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June 3, 1977

Mr. R. H. Engelken, Director
Office of Inspection and Enforcement
Region V
U.S. Nuclear Regulatory Commission
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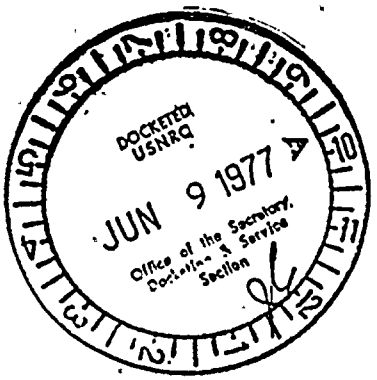

Docket No. 50-275
Unit I
Diablo Canyon Site

Dear Mr. Engleken:

On March 18, 1977 we telephoned your office to advise of a leak in a pipe weld on steam generator 1-2 feedwater nozzle (Field weld No. 3-212) at Diablo Canyon which was reportable under Paragraph (3) (iii) of 10 CFR 50.55. On April 18, 1977 we sent you a preliminary written report discussing the occurrance.

We have completed a comprehensive review of the weld attributes and the following are the results of our investigation to date.

(1) On March 23, 1977 a material review board consisting of PGandE, Pullman Power Products, the contractor which performed the work, and Westinghouse Electric Corporation, the nuclear steam supplier, reviewed Pullman Power Products Welding Procedure Code 200 for adequacy for use on Field Weld No. 3-212. This procedure was used to accomplish 8 welds in Unit I,

4 main steam welds and 4 feedwater to steam generator nozzle welds. After review of the weld procedure the material review board found the procedure to be adequate for the application.

A review of the heat treatment records, including preheat, interpass and stress relieving temperatures, indicated that all readings were in accordance with the weld procedure. It should be noted that the procedure did not prohibit reducing preheat to ambient temperature before stress relieving. The records show there were 31 calendar days between completion of the weld and the start of stress relieving. The records also show that preheat was shut off at the end of each welding shift, resulting in a number of heating and cooling cycles during welding. While this is permitted by the Code, our engineers now feel the procedure can be improved by increasing the preheat interpass temperature from 200° F to 300° F and continually maintaining this temperature until stress relieving is started. This modified procedure was used to make the repair welds on the feedwater to steam generator nozzle piping on steam generator 1-2. The modified procedure will also be used for the remaining welds on Unit 2.

(2) A review of the welder's qualifications was performed to assure compliance with the requirements of ASME Section IX. The welder (K. Stalker, Stamp LB) was qualified on October 24, 1973 to Code 4/5 qualifying him to weld to Code 200 requirements. This welder performed welding of this type from his qualification date through the time when weld 3-212 was started on May 24, 1974. Weld 3-212 was the only weld of P-1/P-12[b] material this welder performed but he welded on five other similar size feedwater system welds over a 3-month period. Of the 6 welds, he had two rejections by radiography (porosity near the weld surface) which required minor repair. Mr. Stalker's welding history was compared with the history of other experienced Pullman welders on site. This review showed his history to be about the same as the others in this group.

(3) A review of the certifications for all materials involved was performed and no departures from the specified requirements were found. The material specifications are listed below:

(a) Pipe-ASTM A106 Grade B and supplementary requirements S1-S6, chemical and physical certification.

(b) Consumable Insert - E 7052, chemical and physical certification.

(c) Bore Filler Rod - E7052, chemical and physical certification.

(d) Coated Filler Rod - E8018, chemical and physical certification.

(e) Steam Generator Nozzle - ASTM A508. The Data Report and Westinghouse Quality Control Release were reviewed. The actual material certifications are available at the site.

(4) The joint configuration for weld 3-212 was reviewed and no irregularities were found. The steam generator feedwater nozzle is schedule 60 with the feedwater pipe being schedule 80. Proper joint configuration, as required by the Code, required the pipe to be counter bored and the bore tapered into the pipe I.D. This type of configuration is not unusual and exists in many areas of the plant.

(5) The original radiograph for weld 3-212 shows good sensitivity and does not contain an indication of a fault which could have resulted in a crack. The radiograph was reviewed and approved by Pullman's qualified technician and by its Quality Assurance Manager, who was a ASNT Level III, and also by a third party inspector, an employee of the California Division of Industrial Safety. It should be noted that the original radiograph was taken before the weld was stress relieved.

After the failure of weld 3-212, the radiographs were again reviewed by various parties including the Nuclear Regulatory Commission, the third party inspector, Pullman's Field Quality Assurance Staff, PGandE Department of Engineering Research representatives, and by PGandE General Construction personnel. No additional indications were noted.

Additional nondestructive examination conforming to ASME Section XI was performed on the four main steam and the other three feedwater to steam generator nozzle welds to assure the integrity of all welds accomplished using the P-1/p-12b weld procedure. The only rejectable indication found was a drop through on the feedwater nozzle weld on steam generator 1-1 which was covered by a separate report.

(6) A review of water chemistry history for all four steam generators was performed. This review included data from the two hot functional testing periods and the wet lay-up periods. There were no significant differences in the water chemistry between steam generators. Chloride ion and dissolved oxygen concentrations were always within specification. The pH level was out of specification at various times but not enough to be of concern. We are confident that the weld failure is not related to water chemistry.

(7) The metallurgical investigation has produced the following information:

(a) The failure initiated on the interior diameter (I.D.) of the nozzle in the heat affected zone (HAZ) adjacent to the weld.

(b) There is an extended fracture origin, with multiple small cracks propagating from the root of deep scratches, believed caused by grinding during pipe fit up. These scratches are present in both the nozzle and pipe I.D.

(c) The cracks in the nozzle HAZ apparently continued to propagate because the nozzle HAZ material has a higher hardness and lower ductility than the surrounding material.

(d) The small cracks at the root of the scratches are filled with Fe_2O_3 indicating that these cracks were formed before or during low temperature (200° F - 400° F) thermal treatments. No evidence of aqueous corrosion products was found in these cracks indicating that stress corrosion cracking was most likely not a factor in the failure.

Analysis of the fabrication records and other available data did not produce any conclusive results as to the cause of the failure, nor did consultation with Pullman Power Products and Westinghous metallurgists. It is our opinion that the contributing factors to this failure were the cycling of the preheat temperatures causing thermal fatigue stresses, the amount of elapsed time between the completion of the weld and the application of stress relieving and the depth of the grinding scratches. As stated previously, the weld procedure has been modified to provide continuous preheat until stress relieving is started.

We plan to continue th investigation and nondestructive examination of these welds under a periodic surveillance procedure.

Sincerely,

Philip A. Crane, Jr.

PAC:EC

CC: Director, Office of
Inspection and Enforcement
ASLB
Parties