.048\tan\alpha - 0.7287)\left[1-\left(\frac{D_{small}}{D_{large}}\right)^2\right] \quad (2\text{-}2)$$

   They are used in calculating loss coefficient directly for the leak-tight sleeves.

   In order to compare with a sudden contraction or a sudden expansion, a multiplier is defined. The multiplier for a gradual contraction appears as follows.

$$M = (14.87\tan^3\alpha - 18.9\tan^2\alpha + 9.048\tan\alpha - 0.7287)\left[1-\left(\frac{D_{small}}{D_{large}}\right)^2\right] \quad (2\text{-}3)$$

   Note that the multiplier for the gradual contraction is a function of both the angle (α) and the diameter ratio.

   The multiplier for a gradual expansion appears as follows.

$$M = (14.87\tan^3\alpha - 18.9\tan^2\alpha + 9.048\tan\alpha - 0.7287) \quad (2\text{-}4)$$

The multiplier for the gradual expansion is a function of angle only. This is because the sudden expansion coefficient takes the following expression.

$$K = \left[1 - \left(\frac{D_{small}}{D_{large}}\right)^2\right]\left[1 - \left(\frac{D_{small}}{D_{large}}\right)^2\right] \qquad (2\text{-}5)$$

The Crane Paper 410 uses the identical correlation as shown above for the sudden expansion.

Table 2-1 tabulates multipliers calculated using Equations (2-3) and (2-4), respectively, for the gradual contraction and expansion. As expected, the multiplier for the gradual contraction depends on angle and diameter ratio while the multiplier for the gradual expansion depends only on angle. For the leak-tight sleeves, it involves two diameter ratios: 0.90 and 0.93. The multiplier for a diameter ratio of 0.90 is 0.66 for the gradual expansion and 0.12 for the gradual contraction. For a diameter ratio of 0.93, the multiplier is 0.37 and 0.05, respectively.

In the submittal, it states that the multiplier for the gradual contraction ranges from 0.37 to 0.66 is thus in mistake. It should state that the multiplier for the gradual contraction ranges from 0.05 to 0.12.

As mentioned above, the multiplier is just tabulated for comparison with the sudden contraction or sudden expansion. Loss coefficient for both gradual contraction and expansion was calculated directly from Equations (2-1) and (2-2).

Table 2-1 Multipliers

Ratio of Diameter	**Angle of Contraction or Expansion**	**Multiplier for Contraction (Calc Note)**	**Multiplier for Expansion (Calc Note)**
0.50	28	0.49	0.66
0.50	18	0.28	0.37
0.90	28	0.12	0.66
0.93	18	0.05	0.37

Note that the Crane Paper 410 does not consider the gradual contraction or expansion. The above correlations for gradual contraction or gradual expansion are taken from Reference 1 that has been used in thermal and hydraulic calculation of steam generators. Idel'chik (Reference 2) also considers gradual contraction and expansion. Table 2-2 presents a comparison between the calculation submitted for review and the calculation by Reference 2 together with sudden contraction and sudden expansion.

Table 2-2 Comparison between correlation and Idel'chik

Ratio of Diameter	Angle of Contraction or Expansion	Loss Coefficient for Gradual Contraction (Calc. Note)	Loss Coefficient for Gradual Contraction (Idel'chik)*	Sudden Contraction Loss Coefficient	Loss Coefficient for Gradual Expansion (Calc. Note)	Loss Coefficient for Gradual Expansion (Idel'chik)	Sudden Expansion Loss Coefficient
0.50	28	0.185	0.143	0.375	0.369	0.160	0.563
0.50	18	0.104	0.188	0.375	0.208	0.090	0.563
0.90	28	0.011		0.093	0.023		0.035
0.93	18	0.003		0.066	0.006		0.017

* Note: Trend of loss coefficient by Idel'chik is peculiar for the gradual contraction; the loss coefficient increases with a decrease in contraction angle.

It appears that current correlations yield results that are conservative when compared to those by Idel'chik. For a gradual expansion, results by correlation are at least twice those by Idel'chik. For a gradual contraction with a diameter ratio of 0.5, when the contraction angle is 28°, the loss coefficient is 0.185 by correlation and 0.143 by Idel'chik; the correlation yields a slightly higher value. For the same 0.5 diameter ratio, when the contraction angle decreases from 28° to 18°, the correlation yields a loss coefficient of 0.104 (a decreasing trend from 0.185, as expected), Idel'chik gives a loss coefficient of 0.188 (an increasing trend from 0.143, not physically plausible). In a closer review of Idel'chik procedure, it is realized that algorithm used in Idel'chik is derived from entrance loss to a tube from an open space (i.e., an infinite diameter effectively).

As discussed above, it is concluded that current calculation of gradual expansion and gradual contraction by the reported correlations are reasonable.

3. We do not recall any mention of an expansion/contraction multiplier to account for transitions that were gradual as opposed to sharp in the laser modeling. Were such multipliers sued? If so, what values were used? The same observation and question applies to the test configuration. How do the coefficients compare with those from a traditional reference such as Crane Technical Paper 410?

Both the laser sleeves and the test configuration evaluated the sudden transitions, not the gradual ones. Therefore, no multipliers were used in both situations. Thus, their comparison with the Crane Paper 410 is similar to the table shown in response to question 1 for the sudden contraction. As for the sudden expansion, they are exactly identical to the Crane Paper 410, because they all use the same correlation (see Equation (2-5) shown in response to question 2).

As for the actual configuration of the laser sleeves and its test configuration, both had had the transition as a gradual expansion or a gradual contraction. Therefore, it is conservative to use a sudden contraction or sudden expansion for both the laser sleeves and its test configuration in calculating the hydraulic equivalency. As demonstrated from comparison between the calculations and tests, the conservatism is at least amounted to a factor of 2; in fact, could be as high as 4 (see Figure 3-1).

By removing the use of gradual transition in calculating the hydraulic equivalency number for the leak-tight sleeves, the calculation procedure, and mathematical expressions will then be identical to the Westinghouse SLEEVE Code. And Table 3-1 tabulates the calculated results of the hydraulic equivalency numbers for both gradual and sudden transitions and their ratios.

Table 3-1 Hydraulic Equivalency Number

Sleeve Installation	Hydraulic Equivalency Number (Gradual Transition)	Hydraulic Equivalency Number (Sudden Transition)	Ratio between Gradual and Sudden Transition
ETZ-sleeve	34	26	1.3
TS-Sleeve	54	37	1.5
ETZ-Sleeve plus TS-Sleeve	23	17	1.4

As shown, the ratios of the hydraulic equivalency numbers range only from 1.3 to 1.5. It is apparent that use of sudden transitions to replace the actual gradual transitions doesn't account for the total conservatism of 2 to 4 times, as demonstrated by test results (see Figure 3-1). In other words, it seems to indicate that there are still other conservatisms in the calculation by the Westinghouse SLEEVE Code.

4. Equation 8 of Attachment 2 to TXX-02107 (approximately end of July, 2002) is stated to be "...precisely the expression used in the Westinghouse "SLEEVE Code". This equation differs from the equation provided in your 5/4/01 communication for the laser analysis. Please explain. Include implications for analysis of test data.

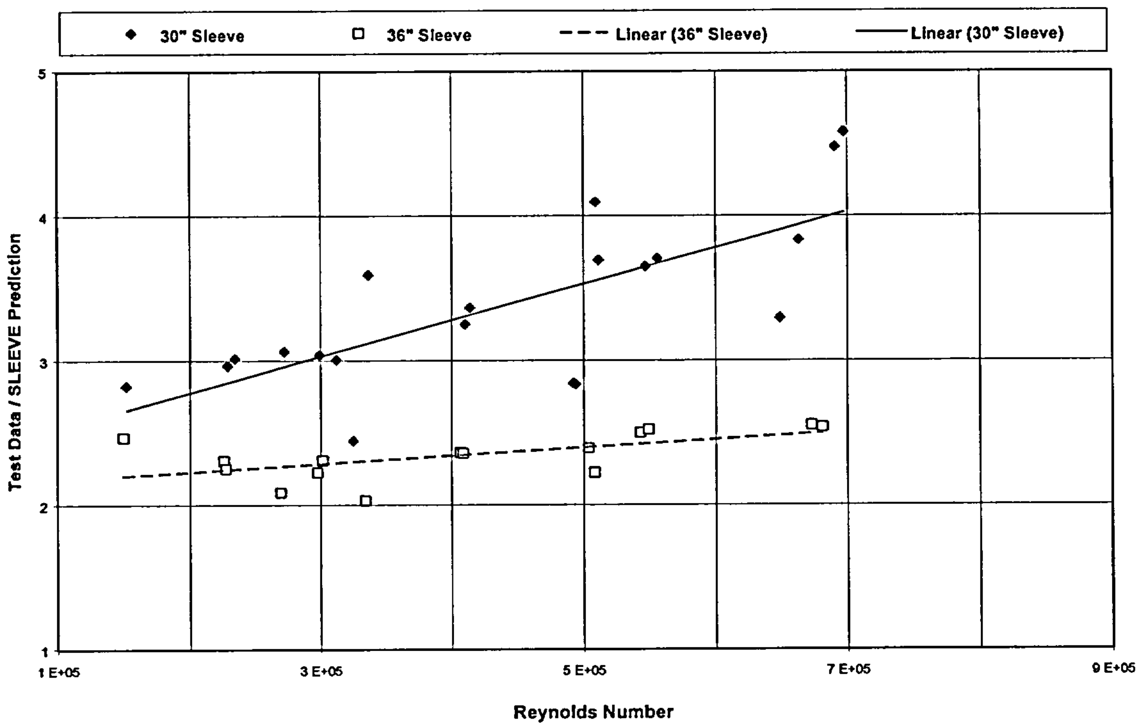
   The equation provided in the 5/4/01 communication was not properly typed. The minus sign in the square root for the loss coefficients should be a division sign.

   Note that both the Westinghouse SLEEVE Code and test data analysis had used the correct equation as reported in the TXX-02107 communication.

References

1. Cox, G. N., and Germano, F. J., "Fluid Mechanics," Van Nostrand, 1942.
2. Idel'chik, I. E., "Handbook of Hydraulic Resistance," AEC-tr-6630, Translated from Russian, Jerusalem, 1966.

Figure 3-1 Ratios of Hydraulic Equivalencies Based on the Test Data to SLEEVE Code Predictions



Attachment 2 to TXX-02159

Pages: 5.0-16

5.5 Programs and Manuals

5.5.9 Steam Generator (SG) Tube Surveillance Program (continued)

f) Plugging or Repair Limit means the imperfection depth at or beyond which the tube shall be removed from service by plugging or (for Unit 1 only) repaired by sleeving and is equal to 40% of the nominal tube wall thickness. The plugging limit for laser welded sleeves is equal to 43% of the nominal wall thickness. *The plugging limit for Leak Tight sleeves is equal to 20% of the nominal wall thickness.* This definition does not apply to that portion of the Unit 1 tubing that meets the definition of an F* tube. This definition does not apply to tube support plate intersections for which the voltage-based plugging criteria are being applied. Refer to 5.5.9e.1m) for the repair limit applicable to these intersections; 83 71 70 71

g) Unserviceable describes the condition of a tube if it leaks or contains a defect large enough to affect its structural integrity in the event of an Operating Basis Earthquake, a loss-of-coolant accident, or a steam line or feedwater line break as specified in Specification 5.5.9d.3, above; 71

h) Tube Inspection means an inspection of the steam generator tube from the tube end (hot leg side) completely around the U-bend to the top support of the cold leg. For a tube repaired by sleeving (for Unit 1 only) the tube inspection shall include the sleeved portion of the tube; 83

i) Preservice Inspection means an inspection of the full length of each tube in each steam generator performed by eddy current techniques prior to service to establish a baseline condition of the tubing. This inspection shall be performed prior to initial POWER OPERATION using the equipment and techniques expected to be used during subsequent inservice inspections; 71

j) F* Distance (Unit 1 only) is the distance of the hardroll expanded portion of a tube which provides a sufficient length of non-degraded tube expansion to resist pullout of the tube from the tubesheet. The F* distance is equal to 1.13 inches, plus an allowance for eddy current measurement uncertainty, and is measured down from the top of the tubesheet, or the bottom of the roll transition, whichever is lower in elevation; 71

k) F* Tube (Unit 1 only) is that portion of the tubing in the area of the tubesheet region below the F* distance with a) degradation below the F* distance equal to or greater than 40%, b) which has no indication of degradation within the F* distance, and c) that remains inservice;