September 6, 1983

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

APPLICANTS' REPLY TO CASE'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW (WALSH/DOYLE ALLEGATIONS)

In accordance with 10 C.F.R. § 2.754(a)(3), Texas Utilities Generating Company ("Applicants") hereby submit their reply to CASE's Proposed Findings on pipe support design allegations. Applicants respond to all material aspects of CASE's Proposed Findings which are supported by record evidence. A substantial portion of CASE's Findings relies upon extra-record material and new arguments not previously raised. As discussed below, use of such extra-record material in proposed findings is prohibited by the NRC Rules of Practice. Accordingly, Applicants do not reply to that material. As demonstrated below, upon consideration of all the evidence on pipe support design, it is clear that there is reasonable assurance that the pipe supports at Comanche Peak have been designed in accordance with applicable requirements and will perform their intended functions. Accordingly, the Board should so find and issue promptly its partial initial decision on these matters.

I. APPLICANTS' REPLY TO CASE'S PROPOSED FINDINGS

A. CASE's Reliance on Extra-Record Material

In reaching its decision on any contested issue, the Board may rely only on the evidence of record in this proceeding, as required by well-established Commission precedent and the Administrative Procedure Act. See 5 USC § 556(e); Pacific Gas and Electric Company (Diablo Canyon Nuclear Power Plant, Units 1 and 2), ALAB-580, 11 NRC 227, 229-31 (1980); Tennessee Valley Authority (Hartsville Nuclear Power Plant, Units 1A, 2A, 1B, 2B), ALAB-453, 7 NRC 341, 351-52 (1978); Public Service Co. of Indiana (Marble Hill Generating Station, Units 1 and 2), ALAB-459, 7 NRC 179, 190-91) (1978). Contrary to these requirements, CASE would have the Board consider substantial extra-record material, both in the form of documents not previosuly admitted, and arguments not previously raised, in reaching its decision on pipe support design allegations.[1] The Board obviously should not consider such material. To do so would be contrary to the principles

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[1] The Board has already ruled on the admissibility of CASE's extra-record documents in its September 1, 1983 Memorandum and Order (Motions to Reopen the Record and to Strike) wherein the Board declined to reopen the record to receive any of that material, but noted that it could take official notice of legal materials, (including industry codes applicable to Comanche Peak) or material which is of "common knowledge." Its decision regarding materials which may constitute "common knowledge" will await its consideration of them in view of the entire record (including this reply). (Memorandum and Order at 5-6.) Accordingly, Applicants address each of these materials below to demonstrate there is no basis for the Board to consider those materials as containing matters of common knowledge. In any event, we submit this Board should not take into consideration matters (untimely raised) which may be of "common knowledge" where there is or could be a dispute as to the application of that knowledge to a particular issue.

described above and the precepts of fundamental fairness. Neither Applicants nor the Staff have had an opportunity to conduct cross examination or present rebuttal evidence regarding these matters and the Board has had no opportunity to ask clarifying questions. See Hartsville, supra, 7 NRC at 352; September 1, 1983 Memorandum and Order at 3-4. These rights which are so essential to a fair adjudicatory system would be denied if the Board should consider that information in reaching its decision.

In addition, although CASE would have the Board believe that the new arguments raised in its Proposed Findings are merely "very simple and logical deductions" from material already in the record,[2] such is not the case. These arguments are simply another attempt to obtain consideration of extra-record matter. As is readily obvious from even a cursory review of CASE's Proposed Findings, these arguments are extensive and wholly unsupported by record citations that would enable the Board (and the other parties) to determine their relationship to the evidence of record. In fact, this material can only be characterized as new, unsworn and untested testimony which is aimed at addressing matters already litigated, but as to which CASE has obviously recognized its position is inadequate. Applicants have repeatedly objected to CASE's constantly shifting and regenerating positions in reaction to persuasive counter-evidence to its initial arguments (E.g., Tr. 6616, 6871).

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[2] See CASE's Motion to Supplement the Record, August 22, 1983, at 8.

Accordingly, the Board should not consider any material in CASE's Proposed Findings that is not supported by citations to the record.

As to the arguments by CASE which are supported by citations to the record, we urge the Board to examine carefully each of those. In several instances, CASE presents extensive arguments regarding its disagreement with Applicants' position, but fails to address the consequences that it believes would follow from the failure to follow its recommendations. In such a posture, the Board is faced with simply academic postulates with no logical nexus to the findings it need make to reach its decision. In such a posture the Board must find that CASE has failed to sustain its burden of going forward and that no issues are raised which warrant further consideration.

B. Issues Addressed by CASE

1. Margins of Safety/Allowable Loads

In Section I of its Proposed Findings, CASE presents three basic arguments to demonstrate that the factors of safety used in the design of pipe supports at Comanche Peak are less than the factors of safety which Applicants and the NRC Staff testified were employed. CASE first alleges that the variations in material properties were not properly accounted for by Applicants. Second, CASE argues that Applicants' calculations of factors of safety were inaccurate. And third, CASE contends that the Final Safety Analysis Report ("FSAR") limits stresses so that the factors of safety are in some way less than what is

stated by Applicants. (CASE's Proposed Findings at I-3.) CASE also presents other general arguments which we also address below.

CASE's apparent argument regarding the effect of variations in material properties on factor of safety calculations is that because an ASME Code case reduced the yield strength for a particular steel, factors of safety for the design of components utilizing that material were thereby reduced. CASE fails to point out that following both technical and legal argument regarding the applicability of that Code case the Board agreed that the justification for not applying the case to Comanche Peak was persuasive (Tr. 6814). CASE simply ignores this fact in its Proposed Findings. CASE's Proposed Findings at I-12 to 13. Thus, absent new information (not presented here), the Board should find that the premise for CASE's argument in connection with the code case is incorrect. Applicants' expert witness on the ASME Code, Mr. Reedy testified that had this change in material properties presented a concern for the adequacy of the design of components utilizing the original material properties a notice to that effect would have been issued by the ASME (Tr. 6810). In addition, given that the change in member properties with which CASE is concerned involved only a change to the yield stress value (and not the ultimate stress value) (CASE's Proposed Findings at I-12), and given that the proper method for

calculating factors of safety is to utilize the ultimate stress value (see discussion below), there was no change in the factor of safety for this material as a result of the Code case.[3]

Further, with respect to the actual calculation of factors of safety, CASE misleads the Board when it argues that yield, rather than ultimate, stress is the most important figure to use in those calcuations. CASE's Proposed Findings at I-13. However, as Applicants and the NRC testified, the appropriate manner for calculating the margin of safety is to divide the ultimate by the maximum allowable for any given material (Tr. 6431, 6923-24; see Applicants' Exhibit 142D, Attachment 2). CASE's entire discussion of factors of safety is premised on this erroneous perception. Such a fundamental error invalidates CASE's conclusions regarding the appropriate factors of safety for various pipe support materials.[4] In addition, the Board should note that the method of establishing allowable stresses in

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[3] CASE also makes the argument here (and in other portions of its proposed findings) that pipe supports are "deflection sensitive", citing Regulatory Guide 1.124. The portion of the Regulatory Guide to which CASE refers concerns "large deformations". CASE's Proposed Findings at I-24, n.4 However, as Applicants demonstrated (and the Staff agreed) (Tr. 5256, 7628-29) that provision does not concern the small deformations involved in these allegations.

[4] CASE presented as new information a portion of a NUREG Report (NUREG/CR-2137) which it claims supports its position regarding factors of safety (CASE's Proposed Findings at I-6). In that the question of factor of safety calculation obviously is a matter of which there is some dispute and thus could not constitute "common" knowledge, the Board should not admit CASE's late-filed document. The same holds true for the "Synopsis" cited by CASE at page I-10 of its Proposed Findings.

the ASME Code result in inclusion of additional factors of safety (Tr. 6926). Thus, there are factors of safety on top of factors of safety in these materials.

CASE also lists several other factors which it contends should be considered in determining the actual factors of safety. CASE's Proposed Findings at I-16. Each of these matters is addressed in other portions of CASE's Proposed Findings and Applicants will reply to those matters in the appropriate sections.

Another matter which CASE raises concerns the factors of safety used for anchor bolts. CASE's Proposed Findings at I-17 to 18. CASE makes a vague argument regarding the factors of safety for these anchor bolts, apparently claiming that the factors of safety should not fall below 4-1. In this regard, Applicants note that the factors of safety used for the expansion anchor bolts which are the subject of this discussion are 5-1 at Comanche Peak (NRC Exhibit 207 at 22; Tr. 5161).[5]

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5 Another argument which CASE raises in its discussion on factors of safety for anchor bolts, is that the use of engineering judgment is a "violation of the law". CASE Proposed Findings at I-19. CASE apparently would not permit the use of any engineering judgment in the design of systems and components at Comanche Peak. However, we note an interesting contradiction between this claim and the position of Mr. Doyle in his testimony. Mr. Doyle testified that engineering is not taking "a cookbook and applying numbers" and in fact engineering requires judgment calls based on a multitude of different factors. CASE Exhibit 669 at 55. Now, however, in order to contradict the testimony of Applicants' expert witnesses, CASE would have the Board believe that the use of engineering judgment is not proper, and in fact, violates the law. We find it disturbing that CASE would so readily restructure its position as the need arises to support its arguments.

Another instance in which CASE's Proposed Findings are misleading is the statement on page I-20 that the tensile allowable for A307 material is greater than that allowed for the higher strength Hilti Bolt. CASE here fails to recognize (or at least point out to the Board) that this is another instance (discussed above with respect to Richmond inserts) in which the difference between the allowables for connections is not only based on the strength of bolts themselves, but rather the connection allowable is established based on the capacity of the system as a whole. (See discussion infra at Section I.B.8.) This confusion on CASE's part was evident at the hearings at which time Applicants and the NRC Staff testified as to this confusion and demonstrated CASE's arguments to be unfounded (See Applicants' Proposed Findings at 34; NRC Proposed Findings a 40-41). We bring this to the Board's attention because it is another example of CASE's reluctance to present in its Proposed Findings a full and fair discussion of the facts in the record. In addition, CASE's unsupported claim that A307 Grade B material is not recommended for use in anchor bolts also is meaningless because the essentially equivalent A-36 material (CASE Exhibit 834, compare A-307 allowable at p. 1 with A-36 allowable, p. 8 (specimens 7-9)) was in fact one of the materials used in the testing of anchor bolts at Comanche Peak. Further, Applicants find it amusing that CASE would claim that the use of

A307 material for anchor bolts is "not recommended" when the ASME Code establishes the allowables for bolts made from that very material (CASE Exhibit 752).

The remainder of the material in Section I of CASE's Proposed Findings involves opinions based on extra-record material. Accordingly, Applicants do not respond to this information.

In sum, based on an examination of the evidence of record, the Board should find that pipe supports at Comanche Peak have been adequately designed utilizing appropriate material properties and factors of safety.

2. U-Bolts As One-Way Supports

The principal argument raised by CASE regarding the use of U-bolts as one-way supports concerns the potential for those bolts to receive or cause unanticipated loads in the piping system if the movement of the pipe exceeds the mandated 1/16 inch clearance (CASE's Proposed Findings at II-1). As to this allegation, Applicants address in their Proposed Findings the possibility of such stresses arising and the analyses performed to evaluate such stresses (Applicants' Proposed Findings at 48-49). The discussion therein fully addresses this aspect of CASE's allegation and demonstrates that Applicants properly evaluated these effects. There are additional comments, however, which are warranted by CASE's Proposed Findings.

We first note that CASE does not disagree that the forces in the lateral direction on the U-bolts will be small, but contends that the allowable for the U-bolt in that direction is also small (CASE's Proposed Findings at II-3). The implication is that the loads imposed in the unrestrained (lateral) direction on U-bolts would result in failure of the bolt. However, as Applicants discuss in their Proposed Findings, limitations are imposed on the movements of U-bolts in the unrestrained direction such that those limited movements do not impose significant stresses on the U-bolt (Applicants' Proposed Findings at 48-49). Thus, CASE's concerns regarding the possible yielding of the U-bolts are unwarranted.

With respect to the claim that the forces induced in the pipe from the supports are not properly considered (CASE's Proposed Findings at II-7), Applicants and the NRC Staff presented testimony that the stresses induced in the pipe by either U-bolt or box frame supports were negligible (Applicants' Proposed Findings at 50). CASE fails to demonstrate otherwise.

Further, we note that CASE quotes only a portion of a statement from CASE Exhibit 821 regarding the reaction of a U-bolt (CASE's Proposed Findings at II-4). This statement actually describes a hypothetical worst case situation (actually not even postulated to occur because of the limitations imposed on deflections described above) which demonstrates that the seismic analysis is conservative in not considering the lateral restraint on the piping from the U-bolt. (CASE Exhibit 821 at 4.)

Applicants' assessment of these effects is a valid exercise of engineering judgment based on the limits imposed on the maximum displacements where stresses are displacement limited (Applicants' Proposed Findings at 48).

Applicants cannot let pass the comment by CASE on page II-8 of its Proposed Findings that questions regarding U-bolt modelling were not addressed until after Mr. Doyle resigned, with the implication that only his allegation led to addressing these questions. In reality, the as-built verification program for pipe supports had recently begun at the time of Mr. Doyle's resignation. This process, in accordance with its intended purpose, routinely identified areas in which further evaluation was needed because of stresses and loads calculated in the piping analyses that were not anticipated in the original design effort or because inadequate consideration had been given to certain effects. Applicants have presented extensive testimony regarding the purpose, scope and results of that as-built verification program which demonstrates the thoroughness by which the piping and pipe support analyses at Comanche Peak are performed (Applicants' Proposed Findings at 18-26). Whether CASE's witnesses also believed there was a need for further evaluation of certain support configurations is immaterial. The pertinent point to be made is that the pipe support and piping design process is thorough, accurate and appropriate for accommodating the reality of the construction process, and resulted in a final product which satisfies all applicable criteria and requirements.

Finally, CASE asserts that NRC IE Bulletin No. 79-14 mandates that all supports "be considered" in seismic analyses (CASE's Proposed Findings at II-10). CASE does not specify the particular provision in that Bulletin on which it basis this statement. Nonetheless, Applicants have considered all supports in their seismic analyses, the only argument presented by CASE concerns the manner in which those supports are considered. Based on the evidence described above, it is clear that Applicants have properly considered the effects of these supports in their seismic analyses.

In addition, there are numerous assertions, conclusions and arguments in this chapter which are not supported by evidence of record and/or are nothing more than vague statements with no demonstrated nexus between the claim and the adequacy of pipe support design. Accordingly, there is no basis on which the Board may conclude other than that the pipe support designs utilizing U-bolts are adequate.

3. Instability of Supports

CASE contends in this portion of its Proposed Findings that Applicants failed to consider adequately the question of pipe support stability. Applicants have thoroughly evaluated the question of unstable supports at Comanche Peak. As discussed in Applicants' Proposed Findings at 44-47, unstable pipe supports at Comanche Peak were identified during the normal design review process and are being modified to assure stability.

In the face of such evidence, CASE attempts to buttress its position on unstable supports by taking out of context the testimony of Applicants' witnesses to suggest that Applicants were unaware of the potential instability of certain supports (CASE's Proposed Findings at III-1 to III-3).[6] In any event, CASE does not dispute that unstable supports will be identified in the as-built verification process and modified, if necessary. Thus, whether the pipe support design process as a whole is adequate with respect to the instability question is not at issue. The only issue is the timing of the identification of possible unstable supports. In this regard, Applicants have presented extensive testimony on the nature of the iterative design process (Applicants' Proposed Findings at 19-21) and the adequacy of that process. CASE apparently would have Applicants employ a one-step design process for all piping and supports. As

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6 To provide the Board with just a few examples of this approach we note that at page III-1 CASE claims that Applicants "failed to rebut the condition of instability." In actuality, Applicants acknowledged that there were supports which would be unstable and that that situation had been previously identified and was undergoing review as part of the as-built verification process. (Applicants' Exhibit 142 at 27; Tr. 4889-90). CASE also claims that the number of unstable supports is still undetermined and that Applicants' estimates of the percentage of supports which were unstable was based on figures from only two of the pipe support design organizations. CASE Proposed Findings at II-2. CASE ignores the testimony of Applicants' witnesses that those were the only organizations for which the as-built verification program had proceeded to the point at which the instabilities would be identified (Tr. 7091-92), and that there was no reason to believe that the percentage would be any different for all groups (Tr. 7087-88).

Applicants' testified, such an approach is unrealistic. Thus, CASE's arguments regarding the timing of identifying unstable supports are without merit.

Another question which CASE now raises concerns the allocation of responsibility for detecting unstable pipe supports (CASE's Proposed Findings at III-4). As is evident from Applicants' and the NRC Staff's testimony, the responsibility for determining stability of a support rests with all phases of the design process. Another misconception which CASE attempts to pass upon the Board concerns a statement by one of Applicants' witnesses that field engineers were "somewhat knowledgeable" (CASE's Proposed Findings at III-4). Throughout its pleading, CASE utilizes this statement to imply (improperly) that the engineers were unqualified or that the entire design process was staffed by individuals not qualified for the functions which they are to perform. A more twisted view of this testimony is hard to imagine. In actuality, this statement referred solely to he field engineers whose function is to assist construction groups in performing field modifications of supports where interferences not known at the time of the original support design prevent installation of the support in full conformity with the original design. As Applicants testified, these individuals are fully qualified to perform this function and their design changes are incorporated in the support design for consideration in the subsequent as-built verification process. These individuals have no design responsibility and thus need not possess the same

qualifications as persons responsible for the design of the piping and supports. In addition, the field engineers have been highly effective in performing their job and only a small portion of their design changes required subsequent modification. (Tr. 4954-58.) Applicants also address this matter in their Proposed Findings at 22, 24-25. Accordingly, CASE's implication that all level of the pipe support design organization is staffed by personnel without qualifications appropriate for their responsibilities is incorrect and misleading.

CASE erroneously states at page III-6, that the question of instability on pipe supports is not examined by Gibbs & Hill. CASE fails to bring to the Board's attention the testimony of the NRC Staff that their review of the Gibbs & Hill review process noted instances of potential instabilities being identified (Tr. 6721). Thus, CASE's claim in this regard is also unfounded.

CASE also makes a rather confusing argument regarding the reliance on friction to achieve stability of certain supports (CASE's Proposed Findings at III-8 to 9). The substance of CASE's concern appears to be that regardless of whether friction forces are employed to achieve stability of supports, the question of whether "three bar link" supports are stable is not addressed. However, as the SIT reported, Applicants' measures to prevent rotation of the box frame (thereby eliminating the three bar linkage) and the cinching of U-bolts on nonrigid supports to prevent rotation (thereby also eliminating the three bar

linkage), assures the stability and functional adequacy of the piping system plus the supports (NRC Exhibit 207 at 28). Thus, CASE's argument is unfounded.

CASE's arguments regarding the reportability and use of nonconformance reports in connection with the identification of unstable supports (CASE's Proposed Findings at III-10 to 11) is fully addressed by Applicants in their Proposed Findings. Applicants' Proposed Findings at 26-28. We do not repeat that discussion here but refer the Board to that portion of the proposed findings as fully responsive to CASE's position.

Finally, we note that each of the items which CASE would have the Board require Applicants to perform, have already been fully addressed on the record and shown to present no safety concern. Specifically, with respect to the effects of cinching of U-bolts on the pipe, Applicants' experts testified and the NRC Staff confirmed, that the cinching has been considered and determined not to create a significant stress in the pipe. (See Applicants' Proposed Findings at 50). With respect to the question of the effects on the pipe and box frames due to the radial expansion of the pipe, this question was also addressed by Applicants and the NRC Staff and shown to involve insignificant stresses (See Applicants' Proposed Findings at 50). Finally, with respect to this question of assuring stability of pipe support , Applicants have demonstrated, and the NRC Staff has confirmed, that the system for design of pipe supports has and

will continue to identify instances of unstable supports and correct those support designs as necessary (See Applicants' Proposed Findings at 44-47).

4. Cinched U-Bolts and Zero Clearance Box Frames

CASE raises two points regarding the effects of cinching of U-bolts which it contends were not adequately considered. The first concerns the effects of thermal expansion of the pipe on the U-bolt. CASE is also concerned with the stress alleged to be induced in the U-bolts as a result of the tightening of the bolt. (CASE's Proposed Findings at IV-1).

As to the question of cinching U-bolts, and the effect on the bolt from the pretensioning, this matters has been fully addressed in Applicants' Proposed Findings and was the subject of thorough Board examination (see Applicants' Proposed Findings at 49). The evidence discussed in those findings fully addresses this allegation. There are, however, other matters which CASE raises in connection with this allegation on which Applicants comment, below.

First, CASE argues that there is a "mandate" for clearances established in IE Bulletin No. 79-14 (CASE's Proposed Findings at IV-2). CASE neglects to bring to the Board's attention the cross-examination of Mr. Doyle in which he admitted that there is no such "mandate" but rather a provision for documenting clearances (Tr. 7055-58). We consider it disingenous for CASE to present material in proposed findings which directly conflicts with the testimony of its own witnesses.

CASE relies upon two provisions of the ASME Code in support of its statement regarding the need for clearances. As to the first provision NF-3127, Applicants note that this provision is not in the edition of the ASME Code applicable to Comanche Peak (see CASE Exhibit 659B).[7] With respect to the second provision, NF-3272.1, we note that this section refers to the axial or lateral growth of the piping system and not the radial growth of the pipe ("expand and contract freely as directed from the anchored or guided point" (emphasis added)), and thus is inapplicable to CASE's argument. Further, CASE's reference to a portion of the pipe support engineering guidelines for Comanche Peak which establish provisions for radial expansion clearances (CASE's Proposed Findings at IV-5 to IV-6) is inapplicable to the situation here, where cinching of U-bolts to assure stability of a support is considered and evaluated separately (NRC Exhibit 207 at 28; Tr. 6740-51). As for the existence of zero clearance box frames, it was shown that such frames (which also would be used on hinged supports) are used only on low temperature systems for which the thermal expansion effects are negligible (NRC Exhibit 207 at 33). As discussed above, the effect of the radial expansion of the pipe on a U-bolt was also determined to be negligible. (NRC Exhibit 207 at 32-33; Applicants' Exhibit 142F at 5.) In addition, CASE erroneously claims that the achievement of stability on box frame supports relies upon the heating of the pipe. (CASE's Proposed Findings at IV-3). The cited transcript

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7 CASE also cites to this exhibit as containing NF-3127. As the Board can see, that provision is not contained therein.

portions concern statements by Mr. Finneran that such would be an effect of the thermal expansion of the pipe. CASE does not acknowledge, however, that the means for assuring stability of box frame supports is not to rely on the thermal expansion of the pipe but rather to attach lugs or use cinched U-bolts. (NRC Exhibit 207 at 28). In short, CASE's claims that the effects of cinching of U-bolts and zero clearance box frames are not properly considered are erroneous.

With respect to CASE's suggestion that there is some inconsistency between the testimony of the NRC Staff witness regarding the cinching of U-bolts (CASE's Proposed Findings IV-7), the Board should note that the first quotation presented by CASE refers to calculations performed by the SIT to confirm the engineering judgment of Applicants, which is referred to in the second quotation. There is no inconsistency between those statements and Dr. Chen's statements are accurate and demonstrate a complete evaluation of the matters which CASE was addressing.

In sum, CASE's allegations regarding the cinching of U-bolts and the consideration of thermal expansion of pipes on cinched U-bolts and zero-clearance boxframes has been thoroughly evaluated and considered by both Applicants and the NRC Staff. Thus, there is no basis for concluding that the design of supports using these techniques is inadequate and requires further analysis or modification as proposed by CASE.

5. Applicability of AWS Welding Code.

CASE argues that the welding of pipe supports at Comanche Peak is governed by AWS Code. The question of the applicable standards for welding on pipe supports at Comanche Peak is addressed in Applicants' Proposed Findings at 68-71. We do not repeat that discussion here but rather refer the Board to it as addressing each of CASE's allegations. In addition, CASE makes certain points in its Proposed Findings to which we respond below. As demonstrated in Applicants' Proposed Findings and in the material discussed below, CASE's allegations regarding the welding codes for pipe supports at Comanche Peak are meritless.

We first note that CASE's witness on welding of pipe supports did not purport to be an expert in welding (CASE Exhibit 669 at 316), but yet makes numerous assertions which the Board should consider as simply being the statements of a lay witness on these matters. (See, also discussion infra, at Section II. B. 28 regarding item H.)

The first point which we address concerns the statement by CASE that the PSE Engineering Guidelines require welding by the AWS Code, CASE apparently believes this provision contradicts the statement by Applicants' witnesses that that Code does not govern the welding of pipe supports at Comanche Peak. While CASE finds it "amusing" that the PSE Guidelines refer to the AWS Code, Applicants find nothing amusing in CASE's failure to bring to the Board's attention the discussion in the record explaining that reference. In this regard we note that Mr. Finneran testified

that the AWS Code is referenced in the guidelines as a reference only, and does not govern the welding of pipe supports at Comanche Peak (Tr.6979).

CASE next discusses the provisions of the ASME Code governing welding, and after two pages of description concerning the provisions of that Code, asserts that the Code does not "contain sufficient information to design a welded joint for any facility, much less a nuclear plant" (CASE's Proposed Findings at V-4). In contrast to CASE's assertions, the NRC Staff testified that the welding on pipe supports at Comanche Peak is governed by the ASME Code and noted no deficiencies in that Code. NRC Exhibit 207 at 49.

In addition, the Beta function which Mr. Doyle argues is imposed by the AWS Code applies only to prequalified welding. Because site welding procedures for safety-related supports are qualified, the AWS provision referred to by Mr. Doyle is inapplicable. (NRC Exhibit 207 at 49; Applicants' Exhibit 142F at 7.) Mr. Doyle himself admits that if the welding procedures are qualified then he had no concern regarding this welding. (CASE Exhibit 669 at 116, 118.)

Finally, with respect to the discussion regarding tube steel ratios (CASE's Proposed Findings at V-5), this matter was also fully addressed at the hearing and is described in Applicants' Proposed Findings at 69-70. With respect to CASE's reference to the ASCE publication, we note ' at the evidence of record establishes that Applicants' pipe support designs are consistent

with the manner of treating member width ratios discussed therein. CASE, however, would go beyond consideration of the principles discussed therein. CASE, however, would go beyond consideration of the principles discussed in the publication and require detailed evaluations based on what the publication "did not indicate." Such an approach obviously is not established by "common knowledge." Thus, for the Board to consider this new arguement and material would, therefore, be improper.

In sum, CASE's principal argument regarding welding is that the ASME Code is inadequate. In this posture, CASE is challenging the NRC regulations adopting the provisions of the ASME Code (10 C.F.R. § 50.55a) claiming that as a generic matter the Code does not provide acceptable criteria for the construction of nuclear power reactors (CASE's Proposed Findings at V-10). Such challenges to the NRC regulations are prohibited and need not be considered by this Board. 10 C.F.R. § 2.758. Further, CASE's allegations regarding the applicability of the AWS Code have been shown to be incorrect. Accordingly, the Board should find that CASE's arguments are unfounded and there is no basis for accepting its recommendation for further action.[8]

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[8] With respect to CASE's reference to a twenty-year old welding handbook (CASE's Proposed Findings at V-8), Applicants note that the handbook does not even consider or mention the existence of detailed welding procedures such as are established at Comanche Peak. Those procedures are intended to prevent the type of welding deficiencies discussed therein. Thus, it is wholly inappropriate to consider such newly-raised, general information (or assertions regarding its use) as either "common knowledge" or as even relevant to welding at Comanche Peak.

6. Wall to Slab Supports

CASE raises three areas of concern regarding multiple plane supports (i.e., wall-to-wall, floor-to-ceiling and floor-to-wall) supports. These allegations concern the effects of thermal expansion under accident conditions, and differential seismic displacement and concrete creep displacements. Applicants have examined each of these allegations in their Proposed Findings at pages 40-44, and refer the Board thereto rather than repeat those findings here. Again, there are certain statements made by CASE in their Proposed Findings which warrant comment. As is evident from Applicants' Proposed Findings and the discussion below, CASE's arguments regarding these types of supports are unfounded or have been properly accounted for in Applicants' design process.

The first assertion by CASE which warrants comment is its statement that the relative displacements between a wall and a floor are greater than the displacements between the floor and the ceiling or wall and a wall in a seismic event (CASE's Proposed Findings at VI-1). CASE does not point out, however, that CASE's witness admitted that this assertion depended upon assumptions which do not necessarily occur (Tr. 7050-51). Further, even assuming the allegation of CASE's witness is correct, no evidence was presented that that situation created a concern which required evaluation in a manner other than already performed by Applicants.

In addition, CASE's arguments regarding the effects of thermal stress have already been disposed of. The effects of differential thermal expansion have been fully addressed on the record and were the subject of the Board's Memorandum and Order (Thermal Stress in Pipe Supports), July 6, 1983, wherein the Board determined that the ASME Code did not require consideration of the effects of thermal expansion in pipe supports. Thus, CASE's attempt to raise this issue once again is improper. See also discussion infra at Section II. B.23.

CASE also addresses Applicants' and the NRC Staff's conclusions regarding the upper lateral steam generator support and moment restraint. Applicants address this aspect of CASE's Proposed Findings below in Section II.B.30.

With respect to the specific actions which CASE would have the Board require of Applicants, The Board should find there is no basis for CASE's allegations and that CASE's request for further analysis by Applicants or replacement of these supports is unfounded.[9]

7. NPSI Support Design

CASE raises several arguments in this portion of its Proposed Findings regarding the adequacy of the design procedures utilized by NPSI. Applicants have already addressed these

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[9] CASE also discusses provision of an AISC manual as supporting its position regarding a reduction in bending allowables (CASE's Proposed Findings at VI-8). This argument is based on a hypothetical support, not even suggested to exist at Comanche Peak. Accordingly, the Board should not admit this new material into the record in that it is irrelevant to the issues being addressed, and neither the materials nor the method of their application is "common knowledge."

matters in their Proposed Findings. We address below not only certain of CASE's comments from its Proposed Findings, but also the material in the record to which the Board should refer to determine that these allegations are without merit.

The first of CASE's allegations concerns the procedure which permitted the release of all moments except for the axial moment in modelling of supports (CASE's Proposed Findings at VII-1 to VII-10). In this regard, the Board should refer to Applicants' Proposed Findings at 35-38. As is evident from the discussion of the record therein, CASE's allegation regarding this procedure is unfounded. Accordingly, the Board should find that Applicants correctly considered the moments in tube steel. The second aspect of CASE's allegation regarding the NPSI design procedure, involves the question of shear transfer (CASE's Proposed Findings at VII-10). CASE alleges Applicants do not adequately consider the transfer of shear stress among bolts in a support, or the manner in which that shear load is imparted upon the bolts. Again, both of these allegations are addressed in Applicants' Proposed Findings at 35-37. As noted therein, neither of these allegations raises a question as to the adaequacy of Applicants' pipe support designs. There are a few points which should to be made, however, regarding CASE's Proposed Findings.

The first aspect of this allegation is premised upon an erroneous assumption that the bolts which attach supports to the concrete structures will not engage the support simultaneously in the event of thermal expansion because the holes for the bolts

are slightly larger than the bolts themselves (in accordance with established construction tolerances). CASE would characterize these holes as "oversized" bolt holes when they are in fact established to strict construction tolerances. In fact, the construction tolerances for the bolts are established in the ASME Code. (See, Section NF-4721 (Attachment A); see, also Tr. 6885 (AISC tolerances)). In addition, Applicants and the NRC Staff testified that it is appropriate to assume the bolts react equally because of the minute deflections necessary to engage all bolts (e.g., Applicants' Exhibit 142D; Tr. 6884-85). Accordingly, the Board should find that CASE's allegation regarding engagement of bolts in shear not only is without merit but is contrary to the existence of essential construction tolerances delineated in the ASME Code.

With respect to the allegation that Applicants have not considered the bending stresses created in bolts which are inserted through tube steel, Applicants address this allegation in their Proposed Findings and refer the Board thereto for a full discussion of the record on this topic (Applicants' Proposed Findings at 35-37). As demonstrated therein, CASE's concern regarding bending moments is unfounded and gives rise to no concern regarding the adequacy of the analysis of the bolts.

CASE also presents extensive discussion regarding the adequacy of the tests conducted on the Richmond inserts. CASE questions whether the testing procedures with respect to the reinforcing steel used in the concrete in those tests were

adequate. (CASE's Proposed Findings at VII-16 to VII-23). As is stated in the portions of the transcript cited by CASE, the NRC Staff believed that the concrete, including reinforcing steel, used in the insert tests was representative of the concrete at Comanche Peak and, in any event, the number of layers of reinforcing steel was not significant (Tr. 6495-6500). These tests also are addressed in Applicants' Proposed Findings at 31-32. The Board should find that the tests performed on the Richmond Inserts were appropriate and adequately reflect the conditions which exist at Comanche Peak.

With respect to the analytical technique used to couple the torsional moment of a support as tension in the bolt and compression in the washer (CASE's Proposed Findings VII-27), Applicants discuss the evidence on this matter in their Proposed Findings at 37-38. However, there is one matter regarding this aspect of CASE's Proposed Findings which warrants addressing. CASE argues that the factor of safety should be calculated based on the ratio of yield strength to the allowable (working strength) rather than the ratio of the ultimate strength to be allowable (CASE's Proposed Findings at VII-34). As discussed above, this assumption is the source of much of CASE's confusion regarding factors of safety. The appropiate method to calculate the factors of safety is to determine the ratio of the ultimate to the allowable (see discussion supra, at Section II.B.1). Thus, CASE's allegation in this regard is unfounded. Finally, we note that each of the actions which CASE would

have the Board order Applicants take are premised on the incorrect conclusions of CASE's witnesses. As discussed above, none of the matters noted by CASE present a serious concern for the adequacy for the design of pipe supports and thus do not warrant further action on the part of Applicants.[10]

8. Richmond Insert Design

This portion of CASE's Proposed Findings concerns the design of the Richmond insert and the method of arriving at the allowables for the Richmond insert for determining factors of safety (CASE's Proposed Findings at VIII-2). The adequacy of the testing for Richmond inserts is thoroughly discussed in Applicants' Proposed Findings at pages 31-40. Therein Applicants address each of CASE's concerns regarding the Richmond insert. Again, however, there are several matters raised in CASE's Proposed Findings on which comment is warranted.

First, CASE claims at page VIII-7 of its Proposed Findings that the NRC Staff agreed that no tests on Richmonds for combined shear and tension had been performed, leaving the implication that the Staff believed such tests should be conducted. However, CASE neglects to bring to the Board's attention the Staff's further conclusion that there was no need to conduct such testing

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10 CASE refers to a portion of a letter enclosed in a Hilti catalogue in support of its arguments regarding consideration of shear and bending stresses in the bolts (CASE's Proposed Findings at VII-25 (and I-20)). Such information is irrelevant where, as here, Applicants have performed tests of bolts with actual configurations which constitute appropriate consideration of both shear and bending stresses for the configurations actually employed at Comanche Peak. Accordingly, the Board should not consider or admit this new filed material into the record, as sought by CASE.

in view of the factor of safety of three demonstrated to exist by the shear tests (Tr. 6436). Thus, CASE's implication that additional testing need be performed is unfounded. In addition, CASE claims that in analyzing the Richmond inserts, Applicants "do not consider the weakest link." CASE apparently would have Applicants consider the A307 bolts as the "weakest link" in its analysis of the inserts. (CASE's Proposed Findings at VIII-11 to V III-12.) Although Applicants addressed this point in their Proposed Findings (at pages 33-35), it bears repeating that CASE is confusing the use of design allowables applicable to the bolt in the insert assembly with design allowables for the insert itself. Applicants have employed, both in testing and design, the appropriate, i.e., weakest link, bolt and allowable for the design or test involved (see NRC Staff Proposed Findings at 40-41). In sum, CASE's assertions in this regard simply demonstrate its inability to comprehend (or to bring to the Board's attention) the fact that Applicants have appropriately considered the strength of the concrete inserts and bolts in their analyses and have conservatively determined the factors of safety associated with those inserts.

CASE's next point concerns the calculation of bending stresses in the Richmond inserts (CASE's Proposed Findings at VIII-14 to VIII-15). Applicants address this matter in their Proposed Findings at 35-36. One matter concerning this allegation which bears additional comment is made at the top of page VIII-16 of CASE's Proposed Findings. There, CASE implies

that Applicants improperly suggested that because the Richmond insert test did not go to failure a greater ultimate strength could be assumed than what was calculated. While Applicants never claimed to be able to predict what would be the response of the bolts beyond the completion point of the test, the point the Board should be aware of is that the factors of safety calculated using the ultimate stress figure from the tests are at a minimum conservatively based on the test results.

With respect to the various "recommendations" made by CASE regarding these allegations (CASE's Proposed Findings at VIII-18), the Board should concluded that based on the above discussion and the material in Applicants' Proposed Findings that there is no reason to follow any of those recommendations.

9. Local Deflections

This portion of CASE's Proposed Findings concerns the allegation that certain seismically induced deflections were not considered in the design of pipe supports (CASE's Proposed Findings at IX-1). While CASE acknowledges that Applicants' criteria limit the maximum allowable displacement of any support to 1/16 inch (and apparently does not contend that such displacement would present any safety concern), it argues that additional factors would produce local displacements greater than that criteria (CASE's Proposed Findings at IX-1 to IX-2). Applicants' Proposed Findings at 57-60 address the allegations of CASE regarding local deflections. As demonstrated in Applicants' Proposed Findings, the evidence of record demonstrates that

Applicants have appropriately considered the effects of local deflections in their design and analyses of pipe supports for which such concerns may exist are routinely identified in the as-built design verification program. In addition, the specific supports identified by CASE's witness were all designed from the early stages of the design process, contrary to what they believed (see Applicants' Proposed Findings at 24), and thus do not reflect the quality of the final design product. Accordingly, there is no basis for concluding that Applicants need reanalyze (as recommended by CASE) any of the supports at Comanche Peak.

10. Self-Weight Acceleration of Pipe Supports

CASE contends that Applicants have not included self weight acceleration of pipe supports in their pipe support designs. CASE apparently takes the position that such accelerations need be considered in the design analysis of each pipe support (CASE's Proposed Findings at X-1 to X-2). Applicants and the NRC Staff have evaluated these seismic accelerations and determined that the loads induced were negligible in most instances and in all cases did not create an over-stressed condition in the supports. Applicants and the NRC Staff determined that it was not necessary, therefore, to evaluate these effects in the designs of individual supports. (See Applicants' Proposed Findings at 52-53.) The evidence of record, as discussed in Applicants' Proposed Findings, fully demonstrates that CASE's concern on this matter is unfounded.

However, there is one matter which Applicants believe warrants comment. This is CASE's argument (CASE's Proposed Findings at X-5 to X-6) that the FSAR requires further evaluation of the seismic acceleration of supports. The Board should note that the FSAR provision referred to by CASE applies only where "no determination of natural frequency is made". In this instance, such a determination was made by Applicants' evaluation of the effect of seismic acceleration of the support (Applicants' Exhibit 142 at 30-31). CASE would have the Board read "determination" as requiring a case-by-case analysis, which is not required by the FSAR. Thus, CASE's argument in this regard is meritless.

In sum, there is no basis for the Board to require Applicants to reanalyze any of the supports at Comanche Peak to include the negligible effects of seismic acceleration of the support and hardware, as CASE recommends.

11. Generic Stiffness Evaluation

In analyzing the seismic response of the piping systems at Comanche Peak, Applicants employ a generic stiffness of value as is common industry practice (Applicants' Proposed Findings at 58-59). In this section of its Proposed Findings, CASE disagrees with Applicants' generic stiffness evaluations. For the most part, CASE's arguments are new, premised on questions which CASE had an opportunity to, but did not, pursue at the hearings or are otherwise premised on material not in the record or arguments for which no support is cited. As previously discussed, Applicants

need not and the Board should not, consider that material. Nevertheless, Applicants addressed certain of CASE's arguments because of the misimpression which may be imparted by those arguments.

First, CASE alleges that the Gibbs & Hill conducted "secret" sensitivity studies of generic stiffnesses (CASE's Proposed Findings at XXI-2). CASE apparently would have the Board base its decision on questions CASE believes should be answered but which CASE did not, although given full opportunity to, pursue at the hearing when the issue was addressed. To have Applicants (and the Board) discern the meaning and import of CASE's vague insinuations at this time is simply inconsistent with the fair conduct of administrative proceedings. Applicants note the CASE had in their possession a report regarding the generic stiffness sensitivity study (CASE Exhibit 823), but did not raise any of its objections during the hearing. Accordingly, there is no basis for CASE to argue with the adequacy of that study at this time.

Another argument presented by CASE (again first raised here) regarding the adequacy of Applicants' generic stiffness sensitivity study is that certain factors were not, but should have been, considered in that study (CASE's Proposed Findings at VI-7). This argument simply demonstrates a misunderstanding of the purpose of a sensitivity study, as was performed by Applicants. That study was undertaken specifically to investigate the effect on the frequency of the piping system

caused by variations in support stiffnesses (in this case between actual stiffnesses and the generic values) (CASE Exhibit 823 at 1). Such a study is designed to evaluate the effect of variations in particular variables (in this case support stiffnesses) on a broader concern (in this case system frequency). Thus, it is not appropriate to introduce (as CASE urges) additional factors into such a sensitivity study. To do so would reduce the validity of that study by reducing the ability to evaluate the actual sensitivity of the calculations to changes in the selected variables. The decision to include or vary different variables in a sensitivity study is appropriately left to engineering judgment. Thus, CASE's arguments are simply belated attempts to impose unsupported opinions into a matter which was fully litigated.

Further, CASE takes issue with the conclusions of Applicants' expert, Mr. Vivirito, regarding the effect of bolt hole tolerances on the seismic analysis of supports (CASE's Proposed Findings at XI-9). Although Mr. Vivirito testified that neglecting the bolt holes in seismic analyses will result in a conservative evaluation, CASE disagrees (again without any citation to record material or otherwise) with that conclusion. As discussed above, CASE apparently would have Applicants determine and evaluate the orientation of each bolt in their holes and perform further analyses on the basis of these determinations. In view of the expert testimony of Applicants' witness and the bolt hole tolerances established in the ASME Code

(see discussion supra, at Section I.B.7), CASE's suggestion that such analyses be performed is wholly unwarranted and contrary to the sound engineering judgment reflected by Applicants' testimony and the ASME Code.

Finally, we must point out a misleading statement by CASE (again unsupported) regarding the method of analysis for pipe stress in dynamic analysis as described by Applicants' expert, Mr. Vivirito (CASE's Proposed Findings IX-9). Specifically, we note that Mr. Vivirito was responding to a question by Judge McCollom regarding the dynamic analysis of structures (Tr. 7081) and not a piping system as CASE implies.[11]

In sum, the evidence of record fully demonstrates the adequacy of Applicants' method of considering support stiffnesses. There is no basis on which the Board may conclude that any further analyses of the piping and support systems need be performed as is urged by CASE.

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11 CASE also includes in this portion of its Proposed Findings (at page XI-3) a reference to a textbook on which it would have the Board rely. However, CASE's argument is premised on a hypothetical support (at page XI-2) as to which CASE makes no demonstration represents a support found at Comanche Peak. In addition, the method of applying the material in that excerpt obviously is not a matter of "common knowledge." Accordingly, the Board should find this new argument to be irrelevant and not warranting admission of the textbook excerpt into the record.

12. Torsional Rigidity and Stiffness Analyses

This portion of CASE's Proposed Findings concerns two allegations regarding the consideration of loads induced in support members from the piping system. Specifically, CASE argues as improper the use of an ITT-Grinnell procedure which used an analytical technique of assuming a high torsional rigidity factor was improper. CASE acknowledges that Applicants testified that this procedure resulted in conservative results (Tr. 7108, 7120, 7131, 7135). CASE goes on to argue with the appropriateness of this procedure. While Applicants' testimony demonstrated that this procedure was a means to conservatively calculate certain loads imposed on supports, the Board should note that this procedure was terminated and is no longer in use at Comanche Peak (Tr. 7136). Interestingly, while CASE cites the Board to Applicants' testimony that this procedure was discontinued, CASE does not bring to the Board's attention Applicants' testimony that the actual torsional rigidity value will be used in the final design review of the supports (Tr. 7136), and CASE's own statement that by removing the procedure Applicants "have rectified the problem" (Tr. 7137). Thus, the Board need not even consider this matter to be a contested issue requiring consideration in its decision.

In addition, CASE also disagrees with another procedure of ITT-Grinnell regarding the distribution of forces to a support imposed by constraint of axial loads with lugs (CASE's Proposed Findings at XII-5). CASE admits, however, that this method is

academically correct and simply argues that construction practices could result in variations of the reacting points, but does not claim that such will occur (CASE's Proposed Findings at XII-6). CASE's argument, therefore, is premised on a hypothetical situation not shown to be relevant to or likely to occur at Comanche Peak. In addition, we note that CASE makes no statement as to the safety significance of its allegation. Accordingly, there is no basis for the Board to conclude that any safety concern is raised regarding these procedures or that there is any need to conduct additional analyses of supports designed in accordance with these procedures.

13. Damage to Support During Hydrostatic Testing

This portion of CASE's Proposed Findings concerns an allegation that CASE's witnesses observed a support "fail" during hydrostatic testing. Applicants fully address this allegation in their Proposed Findings at 75-76. As demonstrated therein, this allegation is unfounded and there is no evidence of record which warrants further evaluations as urged by CASE.

14. Loads Induced on Piping

This portion of CASE's Proposed Findings concerns its allegations that certain loads imposed on piping in seismic events were not considered. These loads include the weight of the supports and attached hardware. (CASE's Proposed Findings at XIV-1.) Applicants address the allegations by CASE regarding the effect of support loads on pipe stresses in their Proposed Findings at 53-54. We believe those findings adequately address

CASE's allegations. We note, however, that CASE's Proposed Findings on this subject consist primarily of general allegations and attacks on Applicants' witness with no particular challenge to the conclusions reached by Applicants or the SIT. Thus, while CASE alleged that its testimony stands "unchallenged", in actuality it is the testimony of the NRC Staff that is unchallenged. Specifically, the Staff notes that the weight of the support structure (which includes attached hardware) is considered by Applicants' pipe stress analysis groups on a case-by-case basis. The Staff further found that Applicants' practice was to include the weight of the support in the pipe stress analysis if the support weight exceeds even a small percentage of the supported pipe weight. Their conclusion was that this approach was acceptable and did not present any safety concern. (NRC Exhibit 207 at 36-37.) The remainder of CASE's assertions in this portion of its Proposed Findings are unsupported or inconclusive. Thus, there is no basis to find that there is any safety concern warranting a different approach to consideration of these loads in pipe stresses.

15. Kick Loads

In this portion of its Proposed Findings CASE acknowledges the testimony of the NRC SIT regarding Applicants' consideration of kick loads, and does not disagree with that discussion except to contend that the SIT did not address when the consideration of kick loads commenced at Comanche Peak (CASE's Proposed Findings at XV-2). Applicants address the consideration of kick loads in

their Proposed Findings at 63. CASE also raises a question in its findings regarding the self-weight excitation of a particular support and its attachments which it submits would cause instability. (CASE's Proposed Findings at XV-3-4.)

Again, CASE does not dispute the NRC's analysis of this concern except to state that Applicants' analyses of these runs were performed after CASE's witness had made his allegations (CASE's Proposed Findings at XV-3 to 4). Thus, there appears to be no dispute over any aspect of this allegation except for the timing of Applicants' consideration of these factors in their pipe support designs.

As discussed previously, that any particular aspect of pipe design support may have been addressed in the as-built process following CASE's witness' allegation is meaningless. The as-built verification process was in its early stages at the time CASE's witnesses left Comanche Peak. Thus, it is to be expected that particular design aspects may not have been addressed until after that date. Further, because all of the supports which were submitted by CASE had not proceeded through the entire design process, it also is not surprising that changes in those designs would be made at a later date to reflect further analyses of the piping and support system or design deficiencies not previously identified. That such instances may have occurred has no causative relationship with the existence or non-existence of

CASE's allegations. Accordingly, CASE's assertions regarding the timing of the identification or evaluation of particular aspects of pipe support design are meaningless.

In sum, there is no basis for the Board to conclude that there is any concern regarding the consideration of kick loads or self-weight excitation in the design of pipe supports at Comanche Peak. Thus, the Board should not consider imposing the "recommendations" made by CASE in connection with this allegation.

16. Friction

This allegation concerns a belief by CASE that two of the pipe support design organizations limited consideration of friction loads to piping movements greater than 1/16 of an inch. Applicants address this allegation in their Proposed Findings at 61-63. We believe that discussion fully evaluates and disposes of the allegation. We nonetheless feel compelled to bring to the Board's attention another example of CASE's incomplete citation to the record in support of its position. In this instance, after discussing Applicants' and Staff's positions on this allegation in its Proposed Findings, CASE refers the Board to the discussion with Mr. Doyle regarding his analysis of this matter. CASE ends its discussion of the record with a paraphrase of Mr. Doyle's conclusion as follows:

> His argument was that although the support will not immediately fail, you have exceeded the allowables established for that specific load condition. (CASE's Proposed Findings at XV-7 (emphasis in original).)

CASE leaves the impression that Mr. Doyle had concluded that the allowables for the type of support involved here would be exceeded and that the support would eventually fail. However, if the Board examines the complete transcript, it will see that Mr. Doyle actually stated that the allowable which he believed would be exceeded is for the normal and upset conditions but that any support failure which would occur would be under faulted conditions, and that allowable would not be exceeded. (Tr. 6827-28). Mr. Doyle went on to describe that his disagreement was with the engineering judgement employed, but that even under his approach the matter was no longer of concern to CASE, concluding that in fact "the problem dwindles into insignificance" (Tr. 6829). Thus, CASE incorrectly would have the Board believe that the issue was still of concern and should be further considered by the Board.

Accordingly, the Board should find that no safety concern is presented by this matter, that there is reasonable assurance that the consideration of friction loads in the design of pipe supports is adequate, and that there is no reason to require the actions recommended by CASE.

17. Induced Loads From Trunnions

This portion of CASE's Proposed Findings addresses the allegation that the effects due to welded stanchions (trunnions) on certain piping runs were not included in the piping stress analyses (CASE's Proposed Findings at XVII-1). Applicants address this allegation in their Proposed Findings at 55-57.

Therein, Applicants fully examine the record on this allegation and demonstrate that these effects are being considered in Applicants' pipe support design process. Accordingly, there is no basis for CASE's allegation. CASE appears to recognize that this matter will be addressed in Applicants' as-built piping analysis, but instead questions once again the timing of that analysis. (CASE's Proposed Findings at XVII-4). We address above, the insignificance of such assertions. (See discussion supra at Section I.B.15.) In addition, we must note that in this instance the particlar loads which CASE apparently would have Applicants consider from the initial stage of the pipe support design process, could not even conceivably be considered at that stage because it initially is not known at that whether welded attachments will be used on the supports (Applicants' Exhibit 142 at 25-26).

Another generic matter which CASE raises is that the SIT limited their review only to those supports specifically identified in connection with the allegation (CASE's Proposed Findings at XVII-6). In reality, the SIT conducted not only a specific review of supports identified by CASE, but a programmatic review to determine whether the considerations involved in particular supports were considered throughout the pipe support design process (NRC Exhibit 207 at 38-39). Thus, CASE's assertion is incorrect.

In sum, the Board should find that there is reasonable assurance that the design of pipe supports at Comanche Peak adequately consider the loads induced from trunnions and that there is no basis for concern regarding the safety of the piping system as a result of these allegations. The Board should also find that there is no basis for concluding that the Applicants should conduct additional piping analyses, as recommended by CASE, because these effects already are considered routinely in Applicants' pipe support design process.

18. Section Properties

The allegations involved here concern the use of material properties for the tube steel used in the design of pipe supports. CASE contends that there are differences in member properties between different editions of various manuals of member properties used at Comanche Peak by the three pipe support design organizations which, CASE alleges, result in variations in calculated loads. This allegation is fully addressed in Applicants' Proposed Findings at 71-73. As discussed therein, the differences in member properties are relatively insignificant and do not result in any significant differences in stresses. Applicants nonetheless have reevaluated the support designs using the latest member property values for those supports on which the effects were greatest. The Board should find that there is no basis for concern regarding the adequacy of the design of pipe

supports using these member properties and that the recommendation by CASE that additional analyses be performed is unfounded.

19. "Errors" In Equations

This portion of CASE's Proposed Findings concerns an allegation that certain of Applicants' calculations submitted contained errors. As shown below, a major portion of this section of CASE's proposed finding is comprised of new assertions regarding these matters. CASE does not cite to material in the record to support its opinions, but rather describes them as an expansion of its previous arguments (CASE's Proposed Findings at XIX-2). As previously noted, it is patently unfair and contrary to the reasoned conduct of the adjudicatory process for the Board to rely on this material. Nonetheless, out of an abundance of caution, Applicants address the principle arguments raised by CASE. As shown below, those arguments present no basis for doubting the adequacy of the design of pipe supports at Comanche Peak.

The first concern which CASE raises does not involve an error in calculations, but rather a disagreement by CASE with the Applicants' method of assessing the effects of thermal expansion on certain support configurations. CASE would have the Board believe that this discussion is simply an expansion of the previous testimony of its witness. (CASE's Proposed Findings at XIX-2). However, if the Board examines the cited portion of CASE's witness' testimony and compares it to the discussion in

its Proposed Findings, it will be obvious that this is something significantly more than an expansion of CASE's previous arguments. In fact, it is a totally new discussion and one on which CASE should not be permitted to rely. Nevertheless, Applicants make the following points regarding this allegation. First, CASE would have the Board require additional consideration of the thermal expansion effects on the posts and welds of these supports. These precise effects have already been considered by the Board and determined to be within the scope of its decision regarding consideration of thermal stresses under the ASME Code (Tr. 6269). Further, CASE argues that the effects on the anchor bolts from this expansion should be, but were not considered. Applicants have already testified that the effects on anchors of thermal expansion of the support need be considered (Tr. 6233-34). CASE presents no evidence demonstrating that Applicants will not consider those effects. There is no basis on which to conclude that Applicants' consideration of those effects will not be adequate.

Another aspect of CASE's Proposed Findings which needs to be addressed concerns its assertion that Applicants have not considered the loads in addition to the thermal expansion loads on anchor bolts. (CASE's Proposed Findings at XIX-4.) This assertion, again a new assertion relying on material not in the record, simply fails to recognize the scope of Applicants' examination of the effects on anchors. As is evident in Applicants' Exhibit 142D (Attachment 2), Applicants have combined

the displacements in addition to thermal in calculating the total displacement which may occur on the bolts and the associated factors of safety. As seen therein, even considering these loads and resulting displacements, the factor of safety is (for the bolt addressed in CASE's Proposed Findings) 6.1. Thus, CASE's assertion on this matter is in error. In addition, CASE has made a fundamental error in its method of analysis on this point. CASE incorrectly contends that loads for displacement-limited stresses should be added to determine the ultimate effect on the bolt. In actuality, it is necessary to combine, for displacement-limited loads, the displacements which would be imposed upon the bolts (see Applicants' Exhibit 142D at page 5 (page 4 of text), final paragraph).

CASE also addresses in this section of its Proposed Findings various concerns regarding the calculations concerning the upper lateral restraint. (CASE's Proposed Findings at XIX-6 to XIX-17.) These arguments are addressed later in Section II.B.30.

Finally, CASE presents a lengthy discussion regarding the moment restraint and the effects of thermal expansion on the joints of that restraint and the shear keys welded to the base plates (CASE's Proposed Finding at XIX-18 to XIX-25). With respect the first aspect of this discussion (effects of thermal expansion on joints), CASE rehashes a lengthy debate during the hearing concerning the question of determining whether the ASME Codes's preclusion of thermal stresses from linear pipe support design also was intended to exclude the stresses arising in pipe

support frames (i.e., multiple member supports). While CASE goes into excruciating detail regarding this discussion, it stops short of noting the ultimate conclusion of this debate. In particular, CASE fails to point out that following this discussion the Board ruled that the support frame should be treated as a single body with respect to the consideration of thermal loads. (Tr. 6269.) At best, it is disingenious for CASE to fail to cite for the Board in its proposed findings the Board's decision disposing of an issue.

Another aspect of CASE's argument regarding the moment restraint concerns the question of shear keys. Applicants have already addresed this matter in their Proposed Findings at pages 39 and 80-81. The discussion therein fully disposes of the question of shear keys by demonstrating that Applicants' analysis of the effects of thermal expansion on the anchors without considering shear keys is conservative.[12]

In sum, there is no basis for the Board to conclude that any of the matters addressed in Section XIX of CASE's Proposed Findings raises any doubt as to the adequacy of the design of pipe supports at Comanche Peak and does not warrant the reanalysis of supports which CASE recommends.

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12 CASE also would have the Board consider a portion of an engineering journal to support its argument regarding the determination of ultimate shear and tension values. (CASE's Proposed Findings at XIX-4). This journal is irrelevant to Comanche Peak and the isues to be decided here in that Applicants performed tests and conducted evaluations using the actual configurations and anchor assemblies used at Comanche Peak. The Board should not consider nor should it admit into evidence this new information which has not been shown to constitute "common knowledge" or even to be relevant to the issues to be decided here.

20. ASME In-Service Inspection

This portion of CASE's Proposed Findings concerns a support design which CASE contends violates the provisions of ASME Section XI governing in-service inspections. In addition, CASE contends that a kick load is imparted on this particular support. CASE does not contend that this support exists at Comanche Peak or, if it did, the kick load was not considerd. Applicants fully address the question of the welding over girth welds and its implications for in-service inspection in their Proposed Findings at 73-74. Further, as Applicants testified (Tr. 5206), the drawing which CASE's witness submitted on this point was merely a preliminary design which was never released for construction. Applicants fully address the consideration of kick loads at Comanche Peak in their Proposed Findings at page 63. Th re is no basis to conclude that Applicants have not properly considered effects of kick-loads or satisfied the requirements governing in-service inspections.

21. Shear Distribution in Bearing Connections

CASE contends in this portion of its Proposed Findings that the bearing-type connections used at Comanche Peak are "inappropriate for use as mechanisms for supporting structures during seismic events" (CASE's Proposed Findings at XXI-1). While CASE alleges that there are advantages to using friction joints, and argues that two systems at Comanche Peak for anchoring supports are satisfactory, it argues (without specification), that adverse consequences would arise by not

considering these connections as friction joints. Thus, while claiming bearing type connections are "inappropriate," CASE does not describe what it believes the consequences of the use of these connections would be. Such unfounded and incomplete arguments need not be further considered by the Board.

In any event, the Board should note two points regarding CASE's discussion. First, CASE continues to maintain that Hilti bolt connections are friction joints (CASE's Proposed Findings at XXI-1), even though Applicants testified that these connections act and are designed as bearing type connections (Applicants' Exhibit 142F at 5-6). Thus, the ability of CASE to even distinguish between friction and bearing joints is doubtful. Second (although the purpose of the assertion is not clear), CASE's statement regarding Bellville washers being "recommended" to determine that torque in a connection is maintained at a predetermined value, is simply the opinion of CASE's witness, because the document cited in support of this position does not even address the purpose of the washers, as admitted by CASE's witness during the hearing (Tr. 7045-46). Thus, CASE once again asserts a position which was shown to be inaccurate during the hearing without acknowledging here that it already admitted to the inaccuracy. Such repeated oversights fly in the face of the Board's directive for the parties to address all relevant and material evidence in their Proposed Findings.

One final point to be made regarding this topic is that having argued that friction joints would be better than bearing-type joints, CASE goes on to argue that assuming Applicants in fact used bearing-type joints, consideration should be given to the manner in which bolts attaching the support to the structure will become engaged upon displacement. CASE argues that it may not be assumed that these bolts will engage simultaneously (in view of construction tolerances for bolt holes) and that the existence of these tolerances would effect the flexibility of the joint. (CASE's Proposed Findings at XXI-4 to XXI-5.) Applicants have addressed both the bolt loading in supports and the effect of slippage (if it should occur) at the anchorage on support seismic response. Applicants' Proposed Findings at 35-37, 54-55. The discussion therein fully addresses CASE's allegations. Thus, there is no basis for finding that CASE's recommendation for further analyses should be followed.

22. OBE v. SSE Loads

CASE argues in this portion of its Proposed Findings that Applicants have not properly considered various damping factors in its seismic analyses (CASE Proposed Findings at XXII-1). The issue from which this new allegation arose concerned certain differences in calculated loads on a support as to which CASE did not understand the reason for the differences. This matter is fully addressed in Applicants' (at pages 67-68) and the NRC's (at pages 75-77) Proposed Findings. CASE did not refute those conclusions during the hearing but rather supports its arguments

now with new material (CASE's Proposed Findings at XXII-3). The Board has already determined it will not admit such late-filed material (see September 1, 1983, Memorandum and Order at 4). Thus, no further consideration of CASE's arguments are necessary.

23. Thermal Expansion Stress

This portion of CASE's Proposed Findings addresses the question of whether thermal stresses induced in pipe supports as a result of increased temperature in the event of a loss-of-coolant accident need be evaluated in the design of pipe supports. This matter was disposed of in the Board's July 6, 1983 Memorandum and Order (Thermal Stress and Pipe Supports). CASE simply disagrees with that decision and the Board's subsequent denial of CASE's motion for reconsideration. CASE presents no arguments which warrant the Board to examine further its prior decisions regarding consideration of thermal stresses.

24. Interfaces Between Pipe Support Design Groups

In this section of its Proposed Findings, CASE alleges that the Site Stress Analysis Group ("SSAG") and the STRUDL Group were performing design functions for which interface procedures need be established. This topic was examined in detail during the hearings and Applicants address the matter in their Proposed Findings at pages 12-18. Therein, Applicants demonstrate that the SSAG and STRUDL Groups were not design organizations as contemplated by ANSI N45.2.11. Thus, there was no responsibility for establishing design interfaces between these groups and the other pipe support design groups. In any event, as discussed in

Applicants' Proposed Findings, Applicants established detailed procedures to document the responsibilities of each engineering organization, including the SSAG, and the lines of communication between the different organizations (Applicants' Proposed Findings at 17). Applicants note that at the conclusion of the discussion of this topic at the hearing, the Board correctly identified the determinative factor in this discussion, viz., that the pipe support design groups, although using the STRUDL Group to perform a portion of their analyses, retained responsibility for the accuracy of their designs (Tr. 6989). Thus, the standards applicable to the establishment of procedures for interface between organizations with design responsibility are inapplicable to the SSAG and STRUDL groups because they are not design groups. Accordingly, the Board should find that Applicants have satisfied the requirements governing the establishment of design interfaces and that CASE's allegations to the contrary are without merit.

25. "Lack" of Quality Control for Engineering at Comanche Peak

In this section of its Proposed Findings CASE addresses its allegations that Applicants did not properly apply the requirements governing the documentation of non-conforming conditions (10 C.F.R. Part 50, Appendix B), or the reporting of significant deficiencies (10 C.F.R. § 50.55(e)). Applicants fully address the question of non-conformances and reportability in their Proposed Findings at pages 26-28. As described therein, both the NRC Staff and the Applicants were in agreement regarding

the proper interpretation of the requirements governing the documentation of non-conforming conditions and the reporting of significant deficiencies and were aware of no instances in which Applicants had not satisified those requirements in the design of pipe supports. Accordingly, the Board should find there is no basis for CASE's position on these matters nor is there any reason to follow CASE's recommendations for further investigations or inspections. However, a few points in this portion of CASE's Proposed Findings warrant additional comment.

First, CASE argues (apparently as an example of situations requiring documentation of non-conforming conditions) that the purpose of the field engineering group, i.e., to resolve interferences in the field expeditiously (Tr. 4958), is somehow improper. Contrary to CASE's argument, the work of this group is important to the goal of installing permanent supports, a function which obviously would not be performed if "temporary supports" (as asserted by CASE) were employed. In addition, regarding CASE's claim that there is a contradiction inherent in a statement by Applicants' witness, Mr. Finneran, regarding field engineers performing some calculations before authorizing modifications, we are unable to discern any contradiction between that statement and any previous or subsequent statement of Mr. Finneran.

In addition, Applicants note that CASE's discussion of the design verification and checking process (CASE's Proposed Findings at XXV-16 to XXV-17) addresses only the last stages of

that process, viz., final engineering approval, in claiming that the practice is contrary to Section 6.1 of ANSI N-45.2.11 (Applicants' Exhibit 148). CASE would have the Board believe this final engineering approval constitutes the design verification and checking process discussed in that ANSI provision. However, the Board should examine the discussion immediately preceeding the portion of the transcript cited by CASE in which the detailed verification and checking process is discussed. This verification and checking process involves two levels of independent review of design assumptions and calculations of each support before the final certification process cited by CASE takes place (Tr. 7185-89). Thus, CASE again misleads the Board by omitting any reference to the key portion of the record regarding its allegation. As can be seen by a review of the complete discussion, Applicants fully satisfy the ANSI provision for design verification and checking.

26. QA/QC Oversight

In this section of its Proposed Findings CASE attempts to demonstrate that the qualifications of the personnel performing pipe support design and design review were inadequate. CASE would have the Board believe that Applicants' employees in the pipe support design area were unqualified for the positions which they held. As discussed below, each of the pipe support design groups at Comanche Peak is staffed with personnel fully qualified to perform the functions for which their groups are intended.

As discussed in Applicants' Proposed Findings at 24-25, the level of experience and expertise of personnel in the pipe support design area varies through the stages of the pipe support design process, but in all cases personnel are fully qualified to perform the functions for which they are employed. Thus, there is no basis for CASE's argument that any of these people were not properly qualified and the Board should find that the qualifications of the personnel in the various pipe support design groups are satisfactory and commensurate with the functions of those groups. Applicants nonetheless discuss below several points which CASE raises which require clarification to enable the Board to consider all the relevant evidence on this matter, rather than only that cited by CASE.

In the first instance, CASE has again resorted to using the description of qualifications of the field engineers as applying to the full pipe support design organization. (CASE's Proposed Findings at XXVI-22 to XXVI-4.) As previously noted, see discussion supra, at Section I.B.3, the field engineers serve a limited purpose (resolution of interferences during the installation of supports) and have no design responsibility (Tr. 4954-58). Thus, their qualifications certainly are not (nor need they be) as substantial as persons with design responsibility. CASE's deliberate misapplication of the facts on this matter is wholly improper.

In addition, we must comment on CASE's statement that all supports which it identified are unstable regardless of up or down stream supports and thus suggests Applicants' statement that the stability of supports depends on the adjacent supports and piping is incorrect. (In support of its position, CASE references only a general discussion by Mr. Doyle on instability.) (CASE's Proposed Findings at XXVI-10 to XXVI-11.) We find this to be an interesting assertion in that even Mr. Doyle himself admitted that the stability of supports is dependent upon the configuration of the adjacent supports and piping system. (CASE Exhibit 669 at 210.)

Further, CASE again attempts to rehash the thermal expansion question (page XXVI-12) in contesting the opinion of Dr. Chang and Mr. Finneran. CASE states, without citation, that all compresive stresses are required to be limited to 2/3 of the critical buckling stress. However, CASE does not acknowledge that the 2/3 critical buckling stress limitation applies to mechanical loadings (not secondary stresses such as thermal stress). This error is evident by comparing the provisions of Section NF-3231 of the ASME Code wherein the limits of mechanical loads and effects from the constraint of free-end displacement (but not thermal stresses) are addressed by reference to Appendix XVII-2000. It is from Appendix XVII, Section 2110(b) that the 2/3 critical buckling stress value arises. (Attachment B) Thus, besides attempting to relitigate a matter (thermal stress) already disposed of by the Board, CASE misleads the Board in the

proper interpretation of ASME Code. We also note (again) that CASE's attempt (again) to assert that construction tolerances for bolt holes must be accounted for in support frequency calculations (CASE's Proposed Findings at XXVI-14,15) directly conflicts with the testimony of Applicants' expert, Mr. Vivirito, that not considering the effects of those tolerances is conservative. See Applicants' Proposed Findings at 54-55.

Another matter warranting comment is CASE's assertion (at XVI-18) that Applicants' witness incorrectly testified the applicability of 10 C.F.R. Part 50, Appendix B to pipe support design. CASE conveniently does not refer the Board to Mr. Finneran's further explanation of that statement, which clarified the intent of the statement cited by CASE (Tr. 5029). Also, the discussion at pages XXVI-23 to 26 concerns the evaluation of thermal expansion stresses, which has already been ruled upon by the Board. Finally, we must also note that CASE again incorrectly refers to Regulatory Guide 1.124 regarding consideration of stresses using plastic analysis in considering large deformations (CASE's Proposed Findings at XXVI-26). Such considerations are applicable to mechanical loadings producing large deformations, rather than the minute local deformations resulting from thermal expansion stresses (see note 3, supra).

In sum, CASE's assertions regarding the qualifications of Applicants' pipe support design personnel are unfounded and the evidence which it cited is in many instances incomplete and misleading to the Board. CASE's other assertions in this portion

of its Proposed Findings are similarly unfounded. Thus, CASE's "recommendations" for additional review of pipe support designs is unfounded, and the Board should so find.

27. Credibility and/or Competence of Witnesses

In this portion of its Proposed Findings, CASE expends an extraordinary amount of verbage in attempting to raise anew matters which have already been considered and disposed of by this Board. CASE points to no instances in which any of those witnesses testified with other than full candor and truthfulness. Rather, CASE would have the Board construe statements which demonstrate disagreement with CASE's position as reflecting on the credibility and/or competence of the witnesses. CASE apparently is unable to accept that persons with greater levels of expertise and experience than CASE's witnesses could disagree with any of CASE's positions. In any event, Applicants address the qualifications and expertise of all witnesses in their Proposed Findings at pages 2-10. Therein, Applicants discuss the qualifications of each party's witnesses based on facts, rather than innuendo and implication. Accordingly, we do not address here each specific instance which CASE claims reflects on the credibility and competence of Applicants' and Staff's witnesses. A reasoned examination of the evidence which CASE presents in support of its assertions will reveal the insubstantial nature of CASE's arguments.

We note below those portions of this section of CASE's findings which have no bearing on the issues at hand and are in reality an attempt by CASE to bring before the Board material which it failed to do when it did not submit Proposed Findings on Contention 5 and which concerns issues the Board has already ruled CASE has abandoned. This material falls into two general categories as follows:

(1) Material stricken or otherwise excluded from the record (CASE's Proposed Findings at XXVII-1 to 2, XXVII-9 to 14; and, XXVII-30).

(2) Material irrelevant to pipe support design (e.g., construction QA allegations) and already ruled upon by the Board and/or determined to have been abandoned by CASE. (CASE's Proposed Findings at XXVII-5 to 9; XXVII-33 to 34; and, XXVII-42 to 48.)

The Board need not, and should not, consider any of this material.

There are a few other observations which we would like to make regarding this section. First, in its discussion regarding a calculational error in one of Applicants' studies, CASE implies that Applicants are reluctant to admit mistakes and thus somehow were unwilling to promptly correct deficiencies in design of pipe supports. The evidence of record, however, indicates Applicants did acknowledge these calculational errors. CASE apparently would have Applicants refrain from commenting on their significance. In addition, the evidence of record fully demonstrates that Applicants' pipe support design process is thorough and reliable. Whether Applicants' exercise their rights to testify regarding the significance of those errors does not

detract from the overwhelming evidence regarding the effectiveness of the pipe support design process as a whole. We add that CASE itself has been rather reluctant to admit the fallacy of any of its allegations. We have identified only one instance (friction loads) in which CASE admitted upon consideration of the evidence before it that its allegation did not present any serious safety question and yet in that instance, CASE did not even acknowledge in its Proposed Findings that such an admission had been made.

Finally, we must comment on CASE's discussion of the testimony of Mr. Vivirito regarding the experience at fossil power stations of piping response in seismic events. We note that this material was simply submitted for the Board's information and Applicants did not request that the Board rely on this material in any way (Tr. 7066). However, because of CASE's extensive dissertation on this matter we feel compelled to address a few of CASE's comments on this matter. In the first instance, CASE claims that it was surprised by this statement. However, we note that CASE did not even request to cross-examine Mr. Vivirito on any of this material at the hearing. If CASE believed rebuttal to this material was important to its position, it should have requsted an opportunity to do so at that time.

We also must take issue with the implication that Mr. Vivirito fabricated his statement (CASE claims it is undocumented), and in particular his statement as to the maximum ground acceleration experienced during an earthquake at a power

plant. CASE would have the Board believe that the maximum acceleration for any earthquake is fixed at .5 G's. (CASE's Proposed Findings at XXVII-27.) We cannot let stand such a claim unchallenged. Mr. Vivirito's comments were drawn from a paper presented at the Second ASCE Specialty Conference on Civil Engineering and Nuclear Power (September 15-17, 1980) by Robert L. Cloud, titled "Seismic Performance in Past Earthquakes." As noted in that paper, at p. 1-3-18, the seismic acceleration experienced at the El Centro Steam Power Station was determined to be about 0.6g vertically. We have attached the applicable portion of that paper hereto (Attachment C). Again, we do not ask the Board to rely on or accept this material into the record. We present it simply to demonstrate the inaccuracy of CASE's remarks on this topic. In view of the regulatory context in which this material was presented (Tr. 7066), and the Board's denial of CASE's motion to supplement the document on which its discussion on this matter is premised (Memorandum and Order (Motions to Reopen and to Strike,, September 1, 1983), the Board need not rely upon the discussions concerning this topic in reaching its decision except as it may deem appropriate as experiential information (Tr. 7064).[13]

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13 CASE's citation to another NUREG in support of its position regarding seismic experience at other power plants (at page XXVII-24) obviously involves matters subject to dispute and thus does not warrant admission thereof into the record as information constituting "common knowledge."

In sum, we submit CASE's arguments regarding the credibility of witnesses are unfounded and misleading, and are in great measure simply attempts to resubmit matters already disposed of, and the Board should so find.

28. Applicants' Proposed Findings

CASE addresses briefly certain aspects of Applicants' Proposed Findings on pipe support design in Section XXVIII of its Proposed Findings. For the most part, CASE merely reiterates its positions on certain topics, with few citations to the record. Applicants submit that each of the matters addressed by CASE are adequately addressed by Applicants in their Proposed Findings. We discuss each of these items briefly below, utilizing alphabetical notations.

CASE Item	
B	This matter is adequately addressed in Applicants' Proposed Findings. *See, also*, discussion *infra* regarding "open" items in NRC Proposed Findings.
C	If Mr. Doyle's concern is with respect to the welds in the support frame (CASE provides no citation to the record), the issue is disposed of by the Board's decision regarding consideration of thermal stresses in support frames.
D	CASE merely disagrees with the relative significance of these effects. Applicants demonstrated in the cited portion of their Proposed Findings that these effects were, in fact, insignificant.
E	Mr. Doyle's statement demonstrates he agreed with the *principle* (as Applicants stated) that adequate stability may be assured by preventing rotation of the pipe within the support frame. He disagrees, however, with the

determination that a U-bolt may be used for that purpose. Applicants demonstrated the acceptability of that use in the cited portion of their Proposed Findings and at pages 47-51 thereof.

F CASE does not address the significance of its error or the significance of its claim even if the error is corrected. We also refer the Board to pages 65-66 of the NRC's Proposed Findings, where the insignificance of this concern is demonstrated.

G Applicants continue to be amazed that CASE ignores the conclusion of its own witness that this matter is not a significnt safety concern. See discussion supra at Section I.B.16.

H CASE appears to admit that Mr. Doyle is not an expert in welding (as they must in view of Mr. Doyle's own testimony), but only claim Mr. Doyle is "versed" in the procedures applicable to welding at Comanche Peak. Applicants submit he was not even "versed" in the applicable codes or procedures concerning welding at Comanche Peak. See Applicants' Proposed Findings at 68-71.

I CASE continues to ignore the importance of considering the entire design process, rather than the "snapshot" it presented to support its allegations. Applicants have presented extensive evidence demonstrating that the entire design process must be considered in determining the adequacy of that process. See Applicants' Proposed Findings at 18-28.

J Applicants fully address the manner in which changes in section property values are evaluated at Comanche Peak in their Proposed Findings at 71-73. CASE simply argues with the timing of that evaluation, which is irrelevant to the decision of whether Applicants properly considered those changes.

In sum, CASE has failed to point to any substantive evidence contradicting the discussion in Applicants' Proposed Findings. CASE had over two weeks to consider Applicants' Proposed Findings. It was able only to identify a few aspects of those Proposed Findings in which it believes Applicants "erred or failed to answer the allegations" or to claim that "many" of the points in Applicants' Proposed Findings are covered in the text of its (CASE's) Findings. (CASE's Proposed Findings at XVIII-1.) To the extent CASE fails to dispute the issues addressed in Applicants' Findings, the Board should find that CASE accedes to the Applicants' positions and determine those matters in Applicants' favor.

29. Reportabilty of Non-Conforming Conditions

This section of CASE's proposed findings quotes extensively from various regulations, industry standards, NRC guidance and policy and Applicants' FSAR and procedures. CASE claims that Applicants are in violation of all of these materials. (CASE's Proposed Findings at XXIX-1.) Except for a brief discussion regarding the documentation of non-conformances in the context of an amendment to the FSAR, CASE does not discuss at all the violations which it alleges have occurred. Thus, there is no information contained in this portion of the proposed findings on which Applicant need comment. We note that CASE has raised the documentation of non-conformances and reportability issues in other aspects of its proposed findings, and we have addressed those in that context. As for CASE's discussion of the amendment

to the FSAR, it simply summarizes the amendment and the changes it perceives have ocurred as a result of the amendment. CASE makes no statement as to any alleged violation or any non-compliance with applicable regulations, standards or guidance. Accordingly, the Board should find that this section presents no information which it need address.

30. Upper Lateral Steam Generator Support

CASE makes several arguments scattered throughout its proposed findings regarding the adequacy of Applicants' calculations concerning the upper lateral steam generator support (CASE's Proposed Findings at I-4 to 5, VI-10 to 11, XIX-6 to 17, and XXVII-16.) Applicants have thoroughly addressed CASE's allegations regarding this support in their Proposed Findings at 77-80. Accordingly, we do not reiterate here that disussion. We must comment, however, on certain portions of CASE's proposed findings regarding this support.

Before addressing the specific assertions made by CASE in its Proposed Findings, we believe that it is appropriate to reiterate to the Board the basic difference in engineering fundamentals between Applicants' and the NRC's expert witnesess, and CASE's witnesses. One key point of disagreement is the source of virtually all contentions regarding pipe support design and is particularly evident in the discussion regarding the upper lateral steam generator support. This disagreement concerns the nature of displacement-limited loads imposed on pipe and pipe supports and the appropriate manner to assess those loads. As

Applicants have time and again demonstrated, loads which are displacement-limited are appropriately evaluated by examining the effects resulting from the maximum displacement. As Applicants have shown, such self-limiting loads may lead to, if one were to simply apply the mathematical formulas for mechanical loadings, calculation of substantial stresses within the displaced material. However, because these loads are fully relieved as the displacement reaches it maximum, the key concern is with the effect on the material from the maximum displacement. CASE, on the other hand, has refused to acknowledge throughout this proceeding that certain loads may be self-limiting and that the mere application of formula intended for calculating stresses under continuous mechanical loadings, produce unrealistic, and in fact, erroneous results. CASE apparently believes that if the stress calculated to be produced in a material by a displacement-limited load exceeds the known ultimate stress of that material, then "failure" must be assumed to occur. This miscomprehension is no more evident than at page XIX-17 of CASE's Proposed Findings, where CASE comments upon the statement of Applicants' expert, Mr. Vivirito, that consideration of effects from thermal expansion should be made if those <u>effects</u> are significant. Mr. Vivirito stated as follows:

> Not if the stresses are significant. If its <u>effects</u> are signficant. (Tr. 6062 (emphasis added).)

CASE states "this statement is without meaning." Further down the same page CASE asserts that the "numbers" calculated for the force in the walls to which the upper lateral support is attached "would have both the beam at or above collapse load and the wall in serious trouble." CASE's refusal to acknowledge the self-limiting nature of certain types of stresses is simply illogical.

Further, we make the following comments regarding statements in CASE's Proposed Findings which are misleading or simply in error and which demonstrate the fundamental misconceptions of CASE's witnesses. First, CASE argues that Mr. Vivirito was incorrect in stating that the difference between his and Mr. Doyle's calculations was approximately 5 per cent. CASE contends the actual difference was 230 percent. (CASE's Proposed Findings at I-4.) This is another example of the fundamental error of CASE's approach. Mr. Vivirito was addressing the differences between calculations of the maximum deflection of the steam generator wall (Tr.6042-43), while CASE is speaking of differences in calculated loads, which it erroneously would have the Board believe are the critical (and only) factors to be considered. Next, CASE contends that because the calculated stresses in the wall are close to the yield stresses of the reinforcing steel, the concrete must be expected to be close to catastrophic failure (CASE's Proposed Findings at I-4 to 5). Again, however, as Mr. Vivirito testified, the important point to consider is that because this is a displacement-limited effect, the key concern is whether the <u>strain</u> on the reinforcing steel,

which with the defelections involved here, remains far below the ultimate strain and thus cannot reach the point of failure which CASE foresees (Tr. 6052-63, 6173-6215, 6830-51). This instance is simply another example of CASE's failure to grasp this controlling consideration.

Finally, we must comment on CASE's proclivity for raising portents of disaster which are wholly irrelevant to the issues at hand. We generally do not concern ourselves with this type of meaningless hand-waiving, but do so here because it is a perfect illustration of CASE's inability to grasp the concept of self-limiting stresses. CASE argues that the well-known failure of a suspended walkway in a Kansas City hotel demonstrates that one cannot "assume that relief will be achieved [by small deflections] and that therefore calculations are not required to be accurate . . . ." (CASE's Proposed Findings at XIX-9). CASE erroneously believes (or at least would have the Board believe) that the continuously applied loads on those walkways (the combined weight of the walkway and people) present the same fundamental considerations as do the self-limiting loads that are under consideration here. Such an analogy obviously is in error. CASE's discussion thereof should be considered by the Board only as an illustration of CASE's inability to grasp the most rudimentary considerations appropriate for evaluating self-limiting stresses.

31. Moment Restraint

CASE also presents a few arguments regarding the moment restraint addressed in detail at the hearings (CASE's Proposed Findings at VIII-11 to 12; XIX-18). Applicants have already addressed these allegations in detail in their Proposed Findings, at pages 80-81. We refer the Board thereto for a discussion regarding the relevant and material issues concerning this restraint.

II. NRC Staff Proposed Findings -- Open Issues

The NRC Staff filed its Proposed Findings regarding pipe support design allegations on August 30, 1983. The Staff's Findings provide a thorough examination of the issues raised in this proceeding regarding pipe support design. We believe the Board should, upon consideration of those findings and Applicants' Proposed Findings, find that the pipe support designs and pipe support design process at Comanche Peak satisfy all applicable requirements and provide a high level of assurance that the supports will perform their intended safety functions.

The NRC Staff, however, has left "open" several matters which it suggests the Board should address in a later decision. We disagree with the Staff's leaving these items "open" for later Board consideration. Ample evidence has been presented on those matters for the Board to reach its decision and/or these matters present questions which are properly left for the Staff to address. Louisiana Power & Light Company (Waterford Steam Electric Station, Unit 3), ALAB-732, __ NRC __ (June 30, 1983),

slip op. at 44-45, 51-52. Accordingly, we believe the Board need not await further information to issue a decision on these matters.

Specifically, we note that the following items left open by the Staff were specifically addressed in Applicants' Proposed Findings wherein it is shown that evidence of record adequately disposes of the issues. These items are:

(1) the effect of reactor shield wall thickness on the analysis of the upper lateral steam generator (NRC's Proposed Findings at 31) see Applicants' Proposed Findings at 78;

(2) the capacity of Richmond inserts with regard to cyclical loadings under normal operating conditions (NRC's Proposed Findings at 44), see Applicants' Proposed Findings at 32-33;

(3) the modelling of tension in the Richmond inserts (NRC's Proposed Findings at 45), see Applicants' Proposed Findings at 37-38;

(4) Applicants' generic stiffness evaluation (NRC Proposed Findings at 63), see Applicants' Proposed Findings at 54-55 and 58-59;

(5) an overstressed condition in a support (identified by Applicants) (NRC's Proposed Findings at 65), see Applicants' Proposed Findings at 59, and;

(6) modelling of torsion in wide flange members (NRC's Proposed Findings at 73), see Applicants' Proposed Findings at 64-65.

Two other "open" issues (inclusion of actual stiffness of a particular support in the pipe stress analysis and whether consideration was given to pipe thermal expansion effects in the analysis of a particular support, NRC Proposed Findings at 62, 64) are simply matters requiring Staff confirmation that Applicants have satisfied particular commitments and are clearly

appropriate for Staff confirmation, particularly where the evidence of record demonstrates that there is no safety concern involved with Applicants' approach.

Finally, a question as to the effect of the section property values in the 7th Edition of the AISC Manual on certain types of welds is identified by the NRC Staff as an open question (NRC Proposed Findings at 84). This matter arose as a wholly new allegation in connection with the Staff's testimony regarding another allegation also raised for the first time by CASE at the hearings (Tr. 6868-74) and as to which CASE was unable to say whether the question was even applicable to Comanche Peak (Tr. 6873-74). The Board has already determined that this is not an issue in this case, but may be the subject of a notice from the Staff to Board (Tr. 6875). Thus, the Board should not hold this matter "open" for later consideration.

In sum, none of the items identified as "open" questions by the NRC Staff warrant awaiting further evidence by the Staff to resolve. Rather, the Board should proceed to a decision on all issues concerning pipe support design based on the evidence before it. As noted above, if the Board deems necessary, it may properly designate these items as matters to be left for Staff to address. However, it should not leave as "open" questions any of the matters so identified by the NRC Staff in their Proposed Findings.

III. Conclusion

For the foregoing reasons, the Board should determine that the issue of pipe support design at Comanche Peak has been fully litigated and a decision on those matters should be issued promptly. In reaching its decision, the Board should find that upon consideration of all the evidence of record the design of pipe supports at Comanche Peak satisfies applicable requirements, and that there is reasonable assurance the supports will perform their intended functions under all conditions.

Respectfully submitted,

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September 6, 1983

ASME BOILER AND PRESSURE VESSEL CODE

An American National Standard

Attachment A

SECTION III—DIVISION 1

Rules for Construction of Nuclear Power Plant Components

SUBSECTION NF

Component Supports

1974 EDITION

July 1, 1974

ASME BOILER AND PRESSURE VESSEL COMMITTEE
SUBCOMMITTEE ON NUCLEAR POWER

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
UNITED ENGINEERING CENTER
345 EAST FORTY-SEVENTH STREET, NEW YORK, N.Y. 10017

NF-4700 REQUIREMENTS FOR BOLTED CONSTRUCTION

NF-4710 BOLTING AND THREADING

NF-4711 Thread Engagement

All bolts or studs shall be engaged for the full length of thread in the nut.

NF-4712 Thread Lubricants

Any lubricant or compound used in threaded joints shall be suitable for the service conditions and shall not react unfavorably with any support element material. Contact surfaces within friction type joints shall be free of oil, paint, lacquer, or galvanizing.

NF-4713 Removal of Thread Lubricants

All threading lubricants or compounds shall be removed from surfaces which are to be welded.

NF-4720 BOLTING

NF-4721 Bolt Holes

Holes for nonfitted bolts shall be $\frac{1}{16}$ in. larger than the nominal diameter of the bolt for bolt sizes up to and including 1 in. and $\frac{1}{8}$ in. larger than the nominal diameter of the bolt for bolt sizes larger than 1 in. The holes shall be drilled, thermally cut, subpunched and reamed. Thermal cutting shall not be used unless the load-bearing surfaces are machined or ground smooth. The die for all subpunched holes shall be at least $\frac{1}{16}$ in. smaller than the nominal diameter of the bolt. Holes in plates over $\frac{1}{2}$ in. thick having a minimum specified yield strength greater than 80,000 psi shall be drilled.

NF-4722 Bolted Connections

(a) Surfaces of bolted parts in contact with the bolt head and nut shall not have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where the surface of high strength bolted part has a slope of more than 1:20, a beveled washer shall be used to compensate for the lack of parallelism.

(b) Bolts loaded in pure shear shall not have threads located in the load bearing part of the shank unless permitted by the Design Specifications.

NF-4723 Precautions Before Bolting

All parts assembled for bolting shall have contact surfaces free from scale, chips, or other deleterious foreign material. Surfaces and edges to be joined shall be smooth, uniform and free from fins, tears, cracks, and other defects which would degrade the strength of the joint.

NF-4724 Bolt Tension

All high strength structural bolts shall be tightened to a bolt torque not less than that given in the Design Specifications. Tightening shall be done by the turn of nut method or with properly calibrated wrenches. Bolts tightened by means of a calibrated wrench shall be installed with a hardened washer under the nut or bolt head, whichever is the element turned in tightening. Hardened washers are not required when bolts are tightened by the turn-of-nut method, except that hardened washers are required under the nut and bolt head when the bolts are used to connect material having a specified yield point less than 40,000 psi.

NF-4725 Locking Devices

All threaded fasteners, except high strength bolts, shall be provided with locking devices to prevent loosening during service. Elastic stop nuts (when compatible with service temperature), lock nuts, jam nuts and drilled and wired nuts are all acceptable locking devices. Disc and helical spring lock washers shall not be used as locking devices. Upset threads may serve as locking devices.

ASME BOILER AND PRESSURE VESSEL CODE

An American National Standard

Attachment B

SECTION III—DIVISION 1

Rules for Construction of Nuclear Power Plant Components

SUBSECTION NF

Component Supports

1974 EDITION

July 1, 1974

ASME BOILER AND PRESSURE VESSEL COMMITTEE
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weld transmitting a tension load in the through-thickness direction of plates and elements of rolled shapes shall be limited to 0.5 S_m as shown in Fig. NF-3226.5-1.

NF-3229 Design Stress Values

The design stress intensity values, S_m, are given in Tables I-1.1 and I-11.1 for component support materials. Values for intermediate temperatures may be found by interpolation. These form the basis for the various stress limits. Values of yield strength are given in Tables I-2.1 and I-2.2. Values of the coefficient of thermal expansion are in Table I-5.0 and values of the modulus of elasticity are in Table I-6.0. The basis for establishing stress values is given in Appendix III.

NF-3230 DESIGN OF LINEAR TYPE SUPPORTS BY ANALYSIS

NF-3231 Stress Limits

NF-3231.1 Elastic Analysis

(a) Design, Normal, and Upset Conditions. The stress limits for Design, Normal, and Upset Conditions are identical and are given in Appendix XVII. The allowable stress for the combined mechanical loads and effects which result from constraint of free-end displacements (NF-3213.10), but not thermal or peak stresses, shall be limited to three times the stress limits of XVII-2000

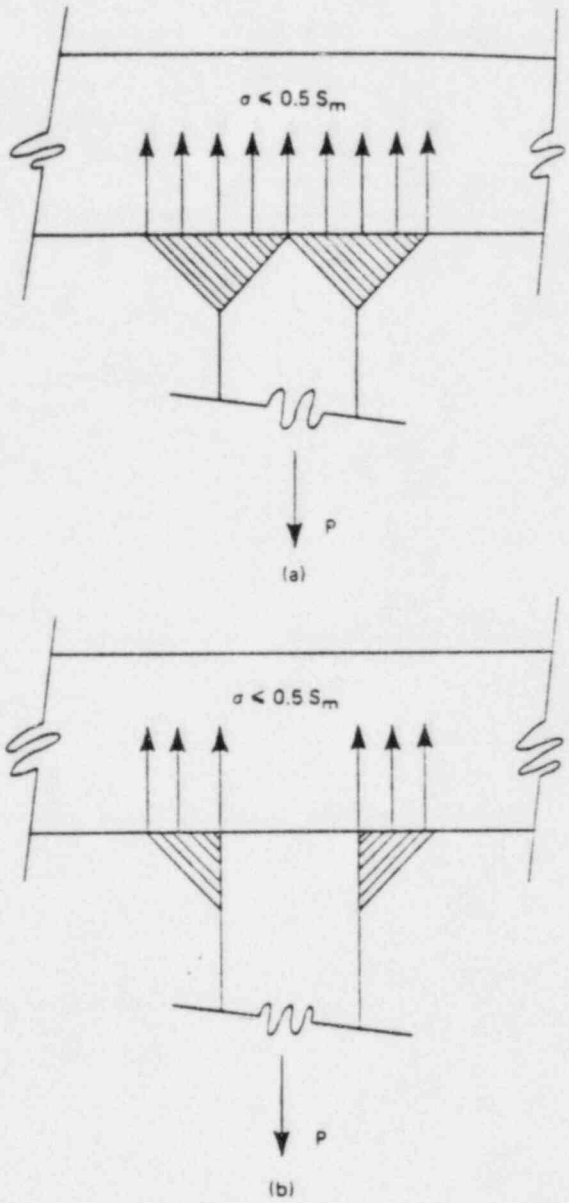
(b) Emergency Conditions. The stress limits for Emergency Conditions may be increased by one-third over the values given in XVII-2000. Constrained free-end displacement and differential support motion effects need not be considered for the Emergency Conditions.

(c) Faulted Conditions. If the Design Specifications specify any Faulted Conditions the rules contained in F-1370 of Appendix F may be used in evaluating these Faulted Conditions independently of all other Design and Operating Conditions. Constrained free end displacement and differential support motion effects and bearing type stresses need not be considered for the faulted Condition.

NF-3231.2 Limit Analysis. As an alternate to the linear elastic analysis method, limit analysis using the design requirements of XVII-4000 may be used.

NF-3240 DESIGN OF COMPONENT STANDARD SUPPORTS BY ANALYSIS

The requirements of NF-3220 or NF-3230 apply as applicable.



S_m = Design stress intensity value
σ = Maximum tensile stress in the through-thickness direction of plates and elements of rolled shapes, evaluated at the contact point of the weld area with the element surface.
P = Applied load.

FIG. NF-3226.5-1 ILLUSTRATIONS OF MAXIMUM DESIGN STRESS IN THROUGH-THICKNESS DIRECTION OF PLATES AND ELEMENTS OF ROLLED SHAPES

ARTICLE XVII-2000
LINEAR ELASTIC ANALYSIS

XVII-2100 GENERAL DESIGN REQUIREMENTS

XVII-2110 DESIGN FOR OPERATING CONDITIONS

(a) Except as otherwise provided in this Appendix, all components of the structure shall be so proportioned that the stress, in ksi, for Design, Normal and Upset Conditions, shall not exceed the values of XVII-2200. For Emergency Conditions, allowable stresses may be increased by ⅓ over the values shown in this Appendix. For Faulted Conditions, stresses may be increased in accordance with the requirements of F-1370 of Appendix F. Bearing type stress limits are excluded from rules for Faulted Conditions.

(b) To avoid column buckling in compression members, local instability associated with compressionflange buckling in flexural members and web buckling in plate girders, the allowable stress shall be limited to ⅔ of the critical buckling stress.

XVII-2120 DESIGN FOR HIGH CYCLE FATIGUE CONDITIONS

Design for high cycle fatigue conditions shall be in accordance with the requirements of XVII-3000 using the allowable stresses of XVII-2200 as modified by XVII-3240.

XVII-2200 DESIGN REQUIREMENTS FOR STRUCTURAL STEEL MEMBERS

XVII-2210 ALLOWABLE STRESSES—DESIGN, NORMAL, AND UPSET CONDITIONS

XVII-2211 Stress In Tension

The allowable stress in tension shall be as given (a), (b), (c) and (d) below.

(a) On the net section, except at pin holes and in the through plate thickness direction, the allowable stress in tension shall be:

$$F_t = 0.60S_y \qquad (1)$$

but not more than 0.5 times the minimum tensile strength of the steel.

(b) On the net section at pin holes in eyebars, pin-connected plates or built up members, the allowable stress in tension shall be:

$$F_t = 0.45S_y \qquad (2)$$

(c) At the contact surface of a weld producing a tension load in the through thickness direction of plates and elements of rolled shapes, the allowable tension stress shall be ½ the values given in (a) above. (Fig. XVII-2211(c)-1)

(d) Table XVII-2461.1-1 gives allowable tension for threaded parts.

XVII-2212 Stress In Shear

On the gross section, the allowable stress in shear shall be:

$$F_v = 0.40S_y \qquad (3)$$

The gross section of rolled and fabricated shapes may be taken as the product of the overall depth and the thickness of the web. XVII-2263.2 gives the reduction in shear stress required for thin webs.

XVII-2213 Stress In Compression

The allowable stress in compression shall be as required by the following subparagraphs.

XVII-2213.1 For Gross Sections Where Kl/r Is Less Than C_c. On the gross section of axially loaded compression members when $K\ell/r$, the largest effective slenderness ratio of any unbraced segment as

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SEISMIC PERFORMANCE OF PIPING IN PAST EARTHQUAKES

*Robert L. Cloud[1]

The seismic performance of power piping can be examined in two ways. What may be expected due to the intrinsic characteristics of the piping that are built in due to design and construction practice? A second approach is to examine the performance of comparable piping in past earthquakes. In the following pages both questions are addressed.

ANSI B31.1 Code

In the United States, power piping in general is designed to meet the requirements of the ANSI (formerly USAS) B31.1 Code for Power Piping. For the present discussion, the 1967 version of this code with supplements are the issues of concern. There was little or no basic change in B31.1 between the 1967 and 1955 versions. The 1955 version, however, was a major departure from the previous issue of 1942 and supplements. In fact it was in the 1955 version of B31.1 that the basic rules and technical philosophy were established for the design of power piping that are in the main and under different labels still in use today.

The advanced features and underlying technical sophistication of the B31.1 Code have gone relatively unnoticed in this era of rapid technical change and innovation. The B31.1 approach first established in 1955 contained design rules for low cycle fatique, incorporated the maximum shear stress theory, and contained other improvements. The ASME Boiler and Pressure Vessel Code contained none of these features at that time. In fact it was not until the Nuclear Vessel Code came out nine years later in 1964 that these technical improvements were applied to pressure vessels.

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discussed above was 5 on the Japanese scale. All of these additional plants were operating at the time of the earthquake and none were damaged. One of the five was shut down for one hour and inspected, but nothing was found.

El Centro Steam Power Plant

The El Centro power plant is located about 5½ miles from the epicenter of the 1979 Imperial Valley Earthquake. This earthquake, which occured on October 15, 1979, was 6.4 on the Richter scale and there were several aftershocks, the largest of which was magnitude 5.2. The Imperial Valley is an active seismic area and was the site of the 1940 El Centro record, which has been widely used in seismic engineering.

Perhaps because of the seismic activity in the area it was very well instrumented and several strong motion records were obtained. In fact, this is probably the best recorded earthquake that has occured to date. Certainly it is the first time so much "near field" data has been obtained. A map of the region is given in Fig. 5, which shows the locations of the fault, the epicenter, the power plant and several motion recording stations. This Figure is reproduced from Ref. (14).

Figure 6 presents acceleration records from several of the sites on the map. A reasonable estimate of the motion experienced at the power plant can be obtained by averaging that recorded at stations 8, 9, and at the "Differential Array". On this basis, the plant experienced about .5g horizontally and about .6 g vertically. In view of the large number of records and the consistency thereof, especially when distance from the fault is considered as well as distance from the epicenter, it

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would appear that for once the degree of uncertainty about acceleration levels experienced at the site is minimized.

The plant has four units; Unit 1 of 20 MW, built in 1949; Unit 2 of 33 MW, 1952; Unit 3 of 44 MW, 1957; and Unit 4 of 80 MW, 1968. Units 1 and 2 were down for maintenance when the earthquake occurred. Units 3 and 4 were tripped off line evidently due to loss of load. Unit 3 was restored to service 5 minutes after the main shock and Unit 4 was restored to service five hours later. During the five hour outage, leaks in the generator hydrogen cooler water supply were repaired.

The damage at the plant was surveyed by a team of engineers from the Pacific Gas and Electric Co. (15), the U.S. Nuclear Regulatory Commission (16), as well as the present writer. In general, there was a great deal of motion at the site, and various traces of the motion were observable, e.g. skid marks of reheater feet, bent seismic stops, etc. There were some failures; leaks occurred in the water supply for the hydrogen coolers as mentioned above; a two inch vallett pipe coupling failed; a buckling failure occurred in an oil storage tank; old wooden forced draft cooling towers sustained damage to the wooden structure; and a lightning arrester broke off a transformer. There was no other serious damage.

At first the most disturbing of the above was the damage to the hydrogen cooler water line and the failed pipe coupling. The water pipes were carbon steel, 3 and 4 inches diameter. There is a severe corrosion problem with this particular piping, evidently due to the character of the water. There had been leaks due to corrosion in these lines before the earthquake which had been weld repaired. The new leaks caused by the earthquake were of a similar type and were also weld repaired.

Conclusion

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The failed coupling was of an unusual design. Basicly it consists of an ordinary steel coupling with a liner of threaded fibreboard inserted. The pipes being joined are then screwed into the fibreboard. The purpose of these couplings is to eliminate stray electrical currents. Further the couplings which failed were on long spans of piping with no extra supports.

The failure of these two components, especially considering their construction and the levels of motion is hardly surprizing. Perhaps more important are the miles of piping and cable trays that did not fail or otherwise cause any problems, even though evidence of special considerations to obtain a seismically resistant design were minimal. Of special interest was the only set of hydraulic snubbers in the plant which were on the main steam line where it entered the turbine hall on the ground floor that evidently failed to lock at all, but the pipe was not damaged even though it appeared to have executed substantial vibratory displacements.

The oil tank was a thin shell structure 135' in diameter which evidently developed a vacuum due to sloshing oil and buckled. Such failures are not unknown and, in fact, might be expected. The wooden cooling tower that was damaged was 30 years old and in poor condition. Three of the four wooden towers were not damaged.

Taken altogether, it can be seen that piping and equipment in good condition with no special design features survived the earthquake. The damage that was observed can be attributed to design that is completely unsuited for seismic conditions, (the oil tank and vallett coupling) and to equipment in severely deteriorated physical condition (water pipes and cooling tower).

Conclusion

The available data and observations on the behavior of power piping in actual earthquakes has been reviewed. In general, it is seen that even for power plants experiencing severe ground motion, the piping remains intact. The data that have been surveyed clearly raise the question of the wisdom of designing piping for earthquake resistance by supporting it ever more rigidly. Linear analysis shows the gain of some conservatism by so doing. In the real non-linear world will this conservatism prove to be an illusion? May it even prove to be a liability, since it was obtained by sacrificing piping flexibility?

Acknowledgement

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing "Applicants' Reply To CASE's Proposed Findings Of Fact And Conclusions Of Law (Walsh/Doyle Allegations)," in the above-captioned matter were served on the following persons by deposit in the United States mail, first-class postage prepaid or express delivery (*) on September 6, 1983, or by hand delivery (**) on the 7th day of September 1983:

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