05/17/84

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 50-446
	)	
(Comanche Peak Steam Electric Station, Units 1 and 2)	)	

NRC STAFF RESPONSE TO APPLICANTS' RESPONSE TO PARTIAL INITIAL DECISION REGARDING A500 STEEL

I. INTRODUCTION

On April 12, 1984, the NRC Staff ("Staff") received the "Applicants' Response to Partial Initial Decision Regarding A500 Steel" (April 11, 1984) ("Applicants' Response"). Attached to the Applicants' Response are the "Affidavit of John C. Finneran, Jr. Regarding A500 Tube Steel" ("Finneran Affidavit"), and a November 18, 1983 letter from Kevin Ennis, BPVC Assistant Secretary, American Society of Mechanical Engineers ("ASME") to M. R. McBay, Texas Utilities Services, Inc. Applicants urge the Board to reconsider its earlier "Partial Initial Decision (Change in Material Properties for A500 Steel)" ("PID") and instead find that Applicants correctly assessed the impact of the revisions to the A500 material values, and that pipe support designs at CPSES utilizing A500 steel provide adequate margins of safety and do not raise any safety concern. Applicants' Response, pp. 1-2. The Staff hereby responds to the Applicants' Response.

II. BACKGROUND

On October 6, 1983, the Atomic Safety and Licensing Board ("Board") issued a PID on the change in material properties for A500 steel, as published in ASME Code Case N-71-10. In its PID, the Board concluded that the Applicants had failed to demonstrate that the design of pipe supports at CPSES which specified A500 steel is consistent with the Commission's General Design Criteria ("GDC") 1 and 4. According to the Board, it was satisfied that Applicants are not required by the ASME Code to use Code Case N-71-10, which reduced the strength of A500 steel by 15% when it is welded. PID, pp. 2, 4-5. Nonetheless, the Board found that Applicants had not adequately demonstrated "that its analysis of yield values for A500 steel used in pipe supports, pursuant to the ASME Code, have left an adequate margin of safety." Id., pp. 2-3. The Board indicated in its PID that the Applicants based their argument of acceptability on the large safety factors in the ASME Code stress allowables, and the fact that the primary safety factor is based on ultimate strength of the steel, while the "safety factor for yield" is only a backup value. Id., pp. 5-6. The Board disagreed with the Applicants' argument, stating that yield values are "crucial for cyclical stresses," and that if yield is exceeded, Applicants have not performed plastic analyses to actually analyze the capability of the steel. Id., pp. 6-7. In sum, the Board concluded that a reanalyzes should be performed by the Applicants using the reduced A500 steel strength values, in order to establish the actual reduction in safety margin. The Board also requested the Applicants to quantify the "combined effect of errors in code values . . . and other variations typically covered by safety factors." Id. p. 7. The parties

were given 15 days to respond to the Applicants' filing of the requested analyses.[1/] Id., p. 8.

III. DISCUSSION

A. Commission Regulations

Applicants argue that neither General Design Criteria ("GDC") 1 and 4[2/] nor 10 C.F.R. § 50.55a require Applicants to assess by analysis (i.e., by conducting quantitative evaluations) the adequacy of pipe supports utilizing A500 steel, based upon the revision of yield strength values

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1/ This was subsequently extended by agreement of the parties.

2/ 10 C.F.R. Part 50, Appendix A. GDC 1 provides:

> Quality standards and records. Structures systems, and components important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. Where generally recognized codes and standards are used, they shall be identified and evaluated to determine their applicability, adequacy, and sufficiency and shall be supplemented or modified as necessary to assure a quality product in keeping with the required safety function. A quality assurance program shall be established and implemented in order to provide adequate assurance that these structures, systems, and components will satisfactorily perform their safety functions. Appropriate records of the structures, systems, and components important to safety shall be maintained by or under the control of the nuclear power unit licensee throughout the life of the unit.

GDC 4 states:

> Environmental and missile design bases. Structures, systems, and components important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, test

(FOOTNOTE CONTINUED ON NEXT PAGE)

for A500 steel which were published in ASME Code Case N-71-10. Applicants' Response, pp. 4-10. As part of their discussion on this issue, Applicants also request that the Board reconsider its finding that the record in this proceeding shows that the reduction in yield values for A500 steel raises a concern about the adequacy of pipe support designs to accommodate cyclic (repetitive) stresses. Id., pp. 10-13. The Staff supports Applicants' position that GDC 1 and 4 require consideration, but not necessarily quantitative analysis, of the potential effects of the reduction in A500 steel yield strength values on the adequacy of CPSES pipe support designs.

The starting point in the Staff's analysis is GDC 1, which sets forth two fundamental principles: (1) that nuclear power plant structures, systems, and components be designed to quality standards commensurate with the safety importance of the functions they perform; and (2) that generally recognized codes and standards be utilized for design and construction, but that they be evaluated to determine their adequacy and sufficiency, and supplemented or modified as necessary to assure a quality product consistent with the required safety function. See PID, p. 3. GDC-4 makes clear that the nuclear power plant

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(FOOTNOTE CONTINUED FROM PREVIOUS PAGE)

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> ing, and postulated accidents, including loss-of-coolant accidents. These structures, systems, and components shall be appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit.

structures, systems, and components important to safety must be designed to accommodate accident, as well as normal operating conditions. Id.

Although the Commission has not explicitly adopted the ASME Code for the design of pipe supports,[3/] the Staff has recognized that Section III, Subsection NF of the ASME Code is an acceptable code for pipe support design. Standard Review Plan ("SRP") Section 3.9.3; SRP Table 3.2.2-1; Affidavit of Dr. Raj N. Rajan Regarding Applicable Requirements for the Design of Welds at CPSES ("Rajan Affidavit") (attached to October 28, 1983 NRC Staff Response to Board Question Regarding Applicable Welding Codes at CPSES). Applicants have committed to utilizing the 1974 ASME Code in their Final Safety Analysis Report for CPSES (Rajan Affidavit, p. 2). It is clear that Applicants were not required under the ASME Code to adopt the revised yield strength values for A500 steel published in Code Case N-71-10. PID, p. 4. However, the Staff argues that Applicants must demonstrate compliance with GDC 1 and 4, in addition to demonstrating compliance with the provisions of the 1974 ASME Code. Thus, although Applicants were not required by the ASME Code or Code Case N-71-10 to use the reduced A500 steel yield strength values published in the Code Case, Applicants were still required to give appropriate consideration to whether the reduced yield strength values had an adverse effect on the adequacy of CPSES pipe supports designed with the older, incorrect yield strength values.

3/ The Staff regards 10 C.F.R. § 50.55a(d)(3) to be irrelevant to the regulatory analysis of pipe support design, since that section identifies the ASME Code as the proper code only for the design of piping. The Staff agrees with Applicants (Applicants' Response, p.10, footnote 10) that the Board's PID incorrectly cited Section 50.55a(d)(2) rather than 50.55a(d)(3) as the provision applicable to CPSES.

However, this requirement for appropriate consideration may be satisfied in any number of ways, including engineering judgement based on previous experience with the effect of material property changes on design analyses, scoping calculations, or assessment of design practices that result in conservative calculation of stresses. Accordingly, the Staff supports Applicants' position that GDC 1 and 4 require consideration, but not necessarily quantitative analyses, of the effect of Code Case N-71-10's reduction in A500 steel yield strength values on the adequacy of CPSES pipe supports designed with the incorrect yield strength values.

The Staff's understanding of the Board's PID on A500 steel is that: (1) Applicants had not made a sufficient evidentiary showing that they had given appropriate consideration to the effect of Code Case N-71-10 on CPSES pipe support adequacy; and (2) Applicants had not submitted quantitative evaluations supporting their judgment that Code Case N-71-10 did not affect their pipe support designs. The Staff submits that until Applicants filed their Response on A500 steel, they had not submitted specific evidence describing their consideration of Code Case N-71-10, or any computational data confirming the correctness of their judgement on the subject. Under these circumstances, the Staff cannot agree with Applicants' proposal that the Board revise its PID to reflect that there was on the record complete evidence regarding Applicants' consideration of Code Case N-71-10, and the correctness of that judgement on the subject. As discussed in Section B below, Applicants have now submitted evidence showing that they did give appropriate consideration to the possible effect of Code Case N-71-10's reduction in A500 steel yield strength values. However, as detailed in Section C, the Staff believes that Applicants have

not yet completely demonstrated in the computational assessments described in Mr. Finneran's affidavit that their original judgement on the impact of Code Case N-71-10 was, in fact, correct, but indicates how this may be done.

B. Applicants' Consideration of the Impact of Changes in Material Properties for A500 Steel

As set forth on pages 2 through 6 of Mr. Finneran's affidavit, Applicants had considered the possible effect of Code Case N-71-10 prior to its endorsement by the Staff in Regulatory Guide 1.85, Revision 21 (November 1982). Finneran Affidavit, pp. 2-3. After considering a number of factors, Applicants concluded that there would be no adverse safety impact from the reduced yield strength values. Id. According to Applicants, it is their understanding that ASME reviews all Code Cases prior to issuance to assure that there are no potential safety concerns raised by prior practices which may be altered by the new Code Cases. If there are such concerns, Applicants understand that ASME either makes Code Cases mandatory, or directly notifies all parties who may be affected of the potential safety concern. Id., p. 3. Applicants were aware that ASME did not make Code Case N-71-10 mandatory, nor did it issue a notice of potential safety concern.[4/] Finneran Affidavit, p. 3.

4/ Although Applicants correctly understood the ASME practice regarding notification of parties by ASME of potential safety concerns (see November 18, 1983 letter from Kevin Ennis of the ASME BPVC subcommittee to the Applicants, Attachment 2 to Applicants' Response), Applicants are incorrect in their assertion that the ASME Code may require Code Cases to be mandatory. Chen Affidavit, p. 3.

Moreover, Applicants state that they did not merely rely upon the ASME review process, but that they also considered several factors that weigh in conservatively in their pipe support design process. Id. Applicants indicate that other pipe support design criteria utilized by their designers would often limit stresses in the tube steel to below the stress allowable. In particular, Applicants reference the 1/16 inch deflection criteria. Id., p.4. Applicants also recognized that other design elements, such as anchor bolts, may at times be the limiting factor in the structural capability of the pipe support. Id. Applicants represent that they utilize design lower stress allowables than are otherwise required by the ASME Code during the pipe support design process. Id., pp. 2, 5; Applicants' Response, pp. 12, 16. According to Applicants, they also typically use stronger tube steel sections than are necessary, in order to provide for contingencies such as future design changes in support loads and stresses. Finneran Affidavit, p. 5. Finally, Applicants indicate that they were aware of production test data which they receive with every shipment of A500 steel which showed that the actual yield strengths for the steel shipped to CPSES are generally substantially greater than the published values. Id. After considering these factors, Applicants concluded that there was no safety concern regarding the adequacy of pipe support designs utilizing A500 steel which were designed with higher yield strength values. Id., pp. 5-6.

Dr. Chen has reviewed these six factors and concludes that these factors considered together provide a reasonable basis for concluding that there would not be an adverse effect on CPSES pipe support design due

to the reduced A500 steel yield strength values published in Code Case N-71-10. Chen Affidavit, p. 3.

C. Confirmation of the Applicants' Original Assessment

To support their original decision (described in Section B above) that Code Case N-71-10's reduction of A500 steel yield strength values did not have an adverse impact on the adequacy of CPSES pipe support designs, Applicants performed two separate evaluations in order to demonstrate that their original conclusion that there would be no adverse effect on pipe support design adequacy was correct. First, Applicants selected a sample of 182 supports designed by PSE, ITT-Grinnell and NPSI which utilize A500 steel. Finneran Affidavit, pp. 6-7. Applicants state that the calculated stresses were compared against a reduced stress allowable reflecting the reduction in the yield strength values for A500 steel. Finneran Affidavit, p. 7. According to the Applicants, none of the supports have been stressed beyond the reduced A500 stress allowable. Finneran Affidavit, p. 7.

Dr. Chen reviewed 19 of the design packages for these 182 supports. Dr. Chen found that for 16 of the 19 supports, Applicants compared the level C stresses against a level B stress allowable which had been lowered to reflect the reduced A500 steel yield strength values published in Code Case N-71-10. The level C stresses were below the reduced level B allowable in all 16 supports. For the remaining three supports (SW-1-100-002-C62R; CC-2-028-704-A33A; CH-2-206-716-A33R), the Applicants compared the level C stresses against a level C stress allowable which was reduced to

reflect Code Case N-71-10. The level C stresses met the reduced level C allowable in all three supports. Chen Affidavit, pp. 3-4.

Applicants' practice of comparing a level C load (stress) against a level B stress allowable (Finneran Affidavit, p. 5) is reasonable and conservative only if the level C load is greater than the level B load. Chen Affidavit, p. 4. In his review of the 19 supports, Dr. Chen found one support (MS-1-004-003-S72R) where the Applicants compared the level C stress against the reduced level B allowable, even through the level B load was higher than the level C load. However, the level B stress for this support was below the reduced level B allowable. Id. If Applicants can demonstrate that in all cases where the level B rather than the level C stress is the bounding stress the Applicants compared the level B stress against the reduced level B allowable and found that the allowable was compiled with, then the Applicants' assessment of 1982 pipe supports would demonstrate that for pipe supports utilizing A500 steel the calculated upset and emergency stresses were within the reduced level B allowable. This would complete the computational support for the Applicants' judgment that the reduced A500 steel yield values published in Code Case N-71-10 would not adversely impact the adequacy of pipe support designs which used the incorrect yield strength values.

Applicants also performed a separate evaluation using actual, as opposed to the published yield strength values for A500 steel. Applicants selected the ten highest stressed supports from the previous sample of 182 supports, and reviewed the certified mill test reports for these supports. Finneran Affidavit, p.8. According to Applicants, the mill tests show that the lowest of the minimum yield strengths for th A500

steel actually used in these supports was 56.3 ksi. The 56.3 ksi yield strength, reduced by 15 percent to reflect Code Case N-71-10, is 47.8 ksi, which is 33 percent higher than the published 36 ksi yield strength in Code Case N-71-10. The 47.8 ksi value is also above the original 42 ksi yield strength value published by ASME before Code Case N-71-10. Applicants conclude that this is additional evidence confirming the Applicants' original decision regarding the adequacy of CPSES pipe supports designed with the higher, incorrect A500 steel yield strength values. Finneran Affidavit, pp. 7-8. Dr. Chen reviewed two of the approximately 12 certified mill test reports for the ten supports, and found that the tested yield strengths were higher than the yield strength published in Code Case N-71-10. Chen Affidavit, pp. 5-6.

The Staff submits that if Applicants demonstrate that they correctly compared the level B stress against the reduced level B allowable in all cases where the level B stress, rather than the level C stress is the bounding stress, then there is adequate evidence for the Board to conclude that Applicants' original consideration and conclusion regarding the effect of Code Case N-71-10 on pipe support design at CPSES was correct.

IV. CONCLUSION

For the reasons discussed above, the Staff concludes that if Applicants demonstrate that they correctly compared level B stresses against the reduced level B allowable where the level B stress, rather than the level C stress, is the limiting stress, there will be a sufficient evidentiary basis for this Board to conclude that Applicants considered the

possible effect of ASME Code Case N-71-10 on the adequacy of pipe support designs utilizing A500 steel, and that their conclusion that there was no adverse safety impact was correct.

Respectfully submitted,

Geary S. Mizuno
Counsel for NRC Staff

Dated at Bethesda, Maryland
this 17th day of May, 1984

05/17/84

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

AFFIDAVIT OF W. PAUL CHEN ON REVISED A500 STEEL YIELD VALUES

I, W. Paul Chen, being duly sworn, do depose and state:

1. My name is W. Paul Chen. I am the manager of the Materials Unit (formerly, Stress Analysis Unit) of the Systems Engineering Department of the energy Technology Engineering Center ("ETEC"). ETEC is a U.S. Department of Energy laboratory which is operated by the Energy Systems Group ("ESG") of Rockwell International. ETEC is under contract with NRC to provide expert technical assistance requested by NRC. A statement of my professional qualifications has previously been admitted into evidence following Tr. 6401.

2. I have read and reviewed "Applicants' Response to Partial Initial Decision Regarding A500 Steel", and the "Affidavit of John C. Finneran, Jr. Regarding A500 Tube Steel."

3. It is my understanding that Applicants considered the possible effect of Code Case N-71-10's reduction in A500 steel yield values on pipe support design adequacy prior to the endorsment of the Code Case by

the NRC Staff, and that the Applicants concluded there was no adverse effect due to the following factors:

A. ASME's review of Code Cases for potential safety concerns, and the ASME practice to either make Code Cases mandatory, or notify all parties affected of potential safety concerns raised by the Code Cases.

B. Applicants' design criteria other than allowable stress values which also serve to limit stresses, such as the 1/16 inch deflection criterion.

C. Applicants' knowledge that other design elements, such as anchor bolts, will be the controlling design element for the pipe support structure.

D. Applicants' general practice of specifying stronger tube steel sections than are necessary, to provide for possible changes in loads and resultant stresses.

E. Applicants' general practice of utilizing level B (upset condition) stress allowables in assessing the normally more severe level C (emergency conditions) loads.

F. Applicants' experience with mill tests for A500 steel shipped to CPSES showing that the A500 steel actually used

on-site has yield strength values which are generally greater than the published yield strength values.

4. I have reviewed the six factors listed in Paragraph 3 to determine if they are a valid basis for concluding that Code Case N-71-10 would not have an adverse effect on pipe support design adequacy at CPSES. These six factors,*/ considered together, are a reasonable basis for concluding that there will not be an adverse effect on CPSES pipe support designs due to the reduced yield strength values published in Code Case N-71-10.

5. Applicants state in their Response and Affidavit that they have conducted an assessment to determine whether or not their original decision that Code Case N-71-10 did not adversely affect the adequacy of pipe support designs was correct. This assessment involved a random sample of 182 ASME pipe supports for Unit 1 and common areas which actually utilized A500 tube steel. Applicants indicate that they reduced the stress allowable based upon the reduced yield strengths published in Code Case N-71-10. They then compared the stress of the most highly stressed tube steel member against the reduced allowable. The results of this assessment are given in tabular form on p.7 of Mr. Finneran's affidavit. The results show that none of the support members were stressed above the reduced allowable. I have reviewed 19 of the design packages for these 182 supports.

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*/ Contrary to Mr. Finneran's affidavit (p. 3), it is my understanding that ASME does not make Code Cases mandatory.

I reviewed the design packages to identify the stresses calculated by Applicants for each of these 19 supports and determined that for 16 of the 19 supports, Applicants compared the level C stresses against a level B stress allowable which had been lowered to reflect the reduced A500 steel yield strength values published in Code Case N-71-10. The level C stresses were below the reduced level B allowable in all 16 supports. For the remaining three supports (SW-1-100-002-C62R; CC-2-028-704-A33A; CH-2-206-716-A33R), the level C stresses were compared against a level C stress allowable which was reduced to reflect Code Case N-71-10. The level C stresses met the level C allowable in all three supports.

It is reasonable and generally conservative to compare a level C (emergency) load or (stress) against a level B (upset) stress allowable, since level C loads are usually, but not always larger than level B loads. See SIT Report, pp. 48-49. However, for those situations where the level B load is larger than the level C load, the level B stress should be compared against the level B allowable. In my review of the 19 supports, I found one support (MS-1-004-003-S72R) where the Applicants compared the level C stress against the reduced level B allowable where the level B load was, in fact, higher than the level C load. However, I determined that the level B stress for this support was below the reduced level B allowable. The Applicants should assure that their conclusion that the calculated stresses do not exceed the reduced level B stress allowable for all 182 supports is also valid for those cases, if any, where the bounding stress is the level B stress rather than the level C stress. If: (1) the one support which I identified was the only instance in which level B stresses were bounding, or (2) in all cases where the

bounding stress is the level B stress, the level B stress is within the reduced level B allowable, then the Applicants' evaluation of 182 supports in fact provides calculational confirmation of Applicants' original judgment that the reduced A500 steel yield strength values published in Code Case N-71-10 do not adversely affect the adequacy of CPSES pipe support designs utilizing A500 steel.

6. Applicants state (Applicants' Response, p. 16-17; Finneran Affidavit, p. 5) that they were aware that the certified mill test reports for A500 steel shipped to CPSES generally showed that the actual yield strength for the steel exceeded the published yield strength values published in the ASME Code. In support of their position, Applicants performed a second assessment, which involved a review of the certified mill test reports for ten of the highest-stressed supports from the 182 support sample. According to Applicants, the lowest actual (tested) yield strength of the A500 steel used in the fabrication of these ten supports was 56.3 ksi. If the 56.3 ksi yield strength is reduced by 15 percent to reflect the adjustment in yield strength published in Code Case N-71-10, the reduced yield strength is 47.8 ksi. The 47.8 ksi yield strength is higher than the 36 ksi yield strength adopted in Code Case N-71-10, and is also above the original ASME yield strength value of 42 ksi.

I have reviewed two of approximately 12 certified mill test reports for the ten supports, and I found that tested yield strengths were higher than the yield strength published in Code Case N-71-10. This assessment,

considered together with the assessment of stresses on the 182 pipe supports, demonstrates that the Applicants' original decision on the effect of Code Case N-71-10 on pipe support design adequacy was correct.

_____
W. Paul Chen

Subscribed and sworn to before me
this th day of May, 1984

_____
Notary Public

My commission expires: _____

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

CERTIFICATE OF SERVICE

I hereby certify that copies of "NRC STAFF RESPONSE TO APPLICANTS' RESPONSE TO PARTIAL INITIAL DECISION REGARDING A500 STEEL" and "AFFIDAVIT OF W. PAUL CHEN ON REVISED A500 STEEL YIELD VALUES" in the above-captioned proceeding have been served on the following by deposit in the United States mail, first class, or deposit in the Nuclear Regulatory Commission's internal mail system (*), or by express mail or overnight delivery (**), this 17th day of May, 1984:

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