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ATOMIC ENERGY COMMISSION
DIVISION OF COMPLIANCE
REGION V
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December 29, 1970

J. P. O'Reilly, Chief
Reactor Inspection and Enforcement Branch
Division of Compliance, Headquarters

PACIFIC GAS AND ELECTRIC COMPANY - DIABLO CANYON UNIT NO. 1
DOCKET NO. 50-275

The attached report contains the details of our recent inspection of construction activities at the site of the subject facility. No items of nonconformance were identified. The announced inspection was conducted on December 1, 2 and 3, 1970 pursuant to PI 3800/2 and in accordance with the master inspection schedule for the project.

The PG&E QA investigation concerning our previous observation of possible inadequate technique in performing liquid penetrant tests appeared to be timely and comprehensive. The results of the investigation failed to show a general deficiency in the PDM QC program. Based on our review of the investigation effort, we considered PG&E's followup action concerning the issue to be adequate.

PG&E's UT test findings concerning the wall thickness of the spools of primary piping in storage indicates possibly that the Westinghouse and Vendor QC inspection efforts may not be sufficiently comprehensive in scope. We concur with PG&E in that more extensive examinations of the piping need to be performed before valid conclusions can be reached. We intend to pursue the subject and will report fully on PG&E's additional test efforts and conclusions after the next scheduled inspection (March 1971).

Generally, our inspector found adequate documentation concerning construction discrepancies and QA audits. In particular, the documentation of the occurrences involving the steam generators and the reactor vessel showed the complete history of relevant facts, circumstances, evaluations and actions.

You will note that the removal of the sea water from the generators was effective and that an article quoted in the report indicates that the exposure to sea water under such conditions does not create chloride stress corrosion problems. The inspection of the reactor vessel penetration tubes (after being struck by a wooden panel) was considered comprehensive and should have detected any damage. Also included in the report are data obtained from PG&E's independent tests which demonstrate the detrimental effect of arc burns on reinforcing steel since it may be of interest to other inspectors.

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The events associated with the discrepant anchor bolts accentuated the need for implementation of a formal procedure clearly delegating specific responsibilities to appropriate personnel to confirm that the information shown on certifications is consistent with what the certification implies. The PG&E on-site QC personnel began this practice after our June inspection.

G. S. Spencer
Senior Reactor Inspector

Enclosure:
CO Report No. 50-275/70-5
by A. D. Johnson
dtd. 12/29/70

cc: E. G. Case, DRS
P. A. Morris, DRL
R. S. Boyd, DRL (2)
R. C. DeYoung, DRL (2)
P. W. Howe, DRL (2)
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Regional Directors, CO
REG Files

U. S. ATOMIC ENERGY COMMISSION
DIVISION OF COMPLIANCE
REGION V

Report of Inspection

CO Report No. 50-275/70-5

Licensee: Pacific Gas & Electric Company
Diablo Canyon Unit No. 1
Construction Permit No. CPPR-39
Category A

Date of Inspection: December 1, 2 and 3, 1970

Date of Previous Inspection: September 15 and 16, 1970

Inspected by: G. S. Spencer for A. D. Johnson — 12/30/70
A. D. Johnson
Reactor Inspector
Date

Reviewed by: G. S. Spencer — 12/30/70
G. S. Spencer
Senior Reactor Inspector
Date

Proprietary Information: None

SCOPE

Type of Facility: Pressurized Water Reactor

Power Level: 3250 Mwt

Location: Diablo Canyon, San Luis Obispo County, California

Type of Inspection: Routine - Announced

Accompanying Personnel: R. W. Smith, Director and G. S. Spencer Senior Reactor Inspector accompanied the inspector on a tour of the site and related facilities on December 3, 1970.

Scope of Inspection: Review (1) status of previously identifi items of concern, (2) discrepancy report (3) QA audit activities.

SUMMARY

Safety Items - None

Nonconformance Items - None

Status of Previously Reported Items - No safety or nonconformance items were reported in the previous inspection report.

Other Significant Items -

1. Overall completion of construction activities was estimated to be 18.7% on December 1, 1970. (Section B.)

2. Ultrasonic inspection of primary piping spool pieces in storage indicated that one identification stamping had breached the minimum design wall thickness. Also random checks of the wall thickness identified a small section of wall area on one spool piece that was less than the minimum design thickness. More tests are planned to be performed by Westinghouse and PG&E to determine the accuracy of the UT test results. (Section C.1.)

3. An evaluation of the constructed mockup section of the area between the wide beam flanges and the containment liner indicated that concrete can be placed in accordance with the planned procedures without detrimental effects to the quality of the end product. (Section C.2.)

4. Plans are to have a procedure which will delineate the specific responsibilities (within PG&E) for verifying that all certification documents are valid and proper, approved and implemented in the immediate future (within 60 days). (Section C.3.)

5. A review of QA discrepancy reports indicated that disposition of items continued to be accomplished pursuant to the PG&E QA standard procedure. (Section D.)

6. Anchor bolts installed in the containment base mat for the steam generator supports were found by PG&E to be in nonconformance with the specified ASTM standard. Since the design of the supports had not been completed the designer changed the design to accomodate use of the installed bolts. Other bolts not conforming to the specifications were rejected. (Section E.)

7. Sea water leaked into three of the steam generators during transporattion from Tampa, Florida to the site. The generators have been cleaned and resealed for storage at the site. (Section F.)

8. During transfer activities associated with the reactor vessel a wooden panel collided with several of the instrument penetration tubes. No damage resulted. (Section G.)

9. The on-site QA engineers have been implementing an active audit program. (Section H.)

10. PG&E's QA section has determined that liquid penetrant tests are being performed pursuant to the appropriate procedures. (Section C.4.)

11. Tests performed by PG&E demonstrated that arc burns on reinforcing steel may be detrimental to the physical characteristics. (Section D.3.)

Management Interview

The inspector met with Messr. Hersey, Friedrichs, Hickman, Richards and other members of PG&E's on-site staff. The scope and findings of the inspection were reviewed.

Mr. Hickman stated that in view of their findings concerning the wall thickness of the piping spool pieces in storage, additional tests will be performed on all of the primary piping in storage to assure design and code requirements are satisfied.

Mr. Friedrichs stated that their evaluation of the concrete mockup section has assured PG&E that the quality of concrete placed between the wide beam flanges and the containment liner is adequate.

Mr. Hersey stated that from QA audit results and their experience associated with the anchor bolts, all contractors and PG&E construction staff have been made aware of the importance of promptly submitting to PG&E a formal report of all discrepancies identified. He also said PG&E QC personnel are to check appropriate certification documents of materials used by contractors at the site to assure the material conforms to the specified standards.

The inspector commented that the QA followup investigation concerning the previously observed questionable liquid penetrant testing appeared to be comprehensive and satisfactory to indicate that the contractor is following the prescribed procedures.

DETAILS

A. Persons Contacted

H. R. Hersey	-	Project Superintendent
R. R. Friedrichs	-	Resident Civil Engineer
A. W. Hickman	-	Resident Mechanical Engineer

G. V. Richards	-	Director, Quality Engineering - San Francisco
F. W. Brady	-	QA Engineer
P. L. Bussolini	-	QC Coordinator
R. W. Wood	-	QA Engineer
B. Good	-	QA Engineer - San Francisco
L. J. Garvin	-	QC Engineer - San Francisco

B. Construction Status

Overall completion of construction of the Diablo No. 1 project was estimated by PG&E's Construction Department to be approximately 18.7% on December 1, 1970. Specifically, the containment building was shown to be 39% complete with 34% of the liner installed. Construction of the auxiliary building was considered to be approximately 48 percent complete. Unofficial projections indicate hot functional tests will not commence until sometime after January 1973 and probably not until March 1973 or later.

C. Resolution of Previous Issues

During the previous visits several items had been brought to the licensee's attention for evaluation and possible action. The following information summarizes the disposition or status of the items.

1. Indentation Stamping of Class I Piping

PG&E's inspection finding showed that identification markings on the primary loop piping in storage at the Pismo Beach facilities were not in compliance with the Westinghouse specifications. Additional tests have been performed to determine whether the impression depths found to be outside of the Westinghouse specifications infringed on the minimum design wall thickness of the pipe. During November 1970, ultrasonic test equipment was used to measure the wall thickness of the pipe. The test results showed that eight indentations associated with one identification marking had infringed on the minimum design wall thickness. A test of the section of the piping free from stamping was also checked. The results showed that an area of about ten square inches was slightly less than the minimum design wall thickness. As a result of PG&E's test data, Westinghouse personnel were scheduled to arrive on site during the week of December 7, 1970 with special optical measuring equipment. This equipment was stated to supposedly be able to measure the wall thicknesses within an accuracy of one mil. Mr. Hickman stated that as a result of their findings they intend to do more testing of the other spools of pipe to assure themselves that the other sections meet the minimum design requirements. Hickman showed the inspector

results of measurements made by Westinghouse of the wall thickness prior to shipping the spool pieces to the site. Each spool piece was measured at locations of approximately one inch and two feet from the ends of each pipe. These measurements indicated that all wall thicknesses were within the minimum design limits. Hickman indicated to the inspector that he believed the ultrasonic test technique used by PG&E had an accuracy value of within at least 10 mils and was probably accurate to within 2 or 3 mils. It appeared from the (PG&E) UT test data that the maximum infringement on the minimum design thickness was approximately .050 inches.

2. Placement of Special Concrete in Area Between Wide Beam Flanges

To assure that the concrete placed between the wide beam flanges and the containment liner at the base of the containment wall would be of proper quality, a mockup section was poured and was later inspected by the PG&E Construction Engineers. (See CO Report No. 50-275/70-4) After the normal curing period, the forms were stripped from the mockup. The concrete was thoroughly examined and no voids or other imperfections were found. The inspector examined the mockup section and concurred with the PG&E findings.

3. Verification of Quality Control Information on Certification Documents

Mr. Richards indicated that a procedure to assign specific responsibilities pertaining to the verification of quality control information on certification documents would be formalized and approved within 60 days. Mr. Bussolini, QC coordinator, said that the General Construction Department personnel at the site had been reviewing all material certifications relating to materials used in the civil structures. Richards indicated that formulation of the proposed procedure had been delayed because of differing views concerning who exactly should be responsible for review of the various certifications. According to Richerds, this especially applies for the items independently purchased by PG&E from outside vendors.

4. Adequacy of Dye Penetrant Tests

During the previous inspection, Mr. William Kelley, Construction Inspector, Region II, observed a Pittsburgh-DesMoines Steel Co. inspector performing a dye penetrant examination on one of the liquid holdup tanks. Kelley felt that the inspector did not remove enough dye penetrant during the cleaning phase of the test and as a result there was a pinkish cast of the developer after it was applied. He also noticed that the developer was applied

from an aerosal can in high winds and the inspector was shielding the work with his body in such a way that he could not see how much developer was applied.

Mr. Brady, site Quality Assurance Engineer, investigated the facts and circumstances surrounding the criticisms voiced by Mr. Kelley. Brady's report of his investigation stated that it was difficult to assess the criticism of PDM's procedures. According to Brady, both L. J. Garvin and W. Wood, who were with Kelley when he watched the test, agree that the developer appeared pink in spots. Mr. Garvin, who is qualified as ASNT Level II for dye penetrant examinations, felt that the test was adequate for detecting defects that would be rejected under ASME, Section VII or ASME, Section III, Class C. The criteria for dye penetrant removal is by its nature, not very specific. ASME, Section VIII, which is the governing code for this test, says ..."any penetrant remaining on the surface shall be removed. Insufficient removal will leave a background which will interfere with subsequent indication of defects. Care must be exercised that penetrant in any defects is not removed." This seems to leave room for judgement as to when just enough penetrant is removed. Similarily, there are no hard, fast rules for applying the developer.

The test in question was performed on a particular completed weld seam after grinding. The liquid holdup tanks involved are fabricated from ¼-inch to 3/16-inch stainless steel. The seams are welded from two sides, typically with two or three passes on one side, followed by grinding the exposed side of the root pass, and then completed with two or three passes. The dye penetrant test is performed after grinding the root pass in order to locate any defects before the weld is completed. This allows correction with a minimum amount of repair work.

PDM has been advised, by letter, of the concern over their procedures. In answering, they observe that the cleaning phase is difficult because the work is in the weld groove. However, they reinstructed their inspectors to exercise additional care in obtaining complete excess penetrant removal.

Mr. Brady indicated that he had personally watched three PDM dye penetrant examinations since the previous inspection. Two of these were in a weld groove. The procedures were noted to be letter perfect. In all of the tests, the inspector removed the penetrant by first rubbing with dry cloth and then rubbing with a cloth slightly dampened with cleaning solvent. The developer was sprayed on in one coat and any thin spots were sprayed with a second coat.

During the test in a weld groove Mr. Brady noticed a light pink color where the grinding marks were close together. However, he stated that he thought this was inherent in testing a ground surface rather than a result of imperfect technique.

In conclusion Mr. Brady indicated that he could not draw any definite conclusions about the test that Mr. Kelley witnessed. There seemed to be agreement that the developer had a light pink color. It could be that this was careless procedure. It could also be a reflection of the difficulty encountered in performing such a test in a weld groove. Or it could be a combination of the two. In any case, Mr. Brady concluded that the PDM and PG&E personnel were qualified for the jobs that they were doing, and that the PDM dye penetrant procedures they were now using were acceptable.

D. Construction Discrepancies

1. Deviations

The inspector reviewed eighteen deviation reports which have been prepared since the previous inspection. Although several of the items have not been fully reviewed and resolved, the inspector confirmed that the items were being processed in accordance with the QA discrepancy procedure. The more significant items included:

a. Sea water had leaked into the steam generator during transportation to the site. (See Section F. of this report for additional detail.)

b. A wooden panel collided with the bottom instrumentation penetration tubes of the reactor vessel while unloading it from the barge at Avila Beach. (See Section G of this report for additional detail.)

c. Penetration alignment was inconsistant with contract specification Design Engineer approved change so that alignment would be consistent with requirements of Section VIII of the ASME Boiler and Pressure Vessel Code.

d. A penetration arrived at the site with defective welds. Field repairs were made and the vendor was directed to improve inspection efforts to preclude the shipping of defective materials.

e. A penetration sleeve was found slightly out-of-round. The Design Engineer accepted the sleeve as was since the slight out-of-roundness would not create future fitup problems.

f. Several liner plates were found to exceed the plumb specification in the contract. The Design Engineer accepted the work as completed since his findings indicated the deviations had no effect on the engineering requirements.

g. The refueling canal penetration was installed in an improper orientation. The penetration was removed and was then properly installed.

h. During rail transportation, the pressurizer vessel evidently received a strong jolt. The recording of the accelerometer monitoring the vessel had on one occasion exceeded the scale reading. Also a brace weld had partially ruptured. In addition, during the journey the rail car had a "hot box" which charred the wooden supports under the pressurizer. Examination of the particular portion of the vessel adjacent to the wooden support showed no evidence of paint damage. The paint is an aluminium type and should show damage if it were exposed to excessive heat. Mr. Hickman believed that the vessel was undamaged by the shock since checks of the heaters in the pressurizer showed no defective conditions. At the time of the current inspection Westinghouse had not as yet determined the severity of the possibly shock shown by the accelerometer since the calibration data concerning the monitor had not yet arrived at the site.

i. Receival inspection of one of the safety injection pumps indicated a metal to metal noise when the pump was rotated. Plans were to inspect, repair and use if possible.

j. Receival inspection of the containment spray pump, serial No. 221B175-2, disclosed a crack in the pump casing near the bearing at the drive end of the pump. Plans were to repair and use if possible.

k. A 100% review of the steam generator and other anchor bolts by PG&E disclosed that all of the bolts for one reason or another failed to meet the ASTM specifications. (See Section E of this report for details.)

2. Minor Variations

The inspector confirmed from a review of the minor variation log that the recorded items had been appropriately resolved at the field level. One interesting minor variation involved arc burns

on reinforcing steel. To determine the effect and consequences of arc burns on the integrity of the reinforcing steel, tensile tests were performed on samples containing arc burns. Significant information from a report of the tests follows.

> "Four (4) test samples of reinforcing steel, size 18, grade 60, were procured for testing. Sample #1 was the reference standard to determine approximate values for yield strength, tensile strength and elongation since the heat number was unknown. Sample #2 had an arc burn produced on it by dragging a weld rod across the rebar. Sample #3 had an arc burn created by touching the rebar with a weld rod and pulling it off. Sample #4 had an arc burn created by holding a weld rod in one spot on the rebar for a count of five (5), creating a molten puddle three-eighths (3/8's) of an inch in diameter. The results are tabulated in Table 1.

TABLE 1

SAMPLE	YLD. STRENGTH	TEN. STRENGTH	ELONG.	FAILURE
#1 - Ref.	63,500 psi	102,500 psi	13%	At Lower Jaw
#2 - Arc Drag	63,500 psi	103,000 psi	15.1%	At Lower Jaw Away From Burn
#3 - Spot	64,250 psi	103,750 psi	12.7%	At Lower Jaw Away From Burn
#4 - 3/8" Puddle	64,000 psi	75,500 psi	1.8%	Thru Arc Burn

> The failure of Sample #4 occurred through the molten puddle created by the arc burn. It can be determined from the results that the arc burn did indeed cause brittleness. A stress point was created in the area of the arc burn causing failure and very little elongation or ductility. Sample #3 though satisfactory, gave evidence of a slight crack in the spot created by the arc burn.
>
> This test is by no means a method of determining the degree of arc burns that might be acceptable in the field. It was performed solely to demonstrate the fact that arc burns on reinforcing steel can be detrimental."

Richards indicated that since the problem was identified, about eight defects have been repaired by installing a cadweld splice. He also said that contractor personnel are exercising more care to preclude arc burns.

E. Other Class I Structures (Steam Generator Supports)

As a result of the inspection conducted during June 1970, the inspector reported in CO Report 50-275/70-3 that the mill certifications for the anchor bolts installed in the containment base slab showed the bolts to be of proper quality. This conclusion was based on a sample review of the ASTM A-490 Bolt certifications. Also, this was the same time that the inspector raised the question as to whether PG&E QC personnel were reviewing all documented information for conformance to code requirements. Subsequent to the inspectors departure, the on-site QA staff performed a complete review of all the bolt certifications. The audit findings were as shown in Appendix A.

The Deficiency Report submitted to PG&E by PDM stated that the REC Corporation received material for the anchor bolts from Ryerson and Crucible Steel Companies along with mill test reports. Apparently the person that has the responsibility for checking the mill test reports was on vacation. A substitute who was not totally qualified approved the mill test reports as conforming to the ASTM A490 specifications. The REC Corporation proceeded with the manufacture of the anchor bolts.

The mill test reports were submitted to Pittsburgh-Des Moines Steel Company's Purchasing Department which has an in-house Quality Assurance man assigned specifically to check mill test reports and materials being received. The PDM Purchasing Department Quality Assurance person noted the discrepancy and notified the REC Corporation that the material was not in conformance with ASTM A490. The REC Corporation notified PDM's Purchasing that the bolts were in specification and they would send proper mill test reports to show this. In the meantime, the correspondence involved took considerable time and the REC Corporation completed the manufacture of the anchor bolts and shipped them directly to the job site.

On receiving the corrected forms, a discrepancy was again found since they did not show the physical properties but had given hardness equivalent readings. The Purchasing Department again went back to the REC Corporation and notified them that this was not adequate. PDM was told that the bolts were adequate and REC would take care of the situation. Because of this ensuing difficulty and paper work, the bolts were installed in concrete prior to the correct paper work and mill test reports reaching the job site.

As soon as it was discovered by the (PDM) Corporate Quality Assurance Department that the above had occurred, immediate steps were taken to find out the full details of the problem and also to survey the REC Corporation in order to determine if they had the capability of producing the above anchor bolts.

1. PDM Quality Assurance conducted an audit of the REC Corporation manufacturing procedures, quality assurance, and quality control organization on August 14, 1970 and found them to be satisfactory to produce materials for this contract. PDM felt the action they had taken was satisfactory to see that this could not occur on future orders.

2. In addition to the above steps, PDM Quality Assurance will make certain that all materials and certifications are within the contractual requirements of the specification prior to permitting shipment of any future materials, from REC Corporation.

In view of the above problems encountered with the anchor bolts, PDM requested specification deviation approval that the anchor bolts, (32-11AR2, 64-11AR4, and 32-11AR6) which are now embedded in the concrete be left in position, and that PG&E consider alternate designs as may be required to accommodate the slightly lower physical properties of the embedded anchor bolts. In addition to the above stated ASTM A490 anchor bolts, there were anchor bolts, (32-11AR1, 64-11AR3, 32-11AR5, and 34-11AR7), that are above the floor embedment liner plates. These anchor bolts will be reordered as soon as possible and will meet the ASTM A490 requirements, according to PDM.

Since the detailed design of the supports had not been completed, PG&E's Design Engineer incorporated the "as installed" bolts into the support design and PG&E accepted the installed bolts, however, the remaining bolts not embedded in concrete were rejected.

F. Steam Generators

Sea water entered three of the four steam generators via channel nozzles during their transfer from Tampa Florida to Avila Beach, California where the generators were unloaded from the barge and transported overland to the site at Diablo Canyon. The condition was discovered during inspection on arrival at the site in July 1970.

Cleaning of the generators was completed during October 1970. Efforts to clean the generators were delayed during September due to labor disputes.

A report of a meeting between Westinghouse and PG&E personnel discussed the design of the shipping closure of the steam generator channel nozzles and why they failed. (Appendix B shows a diagram of the problem area.) The nozzle weld preparations were protected by an angle iron ring seal-welded to the end of the nozzle outside of the weld preparations. Another ring was tack welded to this ring, inside it and the weld preparations, for further

protection during manufacture. When the steam generators were prepared for shipment, the tack welded inner rings were to have been removed and gasketed covers bolted to the seal welded rings. However, the inner rings were not removed, and the covers were prevented from seating as intended, resulting in leakage paths past the tack welded joints. Plastic coatings were sprayed on the outside of the bolted closures, but the coating failed. There was no procedure requiring removal of the temporary rings, although there was a note calling for their removal on a drawing. The procedure has now been revised to call for this step. Westinghouse stated to PG&E that they had such confidence in the closure design that they conducted no tests of the integrity of the shipping preparation.

Examination of the steam generators at the site showed the following:

Ø1. Water in nozzles on both inlet and outlet sides, estimated at 3 to 5 gallons, no evidence of water on the tube sheet.

Ø2. Water in nozzles and in head, estimated at 5 gallons.

Ø3. Closure appeared to be intact.

Ø4. Slight indication of water at ring of one nozzle.

In an effort to determine whether salt water entered any tubes, distilled water has been flushed thru the lowest tube of generator Ø2. Analysis of this flushing water showed chlorides less than 1/10 ppm which indicated little or no sea water entered the tube. Westinghouse felt there is no need to flush other tubes in the generator. Discussion revealed that this procedure would have detected one cubic centimeter of sea water in the tube but would not have detected one drop of sea water in the tube.

According to the report there have been two other incidents of water entering steam generators during shipment. The Indian Point Unit 3 generators had "an order of magnitude" more sea water enter than the Diablo generators. The Zion (Unit 1?) generators had condensation resulting from air leakage, but not sea water. These steam generators for the three projects were shipped over a period of months. The failure of the closures was not detected until after all three units' generators had been shipped. In all cases the temporary shop protective rings had not been removed from the nozzles.

Steam generator tubes are inconel. Tube sheets are forged carbon steel with inconel explosive cladding. Channel heads are cast carbon steel (SA216WCC) with stainless steel (308L) weld clad. Channel splitter plates are inconel. The channel nozzle weld preparations are weld built up of 308L over a transition pass of 309L. The head casting is stress relieved after cladding but before the splitter plate is welded in. The head to tube sheet

weld is stress relieved by local heating. The splitter plate welds are not stress relieved.

The nozzle welds are not sensitized as defined by ASTM 393 or ASTM 262. This is the so-called Strauss test and was indicated to be acceptable by the AEC to determine sensitization. The test was made on duplicate material, not on material from the nozzles themselves.

Inconel was considered to be immune to chloride ion stress corrosion cracking, but will pit on long exposure to sea water, especially if stagnant. No pitting has been seen in the steam generators, which have had a relatively short exposure.

The corrective action proposed by Westinghouse was to wash the channels with deionized water until a one ppm chloride level was reached in the wash water and then swab with alcohol to dry. They believed that this would prevent any future damage from the sea water and was all that was required. It was the same procedure proposed for the Indian Point generators which had greater leakage. Mr. Baulig, Westinghouse, said that 1/10 ppm chloride was relatively easy to achieve in the field, and it was his stated intention to wash to this level, not just to the 1 ppm level required by [illegible]mps.

PG&E accepted the investigation of the incident and the proposed cleaning procedure. General Construction prepared a quality control [illegible]viation report on this incident.

Westinghouse has changed the nozzle closure design from bolted to seal welded. Al Hickman PG&E Resident Mechanical Engineer stated a preference for the original design, if correctly executed, because access for inspection in the field is easier.

The report of chloride analysis supplied by Finalysis Inc., Paso Robles, California, indicated that all final rinses had chloride concentrations of 0.1 ppm or less with the exception of two samples which showed concentrations of 0.6 and 0.7 ppm. Of interest, Mr. Good supplied the inspector a copy of an article titled, Application of Steels for Desalination Plant by Richard T. Jones published in August 1967 in Volume 7 No. 3, Metals Engineering Quarterly (ASM). The article primarily deals with corrosion of stainless steel exposed to salt water environments. The test durations were up to two years.

The article indicated that to determine the effect of stress on the corrosion resistance of the stainless steels (type 304 & 316), Ericsen cups were formed by depressing a hardened steel ball into each stainless steel sample. Conclusions from examination of the stress cups, under low magnification and metallographically, indicated the absence of evidence of stress-corrosion cracking or any preferential pitting corrosion on the cups. (A copy of the article is available in the Region V office.)

G. Reactor Vessel

The reactor vessel arrived at Avila Beach for unloading during September 1970. During unloading operations Bigge, the equipment handling contractor, had previously removed the wooden panel covering the O-Ring box on the barge fore-deck and relocated the O-Ring box to a safe area. While removing the wooden panel (10' x 22') that had been under the O-Ring box a 15 to 20 mph wind caught the panel and whipped it into the starboard mid-section of the reactor vessel botton, dragging its edge across several of the instrument penetration tubes. After an initial inspection, a detailed inspection procedure formulated by Westinghouse and PG&E was implemented. Results of the inspection were reported in the deviation report as follows.

1. The area of impact was determined by holes and abrasions in the protective cover. This area, in turn, was found on the reactor vessel bottom by bits of wood on two (2) of the penetration tube end expandable plug bolt threads. These two tubes had been marked initially because their plugs had been knocked loose and leaked gas. A third tube had its plug end bolt bent, but wasn't leaking. The fabric cover was removed during this process.

   Tubes, S/N 456-09-2 and 456-15-2, had wood chips on their plug bolt threads and tube S/N 456-212-2 had a bent bolt.

2. The burlap boots and polyethylene socks were removed from these three tubes and nine (9) other tubes adjacent to them. They were all checked for straightness by laying a straight-edge on two (2) sides of each tube, 90° apart. No bent tubes were found.

   The socks and boots were reinstalled with new tuck-tape.

3. All instrument penetration tube end expandable rubber plugs were checked for internal gas leakage with an "Ultra-Sonic Translator" (leak detector). One (1) plug was found to be leaking and was re-seated and re-tightened. The leak was stopped.

4. Each tube end plug was physically checked for seating, tightness (soundness) and possible damage to the tube.

   Loose burlap boots were removed and replaced solidly with new tape. No damage was found.

5. On completion of the inspection, the protective fabric weather cover was replaced over the Reactor Vessel bottom.

The results of this inspection disclosed no physical damage to the bottom penetration tubes.

Mr. Brady indicated that the vessel would be transferred to the site from Avila Beach during the week of December 7, 1970. The inspector observed during a tour of the temporary storage area at Avila Beach that (1) the vessel was under surveillance by a guard (2) the vessel was covered with plastic and (3) the gas pressure was monitored by an installed gauge (0.5 to 1 psig of nitrogen is being maintained on the vessel).

H. QA Audits

The on-site QA audit program was reviewed and discussed with Mr. Brady. The review included a reading of recent audit reports, audit schedules and plans. Mr. Brady indicated that to perform an audit associated with a particular phase of contract work approximately 15 man days are expended in preparing, conducting and documenting a particular QA audit.

The audit reports appeared to be comprehensive in describing the scope and findings of the audits. Copies of the audit reports had been distributed to all interested parties and written responses of adverse findings were noted to be filed with the appropriate audit report. Mr. Brady indicated that the need for timely filing of deviation reports had been highlighted on several occasions. However, this problem seems to have been remedied as contractors have become more aware of the urgency for prompt submittal of formal notification whenever discrepancies are identified.

Since July 1, 1970, 15 QA audits of construction activities have been completed. Plans were to complete three more audits before the end of the year pursuant to the approved schedule.

Activities audited included:

1. QC inspections.
2. Transporting, handling and storage of steam generators and reactor vessel.
3. Receival and storage of electrical equipment.
4. Installation of auxiliary salt water piping.
5. Mechanical equipment - inspection, storage and placement.
6. Fabrication of liquid holdup tanks.
7. Containment structure.
   a. Rebar
   b. Liner
   c. Wide Beam Flanges

ASTM A-490 - Specifications

½" - 2-½" diameter

	Minimum	Maximum
Tensile	150 k	180 k
Yield	130 k	
Elongation in 2"	14%	
Reduction in area	40%	
Hardness - Brinell	3.02	3.52

ANCHOR BOLTS

Pump Supports - 64 bolts - 2-½"
11AR1 & 11AR2

Tensile	141,675	5.6% low
Yield	124,815	4.0% low
Elongation	19.3%	ok
Red. in Area	60.6%	ok
Hardness	2.86	5.3% low

Generator Supports - 128 bolts - 2"
11AR3 & 11AR4

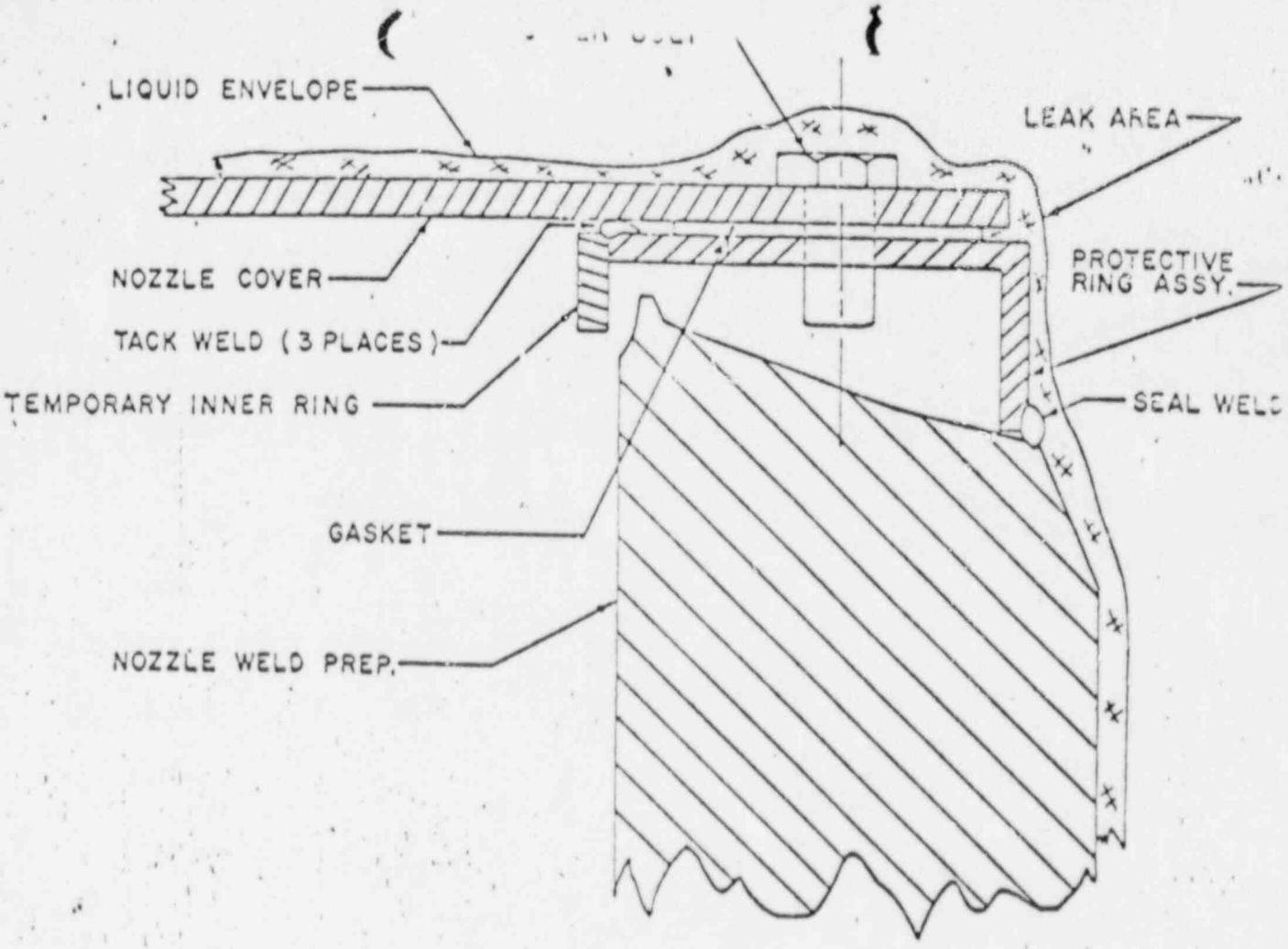
Tensile	139,460	6.9% low
Yield	121,798	6.2% low
Elongation	28.7%	ok
Red. in Area	64.5%	ok
Hardness	2.69	10.9%

Lateral Truss - 64 bolts - 2"
11AR5 & 11AR6

Tensile	158,750	ok
Yield	146,000	ok
Elongation	8.0%	43%
Red. in Area	37.6%	6.0% low
Hardness	311/321	ok

Annulus Supports - 34 bolts - 1-¼"
11AR7

Tensile	161,000	ok
Yield	150,000	ok
Elongation	10%	28.6% low
Red. in Area	36.0%	10% low
Hardness	321/331	ok



THE SALT WATER INTRUSION OCCURED BECAUSE:

1- THE SHOP FAILED TO REMOVE THE TEMPORARY INNER RING PRIOR TO SHIPMENT OF STEAM GENERATORS.

2- THE TACK-WELDS PROJECTED SUFFICIENTLY TO PREVENT THE SHIPPING COVERS FROM SEATING ON THEIR GASKETS.

3- THE "LIQUID ENVELOPE" FAILED DURING THE BARGE TRIP ALLOWING SEA WATER TO CONTACT THE METAL SURFACES.

APPENDIX - B

GM 167027

ATTACHMENT "B" DVR No. 35

APPROVED BY

CHG | DATE | DESCRIPTION

DSGN.

CH. J.G.N.

CH.

DR.

DIABLO CANYON PROJECT UNIT ONE
STEAM GENERATOR REACTOR COOLANT
NOZZLE SHIPPING COVER DETAIL
GENERAL CONSTRUCTION DEPARTMENT

GM | PY | CH | APP.

DRAWING LIST

SUPERSEDES

SUPERSEDED BY

SHEET NO. SHEET

DRAWING NUMBER CHAN.