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
	)	50-323
(Diablo Canyon Nuclear Power Plant Units 1 and 2)	)	
	)	

AFFIDAVIT OF SAMUEL D. REYNOLDS, JR.

STATE OF CALIFORNIA)
COUNTY OF CONTRA COSTA) SS

I, Samuel D. Reynolds, Jr. being duly sworn do depose and state as follows:

1. I am employed by the U. S. Nuclear Regulatory Commission in the Region I Office, Division of Engineering and Technical Programs. A statement of my professional qualifications is attached hereto as Exhibit A and incorporated herein by reference.

2. I am a Lead Reactor Engineer and have had responsibility for special inspection of the Diablo Canyon construction program in my specialty area of materials and welding.

3. I have personally conducted special inspections of the Diablo Canyon facility to evaluate the safety significance of recent allegations.

4. During the periods of November 21 to December 8, 1983 and January 3 to January 19, 1984 I participated as a team member on a special inspection conducted to investigate concerns expressed by current and former employees of a Diablo Canyon site contractor. The special inspection conducted by me was focused in the welding areas with special emphasis on welding of supports.

5. I have read the documents entitled "Joint Intervenors' Motion to Augment or in the Alternative, to Reopen the Record", dated February 14, 1984.

6. I have examined the allegations in the aforementioned motion and as more specifically set forth in the affidavits of Charles Stokes dated 11/83 and 2/84. My understanding of these allegations is based on review of these documents, review of other documents authored by Mr. Stokes, and personal interviews with Mr. Stokes. The purpose of this affidavit is to address the matters raised in items (9) and (10) on page 7 and items (5), (6) and (7) on pages 10 and 11 in the above noted Joint Intervenors' Motion. The allegations and my responses are as follows:

   a. Item 9 (page 7). This item addresses three concerns specifically related to welding fabrication of tubular steel structures.

1. Allegation

Design flaws (improper design assumptions) lead to (flare bevel) welds smaller than permitted by AWS because the tubular sections had corner radii (R) 25% smaller than used in calculations. (The radii were 1½ times the tube wall thickness (1½t) instead of the required 2 times the tube wall thickness (2t)).

Response

For tubular steel welds (flare bevel welds) the size of the weld throat is a function, in part, of the depth of the groove formed by the curvature of the outside radius of the tube steel and the object to which it is to be welded. The depth of the groove is determined by the radius of the rectangular tube steel corners. The smaller the corner radius, the less the groove depth. The maximum weld throat that can be produced is effected by the actual groove depth. Mr. Stokes assumes tubular steel such as that produced by some foreign manufacturers (with smaller corner radii) was used in fabrication of Diablo Canyon supports. Licensee research (reported in PG&E letter DCL-84-03) states that no foreign tube steel with small corner radius has been received and all tube steel was domestically produced with radii of at least 2 times the tube wall thickness. In some cases it is even more. This meets American Tube Manufacturers Institute (ATMI) standards. An exception to the domestically obtained material was 3000 feet of Canadian steel made to ATMI standards.

During an independent check of selected installed tube steel fabrications performed by one inspector working as an NRC contractor all tube steel radii checked met or exceeded the "2t" requirement. The above licensee letter states that Diablo Canyon design groups used radii which are consistent with that of the steel actually used in their calculations of weld strength.

The AWS "prequalified" flare bevel effective throat of 5/16 R was met by welding these grooves flush and was demonstrated by tests conducted by Pullman. These tests demonstrated that standard Pullman welding techniques with 1/8" and 3/32" diameter E7018 electrodes met 5/16 R on smaller tubulars and exceeded 5/16 R by as much as 40-140% for larger tubulars.

Based on the above, it appears that the licensee's practices related to tubular steel design and use is fully consistent with applicable codes and standards.

2. Allegation

The licensee failed to provide full penetration flare bevel welds as required by AWS: . .

Response

In reference to this concern Mr. Stokes' assumes that if the "S" (groove depth) and "(E)" (effective throat) are not indicated in the welding symbol notation, the American Welding Society (in publication AWS A2.4, Welding Symbols) would require full penetration welds similar to that used for prepared single vee groove welds. Mr. Stokes' assumption for flare bevel joints is not correct. The use of the S(E) notation was not required since the depth of the groove was predetermined by the geometry of the tube and the object to which it was to be welded, and since the actual throat produced by flush welding met engineering requirements. The licensee's use of flare bevel groove welds is consistent with AWS code requirements.

3. Contention

The design drawings inaccurately represented the nature of the welds so QC inspectors did not look for the flaws that in fact existed:

Response

Mr. Stokes contends that design drawings were inaccurate in that they did not fully use AWS weld symbology and implies that this resulted in inadequate welds and, further, that this inaccuracy in the drawings did not allow the QC inspectors to detect the inadequate welds. The licensee did not choose to follow all welding symbology indicated in the AWS A2.4 (welding symbol) document. The licensee did not utilize the S(E) designation for joints whose bevel depths were predetermined by natural intersection of members such as in flare bevel and skewed joints and did not specify the bevel angle for partial penetration single bevel joints. This lack of specificity on the design drawings did not result in inadequate weldments as explained below.

In the case of flare bevel joints the standard practice was to weld the joints flush. Examination of over 100 flare bevel joints by me and Mr. Dennis Kirsch of Region V indicated the joints to be flush welded. A random sample by the licensee of 233 flare bevel welds indicated five welds to be slightly less than flush. Licensee evaluation of these five welds indicated they met engineering effective throat requirements.

The licensee single bevel joints did not have the bevel angle specified. AWS considers that partial penetration single bevel welds with 45° included angle are prequalified. Although all discussions that I had with inspectors and production personnel indicate that the 45° (minimum) angle for partial penetration joints was utilized, Mr. Stokes is correct that the Pullman WPS documents "permitted" 37.5° angles (since they are not explicit in this area). Pullman has performed tests to verify that the

standard welding procedures with 37.5° single bevel joints are capable of producing an actual throat exceeding the assumed effective throat. This was done on a "worst case" basis with a 3/4" thick tee joint with a 5/8" deep groove where the assumed effective throat would be 1/2". The results exceeded the 1/2" in all cases and averaged over 0.6".

In the case of skewed fillet welds the license practice has been as follows:

(a) On dihedral angles between 60° and 45° the licensee's design assumed the 1/8" penalty (i.e., taking no credit for 1/8" of the groove depth) on effective throat for "prequalified joints". This is in accordance with AWS D1.1.

(b) Between 45° and 30° the licensee stated they did not utilize the ⅛" penalty because they were utilizing lower allowable stresses than permitted by AISC (18 KSI versus 21 KSI). For added conservatism no credit was taken for the actual weld metal properties which would average close to 90 KSI tensile strength for as welded E7018 where the AISC allowables are based on 70 KSI minimum.

(c) For joints with skewed angles less than 30° no credit was taken for the weld in strength considerations.

Based on the above, there are no indications that failure of the licensee to fully implement AWS A2.4 welding symbology resulted in weldments unacceptable for safe plant operation.

b. Allegation

Item 10 (page 7). Pullman welding procedure specification (WPS) documents were written as ASME pipe welding specifications and not written explicitly for pipe supports and that as such they failed to provide sufficient information to the QC inspectors to monitor the welding activities.

Response

Mr. Stoke's statement that the WPS documents are written as ASME pipe butt welding specifications and are not written explicitly for pipe support configurations is true. However, the WPS document is supplemented by a separate document (no. ESD 223) which clarifies the weld joint requirements.

The basic design document for pipe supports (document no. M-9) requires design to be in accordance with ANSI standards B31.1 and B31.7. These standards require welding qualification to be in accordance with ASME Section IX (SC IX).

Portions of supports are designed to AISC which further references AWS D1.1 for welding supports as a third tier document.

The American Welding Society Code (AWS D1.1 at paragraph 5.2) gives the Engineer the authority to accept, at his discretion, evidence of previous qualification of the joint welding procedures. It is not unusual practice to satisfy this requirement by using ASME Section IX qualifications especially when applied to B31.1 and B31.7 supports which acknowledge SC IX as a qualification document. Therefore, the fact that WPS's were written as ASME Section IX specifications and used on pipe supports and supplementary steel is an acceptable industry practice, is consistent with Code requirements, and does not present a safety concern. Further, in my opinion, the combination of the WPS documents and ESD documents provided sufficient information for adequate inspection of the welds.

Independent examination of welds has provided additional evidence of adequacy. The NRC, Region V has awarded a contract to the Lawrence Livermore National Laboratory (LLNL) to provide third party independent inspection of plant modifications at Diablo Canyon associated with the design verification program. LLNL has conducted inspections in the pipe hanger area for eight months during the period June 1983 to March 1984. A summary of the detailed inspections conducted in the mechanical pipe support area from July to November 1983 shows 280 supports examined with 4 weld discrepancies which were judged to have no safety significance. Some of this data is detailed in combined NRC reports 50-275/83-24; 50-323/83-17 and 50-275/83-29; and 50-323/21.

c. Allegation

Item 5 (page 10). Deficient design drawings resulted in different assumptions for penetration of certain welds.

Response

This allegation is essentially a variation on the contention reviewed in a.1. above. The allegation implies design ambiguity resulted in different assumptions by design teams, leading to unpredictable effective throats on certain welds. Licensee has evaluated this concern and by written response affirmed consistent use of the same assumptions (see a.1 above) for effective throat determination.

As previously indicated in responses to item 9 and 10 (page 7), the licensee and Pullman have demonstrated that the techniques employed for welding of partial penetration and flare bevel joints meet the engineering assumptions utilized in design by "qualification by tests" for usability and meets ASME SCIX for ASME P-1 materials. Other procedure qualification tests

conducted by Pullman demonstrate qualification of materials classified as AWS Group 1 and Group 2 steels.

d. Allegation

Item 6 (page 11). This item discusses deficient welding procedures and includes the Pullman ESD 223 document "Installation and Inspection of Pipe Supports" and states that the procedures were not correctly applied, contained inaccurate information and were not generally available to the welders. It further states that potential mistakes resulting from deficient welding procedures were not caught and reviewed by engineering.

Response

Based on my review of the welding procedures (including ESD 223) utilized and qualified by Pullman I find that they were accurate in that they met the essential variable requirements of ASME SCIX and those of AWS D1.1 Appendix E for procedures qualified by test.

Mr. Stokes alleges that welding procedures and EDS documents were not correctly applied in that the welders were not given personal copies of the WPS documents and ESD documents. There is no requirement that welders be given personal copies of documents. Further, the documents were utilized during welder performance qualifications and were available in the field upon request and maintained by QC in these areas.

In his affidavit related to this issue Mr. Stokes states that potential weld mistakes were not caught by inspectors and reviewed by engineering. As stated in paragraphs a.3., and b., above, inspections by the licensee, the NRC, and an independent NRC contractor have shown that weld quality is acceptable. Based on this it does not appears that Mr. Stoke's concern has merit.

e. Allegation

Item 7 (page 11) indicates that inadequate corrective actions with respect to inspection procedures and weld deficiencies (were not taken).

Response

The results of LLNL independent third party inspection and routine Region V NRC inspections indicate that corrective action for completed supports is not warranted. Corrective action to eliminate possible ambiguities in weld symbology and detailed welding techniques for future welding is being taken by the licensee and his contractors (Bechtel and Pullman).

In my professional judgement the items discussed above do not represent significant safety concerns.

I attest that the foregoing affidavit is true and correct to the best of my knowledge and belief.

Samuel D. Reynolds, Jr.

Subscribed and sworn to before
me this 15TH day of March, 1984.

OFFICIAL SEAL
LISA J. WILHITE
NOTARY PUBLIC CALIFORNIA
PRINCIPAL OFFICE IN
CONTRA COSTA COUNTY
My Commission Expires Feb. 6, 1987

Lisa J Wilhite
Notary Public

My commission expires: 2-6-87

Samuel D. Reynolds, Jr.
Professional Qualifications
Region I - King of Prussia, PA
Nuclear Regulatory Commission

My name is Samuel D. Reynolds, Jr. I am employed by the United States Regulatory Commission as a Lead Reactor Engineer in the Division of Engineering and Technical Programs, Region I, King of Prussia, PA. My primary responsibility in this position is in the inspection of nuclear plants during construction and in service (in my specialty area which is materials, welding and corrosion) to determine compliance with NRC rules and regulations.

I received a Bachelor of Science in Metallurgical Engineering from Lehigh University, Bethlehem, PA in June 1953. I started work as an engineer for Westinghouse Electric Corporation in June 1953 and with the exception of my military service as a Officer in the U.S. Navy (November 1953 to April 1, 1957) continued as an Engineer to Senior Engineer to Supervisor Welding Development to Manager Materials Engineering in the Heat Transfer Division until 1976 when the division was sold. At this time I became a Fellow Engineer in the Breeder Reactor Component Project of Westinghouse. In January 1980 I became a Reactor Inspector in the NRC and am now classified as a Lead Reactor Engineer. I am a Registered Professional Engineer in Metallurgical Engineering in Pennsylvania, and in Corrosion Engineering in California. I am a Fellow of the American Society for Metals and a Registered Corrosion Specialist in the National Association of Corrosion Engineers. I am a member of the ASME Section IX Committee on Welding Procedure and Performance Qualification Testing and a member of the American Welding Society (AWS) Committee A5 on filler metals. I am a former faculty member of Temple University and Drexel University Evening Colleges (each for approximately 5 years teaching metallurgical and welding courses). I am a former Chairman of the AWS Philadelphia Section and former Vice Chairman of the Florida West Coast Section. I have been Vice Chairman of the AWS Welding Handbook Committee and a contributing author to the last three editions of the Handbook. I was a former member of AWS Committee A2 on Symbols, Definitions and Metrication.

I have been involved in preparation and evaluation of welding procedure and performance qualifications for fossil fuel and nuclear power plants for over 25 years.

I have performed inspection operations in the materials and welding areas for the NRC for 4 years and have completed all required NRC courses appropriate to my specialty areas.