

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING APPEAL BOARD

In the Matter of	)	
PACIFIC GAS AND ELECTRIC COMPANY	)	Docket Nos: 50-275
(Diablo Canyon Nuclear Power Plant	)	50-323
Units 1 and 2)	)	

AFFIDAVIT OF JAMES P. KNIGHT
REGARDING THE JOINT INTERVENORS'
MOTION TO AUGMENT OR, IN THE
ALTERNATIVE, TO REOPEN THE RECORD

I, James P. Knight, being duly sworn, state as follows:

1. I am employed by the U.S. Nuclear Regulatory Commission as Assistant Director for Components & Structures Engineering, Division of Engineering, Office of Nuclear Reactor Regulation. In this capacity I am responsible for the review and evaluation of design criteria to ensure the integrity of structures, systems and mechanical components, including the dynamic analyses and testing of safety related structures, systems and components, the geological, geotechnical and seismological characteristics of reactor sites, the seismic design bases, criteria for protection against the dynamic effects associated with natural environmental loads and postulated failures of fluid systems for nuclear

facilities and the stability of soils and foundation systems. A copy of my professional qualifications is attached.

2. I have reviewed Joint Intervenors' motion to augment or, in the alternative, to reopen the record in the matter of the Diablo Canyon Nuclear Power Plant; and in particular the enclosed affidavits of Mr. Stokes dated November 1983 and February 1984 and the transcript of the January 25, 1984 meeting between NRC staff members and Mr. Stokes.
3. In this affidavit I will address specifically those aspects of Mr. Stokes' affidavits that are related to design of small bore piping supports, specifically those items enumerated in the Joint Intervenors' motion as numbers A.(1), A.(2), A.(3), A.(4), A.(5), A.(6), A.(7), A.(8), A.(11), A.(13), A.(14) and B.(1), B.(3), and those items discussed in part D of the motion; in addition matters in the transcript of the January 25, 1984 meeting with Mr. Stokes have been addressed where appropriate.

The staff has been actively reviewing the matters alleged by Mr. Stokes since November 1983. In the process of evaluating Mr. Stokes' allegations the staff conducted interviews with current and former piping support designers at the Diablo Canyon site, examined the training records for site design engineers, examined the procedures

employed to control site design activities, performed technical review of the design calculations for a sample of small bore piping supports and met with Mr. Stokes on two occasions to discuss the bases for his allegations.

Mr. Stokes' allegations as related to the items enumerated above pertain to engineering design activities performed at the Diablo Canyon site and specifically related to the design of supporting structures for piping 2" in diameter and smaller, i.e. small bore piping. Small bore piping is of necessity field run. The term field run refers to the fact that the layout of the small bore piping systems and the location of supports for those piping systems is typically performed after all major piping and equipment is either actually in place or located on final design drawings. This activity is usually limiting in the completion of construction activities of nuclear power plants and thus inevitably the subject of an intensive engineering and field fabrication effort. The small bore piping and piping support design activities at Diablo Canyon were, as is typically the case, performed within the largely self contained design and analyses group located at the plant site. The majority of other design activities, e.g., large bore piping, structures and equipment review and qualification were performed at the PG&E/Bechtel offices in San Francisco. Much of the engineering design effort for small bore piping and small bore piping supports is typically performed using conservative simplified procedures. Computer assisted calculations are employed for complex support configurations. Computer

calculations are also often performed if an acceptable solution is not obtained using hand calculations.

NRC Review of Small Bore Piping Allegations

The following is a summary of staff findings to date with regard to the specific matters enumerated in Joint Intervenors' motion:

A.(1) Construction of new pipe supports near previously failing supports, in order to redo the calculations and "pass" the failed pipe supports, thereby avoiding the requirement to expand the sample due to an initially high failure rate.

The staff evaluated the matter of (1) above as an item under allegation No. 88 reported in SSER No. 21. The details of the staff review are provided in more detail in the affidavit of Dr. Mark Hartzman. In the course of the staff's review it was noted that in a number of instances piping supports were located in close proximity to one another so that a single support could conceivably have been designed to perform the required function. In the staff's view this is the inevitable outgrowth of the numerous changes in the definition of seismic motion that have occurred at Diablo Canyon. In our review we could find no evidence of inpropriety in the selection of support locations or that the use of multiple, closely-spaced supports is consistent with licensing criteria.

A.(2) Design drawings that exaggerated the load ratings, or strength, of hardware such as U-bolts by up to four times more than claimed by those who sold the bolts. The ratings were possible due to inaccurate assumptions about pipe size and room temperature conditions, as well as failure to mention that the bolts were forcibly bent in order to achieve the load ratings. Engineers were instructed to continue relying on the false load ratings, even after the inaccuracies had been exposed.

The staff review of this matter consisted of a brief walk-down of the Diablo Canyon plant with Mr. Stokes to examine examples of situations in which U-bolts were alleged to be inappropriately employed, a subsequent review of the test procedures employed to develop load rating as allowed by the ASME Boiler and Pressure Vessel Code and a review of the interaction equation employed to determine the stress levels in the U-bolts. As related in more detail in Dr. Hartzman's affidavit the staff found that the load ratings applied as criteria were consistent with the provisions of the ASME Code and that the analytical methodology reported by the interaction equation has an acceptable technical basis.

A.(3) Management action to identify the engineers who had failed pipe supports and transfer them from the assignments. They were replaced by engineers who would not challenge the company line.

Throughout the staff review of the specific technical issues raised in Mr. Stokes' and other allegations, the staff has remained alert for specific evidence that management prerogative to make work assignments and to control the flow of work products were abused in a manner and extent that would impact on the technical acceptability of the small bore support calculations. We have been unable to substantiate that such abuses occurred.

In the course of conducting interviews with site design engineers and in the process of working with site design engineers during the review of calculation packages, the staff had direct contact with several of the

individuals assigned to the On-Site Project Engineering Group (OPEG) and was generally available to all the OPEG personnel. While there appear to have been instances of personality clashes and differences of technical opinion between individuals and their supervisors, and possibly instances of poor judgement in the handling of supervisor/employee relationships, the NRC staff has not found evidence of a company policy to intimidate the engineering staff at OPEG. This matter is further discussed in the affidavit of Thomas W. Bishop.

A.(4) Failure to issue controlled documents for engineers to use in sample calculations. The engineers compensated by basing their analyses for Diablo Canyon on calculations drawn from the unique conditions of different plants, such as Davis Besse, Midland, Catawba and others. As a result, the factual assumptions were inaccurate in up to 30% of the cases.

The staff evaluated the above matter as an item under Allegations Nos. 79, 83 and 84 reported in SSER No. 21. In evaluating this matter the staff reviewed engineering manuals, directives, and procedures located at the onsite engineering offices to assess the degree of standardization, currency and availability of design documents. Six design engineers performing onsite design activities were interviewed as part of the review. The staff identified several instances of superseded revisions of engineering documents in use by site design personnel and some instances of technical engineering documents in use by site design personnel and some instances of technical articles and data developed for other reactor projects being used as criteria design for Diablo Canyon small bore pipe supports albeit the articles examined were technically valid in themselves. There was also evidence of

inadequacies in document control such as inconsistencies in procedure lists maintained by different supervisors in design groups and some confusion about responsibility for maintenance of procedures and drawings.

The administrative deficiencies cited above will require corrective actions. Further, these deficiencies probably contributed to the higher than expected error rate in some types of calculations as discussed below. However, the significance of these deficiencies as measured by final acceptability of the small bore piping supports installed in the plant has been negligible; all support calculations reviewed to date, including those found to contain some error, have ultimately shown that the support in question is acceptable as installed, consistent with the findings of the IDVP in ITR 60 and 61 and the IDVP Final Report.

A.(5) Destruction of engineering calculations that failed pipe supports, along with references in the calculations log to the engineering reviews that produced this "wrong" result. In Mr. Stokes' case, the log only reflects his work for five out of more than 100 calculations which he prepared. "The original calculations demonstrating system failures vanished."

A.(6) Complete reanalysis of the failed pipe supports described above by new engineers, although their official mission was merely to conduct routine reviews for the accuracy of previously completed work.

A.(7) A stated policy that once an engineer signed off on calculations, "they were Bechtel property and Bechtel could do what they pleased, including destroying them and having someone else rewrite them."

The staff evaluated these matters under Allegation No. 55. The staff's independent evaluation of small bore pipe design calculation packages produced no evidence of directly altered calculations, i.e., instances where calculations of record had been altered without proper documentation. As discussed in Dr. Hartzman's affidavit there are instances where calculation packages for certain small bore pipe supports were completed by one individual, in some instances also checked, and then discarded. The discarded calculations of which the staff is aware showed that some element of the support did not meet design criteria. Subsequent reanalysis by different individuals which show compliance with criteria comprise the present calculations of record for each of the supports reviewed. Some of the calculations of record contained errors, when these errors were corrected the licensee reports that the support in question was still found to be in compliance with the acceptance criteria.

It is not unusual to resort to various analytical techniques and analytical assumptions, (presuming all have a basis in reality), to demonstrate acceptability nor to dispose of repetitive calculation packages and it is within the prerogative of the design group supervision to change assignments among qualified personnel. It is also true that only the final calculation that the plant owner decides to make the calculation of record and subsequent revisions are required to be kept consistent with ANSI N45.2.9.

The reasons for the approach chosen, i.e., discard of the entire calculation package and complete recalculation, are not clear. At least in part it appears that strong personality clashes and equally strong differences of technical opinion may have been a factor. The staff is presently considering the extent to which follow-up of the matter is warranted by the Office of Investigation. The fact remains, however, that all review and inspections to date continue to lead to the conclusion that the small bore pipe supports as installed at Diablo Canyon are acceptable in accord with the licensing criteria for Diablo Canyon.

A.(8) Redefinition of hardware, such as renaming an unintentional restraint as a support, thereby inaccurately reclassifying a design flaw as an additional factor of safety.

During the course of the staff inspection related to small bore piping support design, including a walk-through at Diablo Canyon Unit 1 with Mr. Stokes, the staff has seen no indication that the practices alleged were employed or if employed have persisted.

A.(11) Angle members, another form of pipe support, that were up to four times too long for allowable bending stress under the relevant professional code. In an hour walkdown, Mr. Stokes found over 200 violations, on approximately 100 out of 300 frames checked. Some unreliable supports have been repaired, while equivalent pieces remain untouched.

As described in Dr. Hartzman's affidavit the licensee has employed criteria for the allowable unbraced length of support members formed of

standard steel angle shapes that are in excess of the commonly used code values. The use of other than code values, with appropriate supporting data, is an option acceptable both to code bodies and to the staff. The data provided by the licensee in support of this choice is complex and will be included in generic studies by the staff and industry.

During the course of a plant walk-through to look for the prevalence of long unsupported angle lengths, among other things, the staff found only one likely candidate. The staff has concluded that while further study is in order on a generic basis, there is a significant technical basis for the licensee's action and, in terms of functional adequacy of the small bore support members there are large margins of safety available.

A.(13) Failure for sustained periods even to issue blank Discrepancy Report ("DR") forms -- the engineering equivalent of Nonconformance Reports -- necessary to report major problems such as those identified by Mr. Stokes.

This allegation was largely substantiated and is related to what the staff perceives as a lack of sensitivity on the part of OPEG site management to address legitimate communication from their employees. As noted in Mr. Bishop's memo the licensee's corrective program is underway. In no case has the lack of DR forms been determined to lead to a safety concern.

B.(2) Enforcement by management of questionable design practices by hiring aliens or "green cards" who were afraid to disagree with superiors due to risk of firing or deportation.

In the staff's view this allegation is related to the matters discussed in Item 3A above. It appears to the staff that the number of foreign nationals employed at the OPEG was far more a function of the labor market than either a corporate policy or an intentional program to hire employees merely because of a low potential for dissent.

B.(3) Creation of and reliance upon a "Quick Fix" design change program that circumvented formal quality assurance procedures and functioned "essentially as an uncontrolled underground engineering program." Engineers were not informed of the proper procedures, yet they "completely redid the design of hangers, deleted hangers, deleted weld symbols from the drawings, and took similar actions without the benefit of any calculations." The normal quality assurance reporting system for nonconformances was bypassed, even with respect to significant hardware deficiencies recorded only on Quick Fix sheets.

The "Quick Fix" program referred to by Mr. Stokes was formally designated the Pipe Support Design Tolerance Clarification program (PSDTC). Staff inspections to date have led us to conclude that the PSDTC was in its purpose a legitimate effort on the part of the licensee to expedite the reverification and review process at Diablo Canyon. Documentation of the activities of the PSDTC is under review by NRC inspectors. Preliminary staff findings to date indicate that shortcomings in administrative procedures similar to those discussed in A(4) above exist, but that the program was designed to ultimately include verification, through proper procedures, of all actions taken. Staff verification of the extent to which these procedures were successfully implemented is a principal facet of the ongoing

inspections. There has been no indication during the course of the overall staff review that the work performed under the PSDTC has resulted in a safety concern.

NRC Assessment (Section D of Motion)

At the January 31, 1984 public meeting the staff discussed preliminary observations for matters that were felt to require additional information from the licensee in order for us to complete our review. In a number of instances the concerns expressed by the staff at the January 31, 1984 public meeting were resolved after further review; specifically, questions related to synchronization of loading by the closely placed supports has been shown to have no significant impact on the overall acceptability of the supports involved, provided adequate attention is given to shimming under hot conditions to assure reasonable distribution of loads. Similarly, the fact that there may be excessive snubbers in place in the piping systems is recognized as an industry wide problem that does not bear significantly on the adequacy of piping systems at Diablo Canyon, but rather is a matter appropriate for orderly review leading to optimization of piping support systems in the early lifetime of the plant, i.e., before significant maintenance activities are necessary. It is interesting to note that the joint intervenors quote a staff finding that "89%" of a sample of 9 snubbers (picked by judgement as likely candidates for being excess) "would not function during a seismic event" without noting the immediately following conclusion that most if not all snubbers could be removed with no adverse effect on the system.

All of the small bore piping support calculation packages (12) identified by the staff at the January 31, 1984 meeting as containing errors have subsequently been re-reviewed by the licensee as part of a broader sample of over 130 additional small bore piping support calculation packages. In every case the licensee reports that each support was shown to be adequate as installed. The staff conducted a special inspection to evaluate the process used to re-review the small bore piping calculation packages. We found with minor exception that the review process was comprehensive and the results reliable.

Also, staff members who had not participated in the review of the IDVP raised questions concerning IDVP review activities that were conducted in accord with the Commission approved program management plans. None of the questions raised reflected any change to staff testimony regarding the IDVP offered at the November 1983 hearing.

Conclusion

In the course of investigating the numerous allegations concerning design of small bore piping supports the staff reviewed a large quantity of material concerning general design practices, implementation of design control measures and the conduct of specific analyses. These efforts included inspections at the On-Site Project Engineering Group (OPEG), the essentially self contained engineering group responsible for small bore piping design and analyses at the Diablo Canyon site, and inspections at the San Francisco offices of PG&E and Bechtel Corporation.

As a result of these inspections allegations related to administration of the OPEG such as deficiencies in document control, site specific training, and effective use of deficiency reports were substantiated in whole or in part. In addition, the staff is conducting inspections designed to explore the broader implications of the specific allegations. In the process of these additional inspections, the staff has identified other areas of QA implementation, specifically related to timeliness and followup of the Diablo Canyon Project audits of the OPEG that appear deficient in the inspector's view. These matters will be pursued further through normal enforcement procedures.

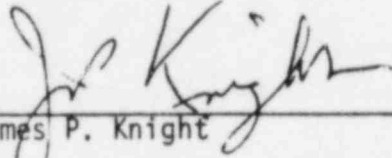
Although the inspections related to investigation of Mr. Stoke's allegations have disclosed that the design quality assurance program for the OPEG is not fully up to acceptable standards, the impact in terms of final acceptability of installed small bore piping supports, has been nil. The principle technical finding has been that one class of small bore support design analyses, i.e., those analyses performed by computer, has been determined to have a higher than expected error rate in the order of twenty percent viz. ten or less percent that experience has shown is likely. On the other hand the error rate in the hand calculations for small bore piping supports was acceptably low. In light of these findings the staff will require that PG&E establish a program to review all computer analyses for small bore piping supports. It should be noted, however, that the review to date of over 130 small

bore support computer calculations has shown that correction of those errors that existed did not change the conclusion that the supports met the design criteria and were therefore acceptable as installed.

Since some piping support modifications are inevitable as a result of initial plant operation (based on operating experience at other facilities), due to unexpected thermal motions or operating requirements of attached or supported equipment, the staff believes that corrective actions stemming from this review should take place during low power operation so that should any modifications be found necessary they could be included in an orderly and consolidated program prior to full power operation.

The staff position is based primarily on the fact that throughout this intensive additional review no party has identified a situation wherein there is any significant likelihood that the safety function of a structure, system, or component would be lost. And, the fact that all technical experts participating in this review, including all NRC inspectors involved in the inspection efforts related above and Mr. Stokes (transcript of 1/25/84 at TR. 116) have expressed their conclusions that there are no significant safety concerns as a result of the matters alleged. This conclusion reinforces the findings of the IDVP and answers the essence of the question before the board.

I hereby certify that the answers are true and correct to the best of my knowledge.


James P. Knight

Subscribed and sworn to before me
this 13th day of MARCH 1984.


Notary Public

My Commission Expires: 7/1/86