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REACTOR CONSTRUCTION PROGRAMS BRANCH

Report No.: 50-530/86-03

Docket No.: 50-530

Licensee: Arizona Nuclear Power Project

Facility Name: Palo Verde Nuclear Generating Station - Unit 3

Inspection At: Palo Verde Site, Wintersburg, Arizona

Inspection Conducted: January 13-24 and February 3-14, 1986

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I. INSPECTION SCOPE AND OBJECTIVES

The objective of this inspection was to evaluate the adequacy of construction at the Palo Verde Unit 3 site. This objective was accomplished through review of the construction program, evaluation of project construction controls, and review of selected portions of the Quality Assurance Program, with emphasis on the installed hardware in the field. The scope and significance of identified problems were also determined.

Within the areas examined, the inspection consisted of a detailed examination of selected hardware subsequent to quality control inspections, a selective examination of procedures and representative records, and limited observation of in-process work.

For each of the areas inspected, the following was determined:

- Were project construction controls adequate to assure quality construction?
- Was the hardware or product fabricated or installed as designed?
- Were quality verifications performed during the work process with applicable hold points?
- Was there adequate documentation to determine the acceptability of installed hardware or product?

II. ELECTRICAL AND INSTRUMENTATION CONSTRUCTION

A. Objective

The primary objective of the appraisal of electrical and instrumentation construction was to determine whether safety-related components and systems were installed in accordance with regulatory requirements, Final Safety Analysis Report (FSAR) commitments, and approved vendor and construction specifications and drawings. Additional objectives were to determine whether procedures, instructions, and drawings used to accomplish construction activities were adequate and whether quality related records accurately reflect the completed work.

B. Discussion

Within the broad categories of electrical and instrumentation construction, attention was given to several specific areas. These included electrical cable, raceways and raceway supports, electrical equipment, and instrumentation tubing and components. Additionally, a review was made of a selected number of documents associated with design change control and nonconformance reporting.

A number of documents were generated by the applicant to record individual observations of the NRC Construction Appraisal Team (CAT) inspectors and are referenced directly in the discussions that follow.

1. Electrical Raceway Installation

a. Inspection Scope

Forty-five segments of installed Class 1E cable tray representing a total length of about 550 feet, were selected from various plant areas for detailed examination by the NRC CAT. These segments were inspected for compliance to requirements relative to routing, location, separation, support spacing and configuration, identification, protection and physical loading. Additionally, 24 runs of installed conduit, with an aggregate length of about 500 feet, were inspected for compliance to specified requirements such as routing, location, separation, bend radii, support spacing and configuration, and associated fittings.

Seven raceway supports were examined in detail for such items as location, material, weld quality, bolt torque and installed configuration.

See Table II-1 for a listing of cable tray, conduit, and raceway support samples.

The following documents provided the basic acceptance criteria for the inspection:

- Bechtel Specification 13-EM-302, "Installation Specification for Cable Tray Hangers," Rev. 9, December 7, 1984.

- Bechtel Specification 13-EM-304, "Installation Specification for Seismic Category I Conduit and J-Box Supports," Rev. 11, January 29, 1985.

- Bechtel Work Plan Procedure/Quality Control Instruction (WPP/QCI) 251.0, "Raceway Installation," Rev. 23, July 31, 1985.

- Bechtel WPP/QCI 251.1, "Raceway Separation," Rev. 4, August 23, 1985.

- Arizona Nuclear Power Project (ANPP) Internal Procedure IP-4.3, "Multidiscipline Systems Analysis Review," Rev. 5, June 15, 1979.

- Bechtel drawing 13-E-ZAC-077, "Cable and Raceway Physical Separation Guide," Rev. 6.

b. Inspection Findings

In the area of electrical raceway the NRC CAT inspectors observed that, in general, Class 1E raceway installations were in accordance with applicable design criteria. Except in two isolated instances quality attributes for cable tray such as material type, location, identification, and installed configuration were found to be as shown on approved construction drawings. The two isolated deficiencies identified were:

- Adjacent tray segments 3EZJRAATRVA and 3EZJRAATSVA have damaged side rails from subsequent construction activity.

- Cable tray segment 3EZA1ACTYBB has an improperly sized splice plate installed.

These two cable tray deficiencies were subsequently recorded on Nonconformance Reports (NCRs) EJ-7190 and EA-7191 respectively and determined by the licensee to be acceptable as is.

However, several other concerns in design or construction of raceway were identified and are discussed in the sections which follow.

(1) Raceway Separation

The examination of the selected Class 1E raceway disclosed a number of installations which were not in accordance with FSAR commitments to Regulatory Guide (RG) 1.75 for "Physical Independence of Redundant Systems." In a number of installations Class 1E components did not maintain the required physical separation from redundant Class 1E or non-Class 1E components. See Table II-2 for a listing of the identified raceway segments that violate separation criteria.

NRC CAT inspectors reviewed the relevant inspection procedures and records in order to determine why this condition had not been identified by quality control (QC) personnel. The review

of WPP/QCI 251.0 and discussions with licensee personnel indicate that the generic attribute of electrical separation had been excluded from inspection activities until just prior to area turnover. Only one aspect of electrical separation had been included in existing inspection requirements. Components which exhibit less than one inch of physical separation were to be identified and documented by inspection personnel. In general, it was observed that this activity had been accomplished and only a few deficiencies of the one inch criteria were identified by the NRC CAT.

NRC CAT inspectors reviewed procedure WPP/QCI 251.1, entitled "Raceway Separation," which details the planned inspection of raceway components. The review indicated that the procedure is thorough and, when used in conjunction with Bechtel drawing 13-E-ZAC-077, it would provide the necessary inspection criteria. However, because inspection activity has not yet commenced, the program effectiveness could not be evaluated by the NRC CAT. Consequently, additional NRC and licensee evaluation will be required to assure that Class 1E raceway installations are in accordance with requirements.

NRC CAT inspectors also observed several raceway installations in which redundant divisional conduits had been attached to a common raceway support. NRC CAT inspectors expressed concern that this configuration does not meet the requirements for "Single Failure Criterion" as specified in Institute of Electrical and Electronic Engineers (IEEE) Standard 279-1971, entitled "Criteria of Protection Systems for Nuclear Power Generating Stations" and endorsed by RG 1.75.

As a result of these observations NRC CAT inspectors held discussions with offsite Bechtel engineering personnel and presented specific examples of this configuration to site engineering for evaluation. The discussions and a review of calculations indicate that an extensive program for evaluations of missile impact on all components is in place. A list of potential high energy missiles and targets was reviewed as well as the specific analysis used to determine the acceptability of the raceway configurations the NRC CAT presented to site engineering. In summary, although the practice of mounting redundant Class 1E raceways from a common support does not appear to meet the intent of RG 1.75, engineering evaluation has been performed to assure that these components will not be adversely affected by a single failure. However, because of the limited scope of the NRC CAT inspection, this issue will require further review by the NRC.

(2) Conduit

No hardware deficiencies were observed within the sample of conduits inspected by the NRC CAT. However, two violations of electrical separation criteria were noted in installations not included within the sample, and are identified below and on Table II-2, Separation Findings:

- Class 1E Division A junction box 3EZC1EAKRJ04 was found to be less than one inch from Class 1E Division B conduit 3EZC1EBRR75.

- Class 1E Division B conduit 3EZCAEBRX34 was found to be less than one inch from non-Class 1E conduit 3EZCAENRR71.

(3) Raceway Supports

Conduit and cable tray supports were examined for conformance to design for attributes such as location, material type and size, anchor spacing and embedded length, welds (location, size and general quality), and installed configuration. Except as noted below, the raceway supports inspected conformed to design requirements or their deficiencies had been previously identified by the licensee.

The spacing of fillet welds on a vertical member connection to building steel for cable tray hanger EZC2CH15 was found to exceed the drawing requirements. Detail 8 of drawing 13-E-ZAC-043 requires a maximum 5 inches of spacing between the welds and the installed welds are spaced 10 inches. The same condition was noted on the adjacent hanger, EZC2CH14. The licensee subsequently documented these deficient hangers on NCR EG-7182 and an engineering evaluation by the licensee found the existing conditions to be acceptable.

Two deficiencies were also found by the NRC CAT with a tray hanger in the Diesel Generator Building. One vertical member attachment for hanger EZG1AH5 is cantilevered off the end of the building steel and the welds do not conform to any of the existing weld attachment details. In addition, the hanger does not have the required transverse brace. A review of the licensee's records indicates that the missing brace for hanger EZG1AH5 was previously identified during a support reinspection performed under Design Change Package (DCP) 3-SCZJ-083 and the hanger was evaluated to be acceptable. However, the discrepant weld connection had not been identified.

Approximately 25 additional cable tray hangers throughout the plant were inspected by the NRC CAT to verify the adequacy of the vertical member weld attachments and to ascertain the presence of the required transverse braces. No other hangers were found with missing braces, but two additional hangers in the Diesel Generator Building were found to have been installed using weld attachments not previously approved by the architect-engineer (A-E) and had not been identified by QC inspectors. Hangers EZG1AH15 and EZG1AH16 have vertical attachments cantilevered from building steel in the same manner as hanger EZG1AH5. These three hangers were subsequently documented on NCRs EG-7167 and EG-7224 and determined by the licensee to be acceptable as is.

Several of the additional 25 cable tray hangers that were reviewed in other areas of the plant were found with vertical member weld attachments that did not meet the drawing details. However, in each of these instances the discrepancy had been previously identified and evaluated by the licensee.

In summary, the NRC CAT identified discrepant weld attachments with 5 of 32 cable tray hangers inspected. Although the licensee has determined technical adequacy in each individual case, the licensee's QC program including reinspection programs failed to identify the deficiencies. Additional licensee attention is required to assure the acceptability of cable tray hanger weld attachments.

The NRC CAT identified two cases of interference between cable tray hangers and a conduit hanger in one instance and a heating, ventilation and air conditioning duct hanger in another instance. Discussions with the Resident Engineer (RE) indicated that these types of interferences were insignificant and not identified nor evaluated by the licensee. In response to further questions from the NRC CAT, project engineering performed a generic evaluation for the seismic interactions between hangers in contact. This evaluation was reviewed by the NRC CAT and was found to resolve the concerns for the electrical raceway interaction.

The NRC CAT inspector questioned the weld configuration of conduit support 3EZGIAARK35 in the Diesel Generator Building. When the support was reinspected by a Bechtel QC weld inspector one of the support welds was found to be undersized. This was documented on NCR WG-1708 and evaluated to be acceptable.

c. Conclusions

Except as noted above, Class 1E raceway systems have been installed in accordance with applicable design and installation requirements. However, in a number of installations the required physical separation had not been maintained. At the time of this inspection programs for the inspection of separation had not commenced. As such, the adequacy of Class 1E raceway installations for separation will require further evaluation by the licensee and NRC personnel.

In addition, the licensee's QC program, including special reinspection programs, failed to identify five cable tray hangers with discrepant weld connections. Additional licensee attention is required to assure the acceptability of welded hanger connections.

2. Electrical Cable Installation

a. Inspection Scope

The NRC CAT inspectors selected a sample of installed Class 1E cable runs that had been previously accepted by QC inspectors. The sample included control, instrumentation, and medium and low voltage power cabling. For each of the cable runs, physical inspection was made to

ascertain compliance with applicable design criteria relative to size, type, location and routing, bend radii, protection, separation, identification, and support.

Additionally, the NRC CAT inspectors selected approximately 166 cable ends for examination. These were inspected to applicable design and installation documents for items such as lug size and type, proper terminal point configuration, correct identification of cable and conductors, proper crimping of lugs or connectors and absence of insulation or jacket damage. See Table II-3 for a listing of cable terminations examined.

The following medium and low voltage power cable, totaling about 450 feet, were selected from different systems, electrical trains and locations:

Cable	Type
3EPK05BC1FP	2-1/C 350 MCM
3ESI01AC1CA	3/C 4.0 AWG
3ECH26EC1FA	3-1/C 350 MCM

The following control cables totaling approximately 300 feet were selected from different systems, electrical trains and locations:

Cable	Type
3EAF02AC1RA	2/C No. 14 AWG
3ECH26EC1RA	2/C No. 14 AWG

The following instrument cable totaling approximately 500 feet were selected from different systems, electrical trains and locations:

Cable	Type
3ESA07CC1XY	3/C No. 14 AWG Shielded
3ESA08DC1YB	12 PR. No. 16 AWG Shielded

The following documents provided the basic acceptance criteria for the inspection:

- Bechtel Specification 13-EM-300, "Installation Specification for Electrical Cables in Cable Trays," Rev. 7, July 13, 1984.
- Bechtel Specification 13-EM-301. "Installation Specification for Electrical Cables in Conduit and Duct Banks," Rev. 11.
- Bechtel Specification 13-EM-306, "Installation Specification for Cable Splicing, Terminations and Supports," Rev. 10, October 23, 1984.
- Bechtel WPP/QCI 254.0, "Cable Installation," Rev. 24, June 28, 1985.
- Bechtel WPP/QCI 254.1, "Electrical Cable Repair," Rev. 8.

- Bechtel WPP/QCI 255.0, "Cable Terminations," Rev. 18, September 11, 1985.

- Bechtel Special Construction Inspection Plan (SCIP) 695.0, "Connector Installation & Termination (Ex-Core Detectors)."

- Westinghouse "Detector and Cable Installation Procedure" NC-TR-86-01, Bechtel reference No. N001-13.04-210-1.

b. Inspection Findings

(1) Routing and Identification

The cables examined by the NRC CAT were found to be routed through their design raceways as documented on Bechtel's EE-580 program routing cards. The cables also were properly identified at each end with their appropriate cable number, and divisional identification was maintained throughout the routing with color coded cable jackets.

In one instance tray segment 3EZJZBDTYAK was found not to have the required edge protector where cables exited the tray into a ceiling penetration. This was subsequently documented on NCR EJ-7198 for correction. The NRC CAT inspectors consider this an isolated case.

No other deficiencies were identified in this area.

(2) Separation

The separation of Class 1E cables outside of equipment was found to be in accordance with project requirements. However, two violations of separation criteria as implemented by Bechtel Specification 13-EM-306 and procedure WPP/QCI 255.0 were identified in one of the main control boards, 3JRMAJB05. Less than six inches of separation was found between Division D cables and non-Class 1E cables where the divisional cables enter floor penetration 3EZJ2ADKSVDS, and less than six inches separation (physical contact at one point) was found between Division C cables and a Division B wireway. These two instances were subsequently documented on NCR EJ-7411 by the licensee for correction.

Separation problems in the main control boards had been identified previously by the licensee. DCP 3CE-RM-084 was written in June 1982 as a result of installation problems in Palo Verde Nuclear Generating Station (PVNGS) Unit 1 main control boards and to identify the revised separation requirements for Units 2 and 3, and Deficiency Evaluation Report (DER) 83-45 documented separation problems in PVNGS Unit 1 panels including the main control boards. The DCP for Unit 3 has not yet been closed and the DER's corrective action for Unit 3 is a separate inspection for separation prior to fuel load.

(3) Power Cable Spacing and Derating

The ampacity ratings of power cables at PVNGS were established by the licensee to comply, as a minimum, with Insulated Power Cable Engineers Association (IPCEA) publications P-46-426 for cables in conduit and P-54-440 for cables in cable tray. The FSAR and project procedures further require a maintained spacing of one cable diameter between 5kV cables in tray.

In general, the Class 1E 5kV power cable installations observed did maintain the required spacing. However, in tray segments 3EZA1CATCAD, 3EZA1CATCAE and 3EZACCATCAC the spacing between adjacent power cables fell below the required one diameter minimum. These deficiencies were subsequently documented on Startup Field Report (SFR) 3SI-078 for rework. Although not in accordance with FSAR and procedure requirements, the deficiencies have no effect on the IPCEA recommended ampacities.

No other deficiencies were identified in this area.

(4) Terminations

In general cable termination activities were found to comply with project requirements. However, deficiencies were identified with vendor terminations in the diesel generator control panels and several isolated deficiencies were identified with field terminations. In addition, a weakness was identified with the QC inspection of ex-core cable terminations.

- Several deficiencies were noted in diesel generator control panels 3JDGAB01 and 3JDGB01. These include:

  - Mounting support springs were found loose or missing from several Agastat relays.

  - Three wires (two vendor installed jumpers and the green conductor of cable 3EHD01AC1RA) were landed on terminal point 401, whereas installation requirements allow a maximum of two wires landed at any one terminal point.

  - Numerous vendor installed terminal lugs were found with excessive bends and cracks in the "neck" area, and landed facing together instead of in the required back-to-back configuration. Vendor wiring was then inspected in several other panels throughout the facility, and these types of deficiencies were observed only in panels supplied by Cooper Energy Services as part of the diesel generator package.

- The NRC CAT inspection of termination 3ECH26EC1FA2 for the charging pump motor revealed a short radius bend in one of the vendor motor leads. The bend radius was measured by Bechtel QC to be less than 0.5 inch although no criteria had been imposed upon or required by the motor vendor. The motor lead was subsequently documented on NCR EA-7223 and

the A-E's recommendation is to retrain the motor lead to meet project requirements for bend radii.

- The EE-580 termination card for the 4.160kV motor termination 3EAF01BC1CA2 referenced the inspection of stress cones. The NRC CAT inspection of the termination and review of the applicable specification showed that stress cones are neither required nor installed. The licensee attributes the references on the EE-580 card to the inner sleeves included with the kit used for the termination. The termination card was subsequently corrected with a Documentation Supplement Sheet.

- In remote shutdown panel 3JZJAE01, the spare green-black conductor of cable 3ESI51AC1RB was missing its protective heat-shrink covering.

- In isolator cabinets 3JSDAC05 and 3JSDBC06, the metal barriers between separation divisions had been removed causing safety and nonsafety-related cables to be separated by less than the required six inches, and in some cases, these cables were in contact.

NRC CAT inspectors also reviewed in-process work activities on Class 1E ex-core detector and cable terminations. The installation of ex-core detector, preamplifier and cable system is an intricate and detailed assembly process. The Westinghouse installation manual states that the installation of this system "includes many separate steps where any single incorrect step could result in a system failure." Because of ex-core failures and detector leakage experienced on PVNGS Units 1 and 2, ANPP through Combustion Engineering had subcontracted ex-core installation work activities to Westinghouse. The scope of this work included development of an installation procedure and termination activities. Responsibility for quality overview had been given to Bechtel personnel.

NRC CAT inspectors observed five ex-core work stations. At two of the stations actual termination activities including cable dressing and component installation were in progress. However, no Bechtel QC personnel were present at either of these locations. A discussion with licensee and Bechtel personnel indicates that the Quality Control Engineer (QCE) is responsible for 100 percent monitoring of the termination activity. However, a concurrent discussion with the responsible QCE indicates some individual judgement as to which portions of the assembly process would require an inspector's presence.

A review of the applicable Special Construction Inspection Plan SCIP 695.0 entitled "Connector Installation and Termination (Ex-Core Detectors)" indicates, in Section 1.1.1, that the QCE is to verify that these terminations are accomplished in accordance with the requirements of the Westinghouse installation procedure. Through discussions with site engineering and a

review of the Westinghouse procedure NRC CAT inspectors determined that in-process inspection of the work activity would be required in order to assure that the requirements of SCIP-695.0 Section 1.1.1 were met.

As a result of field observations and the discussions held with responsible QC personnel, NRC CAT inspectors concluded that the existing quality verification program is not adequate to assure that these critical safety-related terminations are made in accordance with requirements.

As a result of this observation Bechtel initiated a documented training session for all responsible QCEs to emphasize the need for 100 percent coverage while all work is being performed, and a step by step instruction as to QCE inspection requirements per SCIP 695.0 and the Westinghouse installation procedure. In addition, SCIP 695.0 was changed to detail the specific steps which require QCE verification.

Additional NRC and licensee attention will be required to assure that appropriate quality verification activities are performed for ex-core terminations.

c. Conclusions

In general, field cable terminations are performed in accordance with applicable requirements.

However, the quality of vendor terminations in the diesel generator control panels and the QC verification of in-process ex-core terminations require additional attention by the licensee.

3. Electrical Equipment Installation

a. Inspection Scope

Over 30 pieces of installed or partially installed electrical equipment and associated hardware items were inspected. Samples were based on system function and safety classification.

The following specific electrical components were inspected in detail:

(1) Motors

The installation of three pump motors and associated hardware was inspected for such items as location, anchoring, grounding, identification, and protection. The motors inspected were:

Containment Spray	3M-SIA-P03
High Pressure Safety Injection	3M-SIB-P02
Essential Cooling Water	3M-EWB-P01

(2) Electrical Penetration Assemblies

The location, type, mounting and identification of four penetrations were compared with the installation drawings and vendor manuals. The containment penetration assemblies inspected were:

3ESFBZ-38	3ERIAZ-49
3ESFDZ-77	3ERIDZ-79

(3) Circuit Breakers

Circuit breakers for the following Class 1E pump motors were examined to determine compliance with design and installation documents for size, type, system interface and maintenance. The use of circuit breakers with integral undervoltage trip attachments at PVNGS was also investigated.

Containment Spray	3M-SIA-P03
High Pressure Safety Injection	3M-SIB-P02

(4) Switchgear and Motor Control Centers

The following switchgear and motor control centers were inspected for location, mounting, identication, and installation of components:

3E-PBB-S04	(13EZJC04)
3E-PBB-S03	(13EZJC38)

(5) Station Batteries and Racks

The 125V battery rooms including the installed batteries, battery racks and associated equipment were inspected. The location, mounting, maintenance and environmental control for the batteries were compared with the applicable requirements and quality records.

125V DC Battery	3E-PKB-F12
125V DC Battery	3E-PKA-F11

(6) 125V DC System Equipment

The following equipment comprising portions of the 125V dc systems were inspected for compliance to design documents for such items as location, mounting (welds, concrete anchors and bolting) and proper configuration:

Battery Charger	3E-PKD-H14
Battery Charger	3E-PKB-H12
Static Inverter	3E-PNA-N11
Distribution Panel	3E-PNC-D27

(7) Control Panels

A number of Class 1E electrical control panels were inspected for compliance to requirements for items such as location, mounting and type. The panels inspected were:

Remote Shutdown Panels	3JZJB-E01
	3JZJD-E01
Diesel Generator Control Panels	3JDGB-B01
	3JDGB-B02
Main Control Boards	3JRMA-B02
	3JRMA-B04
	3JRMA-B05

(8) Motor Operated Valves

The following 12 motor operated valves were examined in detail for conformance to design documents:

Low Pressure Safety Injection Isolation (LPSI)	3J-SIA-HV-683
High Pressure Safety Injection Flow Control	3J-SIA-UV-617
Shutdown Cooling Isolation	3J-SIA-UV-651
Auxiliary Feedwater	3J-JSG-UV-138
Safety Injection Tank Isolation	3J-SIB-UV-614
Safety Injection Tank Isolation	3J-SIA-UV-644
Shutdown Cooling Isolation	3J-SIC-UV-653
Safety Injection Tank Isolation	3J-SIA-UV-634
Safety Injection Tank Isolation	3J-SIA-UV-624
Containment Spray Mini Flow	3J-SIA-UV-664
LPSI Discharge Loop Injection	3J-SIA-UV-635
Containment Spray Isolation	3J-SIA-UV-671

The following documents provided the basic acceptance criteria for the inspections:

- Bechtel Specification 13-EM-009, "Technical Requirements for 13.8kV and 4.16kV Metal-Clad Switchgear," Rev. 6, June 1, 1984.
- Bechtel Specification 13-EM-051, "Technical Requirements for 48V & 125V DC Battery Chargers," Rev. 5, February 25, 1977.
- Bechtel Specification 13-EM-050, "Technical Requirements for 125V DC Batteries," Rev. 6, July 23, 1980.
- Bechtel Specification 13-EM-021, "Technical Requirements for DC Control Centers," Rev. 5, May 8, 1978.
- Bechtel Specification 13-EM-018, "Technical Requirements for 480V Motor Control Centers," Rev. 1, February 2, 1977.

- Bechtel WPP/QCI 28.0, "Maintenance of Materials and Equipment," Rev. 15, June 30, 1978.

- Bechtel WPP/QCI 258.0, "Electrical Equipment Installation," Rev. 7, May 31, 1985.

- Bechtel WPP/QCI 258.1, "Battery Systems Installation," Rev. 2, April 18, 1985.

- Bechtel WPP/QCI 258.2, "Electrical Penetration Assembly Installation," Rev. 5, November 6, 1985.

- Bechtel WPP/QCI 258.3, "Control Panel Installation," Rev. 7, February 6, 1985.

- Bechtel WPP/QCI 259.1, "Installation of Electrical Penetration Slip-On Flanges," Rev. 2, August 7, 1980.

- PVNGS Manual, Procedure 93EG-OZZ27, "Battery System Checkout," Rev. 3.

b. Inspection Findings

(1) Motors

The three 4kV pump motors that were examined were found to be the type, size, and configuration specified. The motor mounting configuration such as bolt size and material was found to conform to vendor seismic qualification requirements.

In general, maintenance activities and records for the three motors conform to vendor and project requirements. No maintenance was performed on the replacement motor for containment spray pump 3M-SIA-P03 while the motor was in the construction warehouse from December 1984 until it was installed in March 1985, even though NCR NA-1607 was written against the motor for lack of maintenance and its disassembled condition. However, subsequent maintenance activities and motor tests indicate no deficiencies with the motor.

It was also noted during the review of the maintenance records that the specific motor is not identified on the construction Maintence Activity Cards (MACs) or the startup Maintenance Data Sheets although the MACs have a specific field for vendor identification; the identification used is Bechtel's tag number for the pump-motor assembly. Transfers of equipment such as motors between units are documented on Material Transfer Authorizations which again only use the full assembly tag number and do not specifically identify the particular item being transferred. This makes the maintenance status of transferred equipment difficult to determine.

The licensee subsequently issued Corrective Action Report (CAR) CA86-0012 to review the need for vendor identification on the MACs and has determined that the information is optional. A

proposed change to WPP/QCI 28.0, "Maintenance of Materials and Equipment," will clarify this point.

The project's preventative maintenance program is more fully discussed in Section III, Mechanical Construction, of this report.

(2) Electrical Penetrations

The penetrations examined were found to have been installed in accordance with applicable design documents. Inspection records were reviewed and indicate the penetration assembly process had been appropriately monitored by QC personnel and had been completed in accordance with vendor and site engineering requirements.

No deficiencies were observed in this area.

(3) Circuit Breakers

The examination of the selected circuit breakers for the containment spray and safety injection pump motors indicated that they had been purchased, installed and maintained in accordance with the applicable design documents. Important installation attributes such as proper alignment, main contact penetration, and safety interlocks were verified by physical inspection and review of construction and test records.

No deficiencies were observed in this area.

(4) Switchgear and Motor Control Centers

The examination of 4160V switchgear units disclosed several construction deficiencies which are discussed below.

In switchgear 3-E-PBB-S04G weld configurations for panel mounting do not match those specified by design details. Design documents specify a 3/16 inch continuous fillet weld between embedded channel and the equipment. However, in several locations weld lengths have been interrupted by grout holes in the channel. In reviewing applicable inspection records NRC CAT inspectors noted that this condition had not been noted by inspection personnel. As a result of this observation the licensee subsequently issued NCR WJ-1717 followed by CAR CA-86-0005 to document and correct this condition.

Additionally, site engineering has determined that although not in accordance with design requirements, the existing weld configuration is adequate to perform its intended function and has dispositioned the NCR "Use-As-Is". This deficiency is part of a generic concern regarding Class 1E equipment mounting which is discussed in detail in Section II.B.3.b.(6), below.

The Class 1E motor control centers examined were found to have been installed in accordance with design requirements.

No other deficiencies were identified in this area.

(5) Station Batteries and Racks

The condition of the battery rooms was found to be in good order, clean and free of debris. Ventilation systems were installed and in operation. Although access to these areas had not been limited by keyed entry, it was noted that construction activity in the area was minimal and that appropriate danger signs have been posted to prohibit smoking or open flames.

The 125V batteries were examined and found to be in good condition. Slight damage was identified in the casing of cell (9-10) in battery bank 3E-PKB-F12. As a result of this observation the licensee issued Startup Work Authorization (SWA) 6784 to evaluate this condition. Battery rack assemblies were also examined and were found to conform to design requirements.

Maintenance activities were reviewed and, in general, had been performed in accordance with specified requirements.

Several concerns were identified regarding the classification and adequacy of block walls installed in this area. These concerns are discussed in detail in Section V, Civil and Structural Construction, of this report.

(6) 125V DC System

In general, the examination of components which comprise portions of the 125V dc system indicates that construction activities had been accomplished in accordance with applicable procedures and design documents. However, deficiencies in the areas of equipment mounting and vendor component quality were identified in several items of Class 1E equipment.

The examination of battery chargers 3EPKDH14, 3EPKBH12, and 3EPKBH16 disclosed a weld configuration which does not match the mounting detail specified by applicable design documents. Drawing EO-51-20 Rev. 5 specifies a fillet weld six inches long in three places on each side of the equipment. In actual field configurations the equipment examined exhibited welds in lengths which vary from 3 1/2 inches to 4 1/2 inches. As detailed in Section II.B.3.b.(4), above, this condition exists in part due to the location of grout holes in the channel embeds. However, several deficiencies were observed which were not the result of grout hole interruption, but simply a failure to comply with design requirements for the length of weld. A review of the applicable inspection records indicates that they do not detail these conditions nor was an engineering approval of these design deviations on file.

In response to this observation the licensee issued NCRs WJ-1705 and WJ-1706 to document and correct this condition. In each instance, the disposition for the NRCs has been "Use-as-Is" based upon engineering evaluation which has determined that the existing weld configuration is acceptable for the design loading.

Because of the number of deficiencies identified by the NRC CAT inspectors in the mounting of switchgear, battery chargers and remote shutdown panels (6 of 11 panels mounted by welding exhibited configuration deficiencies), the licensee also issued CAR CA-86-0005 in order to:

"1. Determine root cause.

2. Reinspect mountings of safety-related equipment in Unit 3.

3. Document results...and evaluate if deficiencies were undetected, the effect on plant safety.

4. Provide corrective action to prevent recurrence."

As a result of this CAR several licensee actions were initiated. These included items such as: a limited reinspection of Unit 3 Class 1E equipment (results indicate that of 27 pieces of equipment examined, 10 exhibited weld configuration deficiencies), a determination that a number of the deficiencies were the result of an "apparent judgement call" by the QCE inspecting welding, an additional inspection of welds on components originally inspected by the referenced QCE, documented training of all welding QCEs to stress the importance of performing inspections to design requirements, and a "Quality Talk" presentation to discuss the findings of the referenced CAR and current procedural requirements. Based upon these actions the licensee had concluded that no further reinspection of previous work was required.

In general, the actions taken by the licensee in this area were thorough and appropriate. However, based upon the type and quantity of Class 1E equipment mounting deficiencies identified by the NRC CAT inspectors and the subsequent reinspection of 27 pieces of equipment by the licensee, NRC CAT inspectors expressed concern with regard to the conclusion that no further reinspection of previous work is necessary. As a result of the NRC CAT concern and after additional evaluation by the licensee, the licensee has amended CAR CA-86-0005 to provide for a 100 percent reinspection of Class 1E equipment mounting in Unit 3.

This additional licensee attention should assure that Class 1E equipment is mounted in accordance with approved design documents or that deficiencies are identified and evaluated.

Deficiencies were also identified with the quality of vendor supplied equipment. Four Power Conversions battery chargers examined by the NRC CAT inspectors exhibited loose soldered connections on the equipment "firing boards". Inadequate solder joints were observed at both pin-to-connector and pin-to-circuit board connections. These deficiencies could cause improper operation of the battery chargers and as a result degrade the Class 1E dc system. As a result of this observation the licensee issued SWAs 6723, 6742, and 6868 to document and correct this condition.

Additionally, because of the generic nature of the identified deficiencies and potential for impact on a system critical to safe operation of the plant, the licensee has issued CAR CA-86-0006 and DER 86-07.

No other deficiencies were identified in this area.

(7) Control Panels

In general, the installation of Class 1E control panels was found to be in accordance with applicable requirements. A number of vendor related wiring deficiencies were identified in the Unit 3 diesel generator control panels and are discussed in Section II.B.2.b(4), above. Other deficiencies noted with the panels observed are noted below.

The vendor drawings for the main control boards require the vendor wiring to be Rockbestos Firewall SIS No. 14 AWG for panel 3JRMAB02 or its equivalent for the other panels. What has been installed in most of the panels is the Rockbestos Firewall, Brandrex SIS No. 14 AWG, Boston Insulated Wire SIS No. 14 AWG, Volkene Supreme, and wire with no identification marking. The licensee's position is that since the main control boards remain in a mild environment regardless of plant conditions, qualification of the wire by type testing is not required. They qualify the wire through design by showing that National Electric Manufacturers Association (NEMA) standard insulation materials are suitable for the established conductor temperatures and temperature rises. However, electrical separation criteria is based on an established flammability for the insulation material which the licensee has not demonstrated and the unmarked wire is not traceable to an industry standard for insulation type or maximum conductor temperature. Consequently, the adequacy of the switchboard wire to meet the requirements of RG 1.75 requires additional attention by the licensee.

The examination of the remote shutdown panels disclosed a welding configuration which did not match the details specified by applicable design documents. Drawing N001-13.01-739 Rev. 9 specifies a 3/16 inch fillet weld 1 3/8 inches and 6 inches long on all four corners. However, actual field configuration exhibits welds which vary in length from 3 1/2 inches to 3 3/4 inches long. As a result of this observation the licensee has issued NCR WJ-1704 and subsequently CAR CA-86-0005 to document

and correct this condition. A detailed discussion of the generic implications of this issue is provided in Section II.B.3.b.(6), above.

The NRC CAT inspectors noted several Class 1E panels with identification tags color coded as non-Class 1E equipment. The nameplates for the Divisions A and B Qualified Safety Parameter Display System (QSPDS) cabinets consisted of a black background (non-Class 1E) in lieu of the required red (Division A) and green (Division B) background. No other mismarked equipment was identified by the NRC CAT and these deficiencies are considered isolated to the QSPDS cabinets.

NRC CAT review of the seismic qualification report for the diesel generator control panels revealed that several instances of misoperation of certain electrical components were documented in Wyle Laboratories test report number 44369-4. The problems described in the test report include relay contact chatter on several channels and loss of channels during a number of test runs, mechanical binding of contacts, and circuit breakers tripping during test runs. The Wyle report does not document any disposition or explanation for the noted conditions.

When questioned as to the disposition of the documented problems, the licensee produced Structural Dynamics Research Corporation test report number 10643. This report shows that two 1-K-1 relays were later tested on a generic test rig and, in this configuration, meet seismic qualification requirements. However, there was no direct correlation between the two reports and it could not be determined if the test conditions used by Structural Dynamics Research Corporation accurately simulated actual installation conditions. In addition, the Structural Dynamics Research Corporation report did not address the other relay and breaker problems identified in the Wyle Laboratories report.

Subsequent to the NRC CAT inspection, the licensee provided additional information concerning this matter. This information states that additional reports exist for the seismic qualification of all the components for which malfunctions are identified in the original diesel generator control panel qualification report. This area will require further review by the NRC.

(8) Motor Operated Valves

An initial sample of six motor operators for valves were examined by NRC CAT inspectors. As the result of the apparent deficiencies which existed in the original sample, an additional sample of six valves were examined.

The configuration of Class 1E valve operator wiring was compared to the applicable electrical and elementary schematics and, in general, both vendor and field installed wiring conformed to the requirements of these documents. However, a

number of concerns were identified with regard to the environmental qualification of components installed in valve operators located inside of containment.

The examination of safety injection tank isolation valves 3J-SIB-UV-614, 3J-SIB-UV-644, 3J-SIA-UV-634, and 3J-SIA-UV-624 disclosed that unidentified wire had been installed from the torque switch to the limit switch terminal block and from the local terminal block to the valve space heater. Additionally, several examples of Raychem Flametrol wire were observed in these and other valves located inside of containment. Discussions with licensee personnel indicate that, based upon review of the applicable qualification report, Rockbestos Firewall III is the only switchboard wire approved for use in this application.

As a result of these observations an investigation was performed by the licensee in order to ascertain the origin and status of the wire in question. The following sections summarize the results of that research:

- With regard to the use of unidentified wire, the licensee produced documentation which indicates that site modifications to valve operator limit switches, torque switches, terminal strips, and vendor wiring had been performed in accordance with the requirements of WPP/QCI 262.0 "Construction Inspection Planning For Vendor Supplied Components Requiring Work/Test." The document specifies the replacement of original vendor wiring with Class Q cable. This was accomplished by stripping out the black conductor of a qualified Class 1E cable and recording the cable type designation and reel number on the WPP/QCI 262.0 form.

  Consequently, although physical identification was not maintained, the subject wire can be traced through documentation to specific reels of qualified Class 1E cable.

- With regard to the use of Raychem Flametrol wire, discussions with the valve vendor (Limitorque) indicate that this wire has been type-tested and is qualified for use inside of containment locations at other sites. However, specific qualification reports have not been submitted for its use at the PVNGS.

During the review of this issue NRC CAT inspectors reviewed ANPP letter ANPP-33605-EEVB/BJA dated September 30, 1985, to the USNRC Office of Nuclear Reactor Regulation. In synopsis, this letter represents a request for extension for environmental qualification of PVNGS Hydrogen Recombiners. The letter also indicates that the licensee has successfully completed all other qualification efforts.

NRC CAT inspectors concluded that this statement was not entirely accurate due to the absence of approved qualification reports for certain wire types in Class 1E valve operators.

The potential for deficiencies in environmental qualification of wire for Limitorque motor operated valves is discussed in NRC Information Notice 86-03. The NRC CAT finding should be considered in the licensee's review of the Information Notice.

In summary, many of the apparent material deficiencies in this area have been resolved through documented evidence of work and inspection activities. However, the documented evidence for environmental qualification of certain wire types will require additional review.

c. Conclusions

In general, the installation of Class 1E equipment conforms to design requirements. However several concerns were identified.

A number of pieces of Class 1E equipment examined were not mounted in accordance with approved design documents. Examples include equipment which comprise portions of the 125V dc system, 4160V switchgear, and the remote shutdown panels.

Vendor equipment deficiencies were observed in several Class 1E components. Examples include diesel generator control panels and the 125V dc battery chargers. These deficiencies may cause improper operation of equipment as in the case of poor connections on the battery charger dc firing boards.

The status of environmental qualification of certain equipment requires additional review. This includes documented evidence for qualification of wire in motor operated valves and seismic qualification for the diesel generator control panels and components.

4. Instrumentation Installation

a. Inspection Scope

The NRC CAT inspectors selected a sample of 17 completed runs of instrument tubing, comprising about 550 feet, and their associated supports for a detailed inspection in accordance with specification requirements and isometric drawings. Four instrument racks were examined for conformance with requirements including installed configuration, mounting details, material conformance, identification, and location. Nineteen instruments were examined for conformance with requirements for location, mounting details, and type and range of instrument.

See Table II-4 for a listing of instrumentation components included in the sample.

Five plant process systems were examined to determine conformance to relevant design requirements. The systems examined were:

Pressurizer Pressure	Channel B
Auxiliary Feedwater Flow	Channel A
Auxiliary Feedwater Flow	Channel B
Condensate Storage Tank Level	Channel A
Condensate Storage Tank Level	Channel B
Steam Generator Level	Channel A

The signal path of these six instrument loops were traced from their process connections to their final output devices. Components inspected for each loop included sensing lines, transmitters, signal conditioning and isolating devices, indicating and controlling instruments, and the various connecting cables, electrical penetrations, panel wiring, and terminal points along the signal path. Most instrument components were examined for such attributes as type, output, identification, location, mounting, and physical separation of redundant components.

In addition, due to an extensive amount of transferring of instruments between PVNGS Units 1, 2 and 3, a sample of four instruments currently installed in Unit 3 was selected for documentation review to assure that such location transfers are supported by adequate and trackable documentation. The review included shipping and receipt records, component certifications, component transfer authorization forms, and installation records.

The following documents provided the basic acceptance criteria for the inspection:

- Bechtel Specification 13-JM-702, "Installation Specification for Instruments and Controls for Equipment Quality Classes Q, R, and S," Rev. 13, September 4, 1985.
- Bechtel P&I Diagram 13-M-SGP-002, "Main Steam System," Rev. 13, May 15, 1985.
- Bechtel Instrument Loop Diagram 13-J-CTE-054, "Condensate Storage Tank Level," Rev. 6, January 7, 1986.
- Bechtel Instrument Loop Diagram 13-J-CTE-055, "Condensate Storage Tank Level," Rev. 7, January 30, 1986.
- Bechtel Instrument Loop Diagram 13-J-AFE-058, "Auxiliary Feedwater Flow," Rev. 8, May 23, 1985.
- Bechtel Instrument Loop Diagram 13-J-RCE-064, "Pressurizer Pressure," Rev. 7.
- Bechtel Instrument Loop Diagram 13-J-SGE-064, "Main Steam System," Rev. 5, September 12, 1985.
- Bechtel Instrument Loop Diagram 13-J-ZZE-044, "Distribution Module Device Wiring Control Room Control Boards," Rev. 5, August 18, 1984.

- Bechtel Elementary Diagram 13-E-SAB-005, "Eng'd Safety Features Actuation System Auxiliary Protective Cabinet A," Rev. 6, February 27, 1985.

- Bechtel Elementary Diagram 13-E-SBB-005, "Plant Protection System Cabling Block Diagram," Rev. 4, February 7, 1985.

b. Inspection Findings

In general, the installation of instrumentation and associated components was found to be in accordance with requirements. However, two isolated deficiencies were observed and are noted below:

- Two adjacent tube clamps along the "HI" tubing run from instrument 3J-RCB-PDT-115B were installed as 2D2 and 3D type clamps, respectively. The approved thermal isometric drawing shows them to be 3D and 2D2, respectively. 2D2 clamps are two-directional clamps which allow the tubing to move due to thermal expansion and contraction, while 3D clamps are three-directional clamps which allow no movement of the tubing.

- During the plant process system inspection, it was observed that cable 3EAF58BC1AX was terminated at the test connections of instrument 3J-AFB-FT-41A instead of at the signal connections, as required. As this system had not yet been released for system check-out and testing, it is possible that this condition would have been detected and corrected by testing personnel. The licensee subsequently documented the discrepancy on NCR EC-7394 for correction.

In addition, several deficiencies were observed in shop welds associated with instrument racks inside containment supplied by Combustion Engineering. These deficiencies are discussed in Section IV, Welding and Nondestructive Examination, of this report.

c. Conclusions

The NRC CAT inspectors determined that, based on the selected sample, instrumentation installations conform to applicable design requirements.

TABLE II-1

RACEWAY INSPECTION SAMPLE

Cable Tray:

3EZ1ABBTXCL	3EZ1ABBTXCN	3EZ1ABBTXCK	3EZ1ABBTXCJ
3EZ1ADBTXCH	3EZ1ADBTXCG	3EZ1ADBTXCE	3EZ1ADBTXCD
3EZ1ADBTXCC	3EZ1ADBTXCB	3EZ1ADBTXCA	3EZJ1AATCBD
3EZJ1AATCBC	3EZJ1AATCBB	3EZJ1AATCBA	3EZJ1DATCAA
3EZJ1CATCAB	3EZJ1CATAAC	3EZJ1AATCAD	3EZJ1CATCAE
3EZJ1CATCAF	3EZJ1CATCAG	3EZG1ABTTBA	3EZG1ABTTBB
3EZG1ABTTBC	3EZG1ABTTBD	3EZG1ABTTBE	3EZG1ABTTBF
3EZG1ABTTBJ	3EZJ1BBTTAH	3EZJ1BBTTAJ	3EZJ1BBTTAG
3EZJ1BBTTAF	3EZJ1BBTTAE	3EZJ1BBTTAD	3EZJ1BBTTAC
3EZJ1BBTTAB	3EZC2CATZAA	3EZC2CATZAB	3EZC2CATZAC
3EZC2CATZAD	3EZC2CATZAE	3EZC2CATZAF	3EZC2CATZAG

Cable Tray Supports:

Number	Location	Number	Location
3EZA1D-H45A	Aux. Building	3EZA1D-H18	Aux. Building
3EZA1C-H24	Aux. Building	3EZG1A-H09	D.G. Building
3EZG1A-H05	D.G. Building	3EZC2C-H15	Containment
3EZC2C-H13	Containment		

Conduit:

Number	Length (feet)	Number	Length (feet)
3EZA1AARF01	34	3EZC1EARR21	21
3EZA1AARK04	30	3EZC1EARR26	18
3EZA1ACRK04	85	3EZC1EARR62	18
3EZA1BBRR58	8	3EZC1EARR64	19
3EZA1BBRR59	8	3EZC2EARR48	46
3EZA1BBRR60	9	3EZC2EARX08	22
3EZA3BARX09	15	3EZC3AARR13	18
3EZA3BBRK01	20	3EZJ1BBRK21	11
3EZC1AARX03	31	3EZJ1BBRK22	11
3EZC1CARK06	23	3EZJ1BBRK32	11
3EZC1CARK07	22	3EZJ3AARK21	8
3EZC1CARK08	21	3EZJ3AARK22	11

TABLE II-2

SEPARATION FINDINGS

Raceway segment in the A columns do not maintain required separation from the corresponding raceway segment in the B columns. The (*) indicates physical separation of less than one inch between the two raceway segments.

Column A	Column B		Column A		Column B
3EZA1CCTXAB	3EZA1CATCAG		3EZA1CCRX02		3EZA1DATCAA
3EZA1BARK17	3EZA1BNTAAA		3EZA1BCRK05		3EZA1BNTAAA
3EZA1BBRY02	3EZA1BNTAAA		3EZA1BBRC03		3EZA1BNTAAA
3EZA1BCRK05	3EZA1DBTGAF		3EZA1BCRK05		3EZA1DBTFCF
3EZA1DCRX01	3EZA1DBTCAJ		3EZABABRK09		3EZABCATKAA
3EZABABRK10	3EZABCATKAA		3EZABABRK11		3EZABAATKAA
3EZABARRK12	3EZABCATKAA		3EZABDBTCAA		3EZABBARK01
3EZABDBTCAA	3EZABBARK02		3EZABDBTCAA		3EZABBARK03
3EZABDBTCAA	3EZABBARK04		3EZAAAATMAD		3EZAAACRK08
3EZAABDRK10	3EZAABBTMAD		3EZAABDRK09		3EZAABBTMAD
3EZAABDRK04	3EZAABBTMAD		3EZC1EBRR75	*	3EZC1EAKRJ04
			3EZCAEBRX34	*	3EZCAENRR71

TABLE II-3

CABLE TERMINATIONS

Remote Shutdown Panel Section A (3JZJAE01)

Cables: 3ESG64AC1XD, 3ESG21AC2RE, 3ESA03AC1RT, 3ESA03AC1RU, 3EAF04AC1RD, 3ECHC2AC1XB, 3ESI16AC1RE, 3ECH39AC1RE, 3ESG64AC2XD, 3ESB05AC1RW, 3EAF56AC1XB, 3ECH11AC1RB, 3ESI80AC4XC, 3EAF57AC1XA, 3ECHA1AC1XB, 3ESG21AC1RC, 3ERC64AC1XD, 3EAF57AC1XB, 3EAF07AC1RD, 3ESI80AC3XC, 3ESI54AC1RB, 3ESG60AC3XD, 3ESI80AC1XC, 3EAF58AC1XC, 3ESG60AC1XD, 3ECH12AC1RF, 3ESG18AC1RC, 3ERC10AC1RD, 3ESG18AC2RE, 3ESI50AC2RB, 3ESI50AC1RB, 3ESG51AC4XD, 3ECH14AC1RF, 3ESI71AC1XC, 3ESG01AC1RD, 3ESI51AC1RB, 3ESG51AC1XD, 3EAF10AC1RD, 3EZJ01AC1RN, 3ERC74AC1XD, 3ESG02AC1RD, 3ERC57AC1XE, 3EAF04AC1RI, 3ESG01AC1RN, 3ESG02AC1RN, 3ERCB0AC1XG, 3ESI71AC2XC, 3ESE54AC1XB, 3EAF57AC1RB, 3ESI51AC2RB.

Remote Shutdown Panel Section D (3JZJDE01)

Cables: 3ESA03DC1RT, 3ESA03DC1RU, 3ESG20DC1RF, 3ESG20DC1RC, 3ESG22DC1RC, 3ESB08DC1RW, 3ESG20DC1RD, 3ESG20DC1RE, 3ESG22DC1RD, 3ESG22DC1RE.

Diesel Generator Control Panel A (3JDGAB01)

Cables: 3EDG07AC1RE, 3EDG07AC1RF, 3EDG07AC1RG, 3EDG07AC1RH, 3EDG07AC1RJ, 3EDG07AC1RK, 3EDG07AC1XA, 3EDG07AC1RL, 3EDG07AC1XB, 3EDG07AC1RM, 3EDG07AC1XC, 3EDG07AC1RP, 3EDG07AC1RA, 3EDG07AC1RB, 3EDG07AC1RC, 3EDG07AC1RD, 3EDG07AC1RT, 3EHD05AC1RA, 3EDG07AC1RQ, 3EHD01AC1RA, 3EPE01AC1RB, 3EDF01AC1RB, 3EDG03AC1RN, 3EDG03AC1RP.

Diesel Generator Control Panel A (3JDGAB02)

Cables: 3EPE01AC1RD, 3EPE03AC1RA, 3EPE01AC1RJ, 3EDG03AC1KO, 3EPE02AC1RA, 3EPE02AC1RB, 3EPE01AC1RF, 3EPE02AC1RC, 3EPE02AC1RD, 3EDG03AC1KM, 3EPE02AC1RE, 3EPE02AC1RF.

Relay Panel (3JSDAC05)

Cables: 3ESD01AC1RA, 3ESD01AC1RB, 3ESD01AC1RC, 3ESD01AC1RD, 3ESD01AC1RE, 3ESD01AC1RF, 3ESD01AC1RG, 3ESD01AC1RH, 3ESD01AC1RI, 3ESD01AC1RJ, 3ESD01AC1RK, 3ESD01AC1RL, 3ESD01AC1RM, 3ESD01AC1RN, 3ESD01AC1RO, 3ESD01AC1XA, 3ESD01AC1XB, 3ESD01AC1XC, 3ESD01AC1XD, 3ESD01AC1XE, 3ESD01AC1XF, 3ESD01AC1XG, 3ESD01AC1XH, 3ESD01AC1XI.

Main Control Board Section A2 (3JRMAB02D)

Cables: 3ERM42AC1XA, 3ERM42AC1XB, 3ERM42AC1XC, 3ERC64AC1XA, 3ESG64AC1XE, 3ESI80AC3XD, 3ESG60AC1XE, 3ERC74AC1XA 3EHC55AC1XD.

TABLE II-3 (Continued)

CABLE TERMINATIONS

Main Control Board Section A4 (3JRMAB04A)

Cables: 3ERM44AC1XA, 3ESB03AC1RT, 3ERC10AC1RF, 3ERC10AC1RA, 3ERC10AC1RB, 3ESB03AC1RS, 3ERC10AC1RI, 3ERC10AC1RJ, 3ERC20AC1RA, 3ERC20AC2RA, 3ERC20AC3RA, 3ESH01AC1WA, 3ESH01AC1KB, 3ERC20AC1RE, 3ERC20AC2RE, 3ERC20AC3RE.

Main Control Board Section A3 (3JRMAB03B)

Cables: 3ECH11AC1RA, 3ECH18AC1RC, 3ECH24AC1RA, 3ECH12AC1RB, 3ECH37AC1RC, 3ECH26AC1RA, 3ECH14AC1RB, 3ESB03AC1RU, 3ECH39AC1RD, 3ERM43AC1XA, 3ESB03AC1RT, 3ECH24AC1RK, 3ECH26AC1RG, 3ECH28AC1RA.

Power Cable Terminations

Cables: 3ECH26EC1FA, 3EAF01BC1CA, 3ESI01AC1CA, 3EPK05BC1FP.

TABLE II-4

INSTRUMENTATION SAMPLE

Instrument Racks:
- 3J-SBB-A01
- 3J-SBB-A03
- 3J-SBD-A03
- 3J-SIE-A01-D

Instrument Tubing Runs:
- AFB-PT-17
- AFB-FT-41B (Hi & Lo)
- AFB-FT-41A (Hi & Lo)
- AFA-FT-40A (Hi & Lo)
- AFA-PT-18
- RCB-PDT-115B (Hi & Lo)
- RCC-PDT-115C (Hi & Lo)
- RCA-PDT-115A (Hi & Lo)
- SIN-PT-308
- SIA-FT-338 (Hi & Lo)

Instruments:

3J-RCB-PT-104	3J-RCA-PDT-115A
3J-RCB-PT-102B	3J-RCC-PDT-115C
3J-RCB-PT-101B	3J-RCB-PDT-115B
3J-RCB-LT-110Y	3J-SIN-PT-308
3J-SGB-LT-1113B	3J-SIA-FT-338
3J-RCB-PT-199B	3J-AFA-PT-18
3J-RCB-ST-113B	3J-AFA-FT-40A
3J-SGD-LT-1113D	3J-AFB-FT-41A
3J-RCD-ST-113D	3J-AFB-FT-41B
3J-AFB-PT-17	

Transfer Documentation Review:

3J-SGA-LT-1114A	Model 764	S/N:	1951
3J-SGB-LT-1114B	Model 764	S/N:	1952
3J-SGA-LT-1123A	Model 764	S/N:	1913
3J-RCD-PDT-115D	Model 764	S/N:	1909

III. MECHANICAL CONSTRUCTION

A. Objective

The objective of the appraisal of mechanical construction was to determine if installed and Quality Control (QC) accepted mechanical items conformed to engineering design, regulatory requirements and licensee commitments.

B. Discussion

The specific areas of mechanical construction evaluated were piping, pipe supports/restraints, mechanical equipment, preventive maintenance and heating, ventilating and air conditioning (HVAC) systems. To accomplish the above objective, a field inspection of a sample of QC accepted hardware was performed in each area. In addition, certain programs, procedures and documentation were reviewed as required to support or clarify hardware inspection findings.

1. Piping

a. Inspection Scope

Piping depicted on eleven Bechtel isometric drawings, representing approximately 1760 feet of large and small bore piping, which had previously been accepted by Bechtel QC and was inspected by the NRC Construction Appraisal Team (CAT) is listed in Table III-1. The inspection sample included piping located in the Unit 3 Auxiliary Building, Containment Building, Main Steam Supply Structure (MSSS), and the Fuel Building. Piping sizes ranged from 3/4 to 24 inches, and pipe classifications were American Society of Mechanical Engineers (ASME) 1, 2 and 3. Attributes inspected included configuration (component orientation and dimensions), component location and type, valve operator orientation, clearances, flanged joints (gasketing, bolting material, proper makeup), and hydrostatic testing. In addition, site construction practices were observed.

The NRC CAT inspectors evaluated pressure test planning, procedures and test results reviews, including rework/retest controls. The NRC CAT inspectors observed and reviewed test documentation for three pressure tests:

- Nitrogen pressure tests 3-6932-SG and 3-6933-SG
- Hydrostatic pressure test 3-6864-SI

The NRC CAT inspectors evaluated as-built design verification walkdown procedures addressed by NRC IE Bulletin 79-14. Included in this review were walkdown packages 44, 51 and 55 (which had been completed in the field and submitted to Bechtel engineering in Norwalk, CA). Walkdown Package 44 was field verified by the NRC CAT.

Field implementation of design change documents were included in the NRC CAT inspection. For the eleven piping isometric drawings, this involved 37 design change documents, including Design Change Notices

(DCNs), Modification Change Requests (MCRs), and Field Change Requests (FCRs).

The following documents provided the acceptance criteria and background information for the NRC CAT inspection:

- Bechtel Specification 13-PM-204, Rev. 15, "Field Fabrication and Installation of Nuclear Piping Systems."
- Bechtel Drawing 13-P-ZZG-012, Rev. 17, "Piping Material Classifications."
- Bechtel Work Plan Procedure/Quality Control Instruction (WPP/QCI) 200.0, Rev. 25, "Field Piping Fabrication."
- Bechtel WPP/QCI 202.0, Rev. 22, "Piping System Installation."
- Bechtel WPP/QCI 203.0, Rev. 23, "Piping System Pressure Testing."
- Bechtel WPP/QCI 207.0, Rev. 12, "Dissassembly and Reassembly of Quality Class Q, R and S Valves."
- Bechtel Procedure KIP 043-N, Rev. 6, "PSE Field Engineering/ Craft Support PSE Program."
- Arizona Nuclear Power Project (ANPP) Internal Procedure IP-4.35, Rev. 5, "Final Design Verification for Safety-Related Piping Systems."

b. Inspection Findings

NRC CAT inspection observations associated with specific piping isometric drawings are listed in Table III-1. Generally, piping met the design drawing requirements. However, deficiencies were identified in bolted flange connections, pipe to components interferences, and one case of an undersize socket weld.

The NRC CAT identified three instances of improper bolting material in flange connections. In two cases, high-temperature alloy steel bolting was observed in stainless steel piping systems containing borated water. The Bechtel Piping Material Classification sheets for these two cases require stainless steel bolting.

(1) On isometric 13-P-CHF-207, Sh. 1, a charging pump discharge header orifice flange was observed to be assembled with alloy steel fasteners, instead of the required stainless steel fasteners. This condition was documented in Startup Work Authorization (SWA)/Nonconformance Report (NCR)-6631. This instance was investigated by Arizona Public Service (APS) in Corrective Action Report (CAR) CA 86-0002, by inspecting 35 additional flanged connections in piping systems containing borated water, with no additional discrepancies. This appeared to be an isolated case.

(2) During observation of Reactor Coolant Pump (RCP) reassembly, alloy steel fasteners were observed in flanges connecting Combustion Engineering Inc. (C-E) furnished piping to the RCP seal nozzle weldments. These fasteners were supplied by C-E, and were in accordance with C-E drawings, although stainless steel bolting was required per Bechtel Piping Material Classification Sheets.

APS Nuclear Engineering has evaluated this condition as acceptable; however, they also stated in the evaluation (APS File No. 86-005-216) that: "This application though, requires good maintenance and surveillance practices to minimize leakage and subsequent boric acid corrosion of the bolts." The maintenance and surveillance activity specified by engineering and the generic implications of the violation of the Bechtel Material Classification Sheet will require further action and evaluation by the licensee.

(3) During the NRC CAT preventive maintenance inspection of Diesel Generator (DG) A, high-strength structural hex head bolts were observed in two flanged connections in DG A ASME piping flanges, in place of the high-temperature alloy steel as required by the Bechtel Piping Material Classification Sheet. Subsequent to the finding Bechtel QC personnel performed a reinspection of similar ASME piping flange connections in the DG Building (123 of 175 connections), and a 10 percent sample in other plant locations (100 of 1000 connections) in accordance with CAR CA 86-0002. They identified five flanges with bolting discrepancies in the DG building (NCR PG-12136, -12138, -12151, -12160, and -12172), and none in other plant buildings. This problem involved bolting one inch diameter and under, which did not require heat code traceability and documentation by QC, but only grade marking verification.

Several instances of potential pipe and pipe support interferences with adjacent structures and components were identified, and engineering evaluation requested. Of these, the following two instances were evaluated as unacceptable clearances requiring rework.

° On isometric 13-P-SIF-103, pipe clamp to support steel. (NCR PC-12, 12E)

° On Reactor Coolant Pump (RCP) 2A seal piping to grating. (NCR CC-5341)

See additional discussion of interdisciplinary clearances in Section III.B.2, Pipe Supports/Restraints of this report.

On isometric 13-P-CHF-207, Sh. 2, one undersize socket weld fillet was identified. Refer to Section IV of this report, "Welding and Nondestructive Examination", for a complete discussion of NRC CAT socket weld inspection findings.

The procedures related to final system walkdown inspections and engineering reconciliation of as-built conditions to meet IE Bulletin 79-14 requirements were found by the NRC CAT to be thorough and well written. Responsible personnel were knowledgeable of requirements and responsibilities.

No deficiencies were noted in the inspected hydrostatic test packages or in the implementation of design change documents.

c. Conclusions

Piping was found generally to conform to applicable design requirements. However, the use of improper material in piping bolting indicates a need for increased attention to the control and verification of flange bolting materials by crafts and QC.

2. Pipe Supports/Restraints

a. Inspection Scope

At the time of this inspection, approximately 98 percent of the 8,403 ASME pipe supports/restraints had been installed and QC accepted.

Twenty-five ASME Class 1, 2 and 3 (APS Quality Class "Q") and 13 APS Quality Class "R" and "S" supports/restraints were selected for detailed inspection. These supports/restraints represented a variety of types, sizes, systems and locations. These supports had been inspected and accepted by Bechtel QC. These supports/restraints were inspected for configuration, clearances, member size, location, fasteners, angularity and damage. QC documentation for the supports/retraints were also examined for completeness, accuracy, and conformance to procedural requirements. See Table III-2 for a listing of the inspection sample.

In addition, approximately 100 adjacent supports/restraints were observed at random in the field (without detailed drawings) for attributes such as loose or missing fasteners and locking devices, improper clearances or angularity, and damage.

In the review of pipe supports/restraints, the NRC CAT noted that support/restraint material thickness was not verified by QC personnel and that confusion existed in the area of pipe to support clearances. As a result, the NRC CAT performed additional inspections to independently verify support/restraint tube steel wall thicknesses and pipe to support clearances for cases in which engineering intended point contact.

The NRC CAT examined the Bechtel program for properly classifying and designing pipe supports non-Quality Class Q on nonsafety-related systems that are located in proximity to safety-related equipment and are thus required to retain structural integrity during a safe shutdown earthquake. Three non-Quality Class Q piping runs in containment were inspected in the field to verify the adequacy of the Bechtel "hazards walkdown". The "hazards walkdown" consists of

detailed inspection of all plant areas containing Q Class hardware to identify non-Q class items that could impact the Q class hardware if the non-Q class supports failed during a seismic event.

Approximately 45 design change documents, Field Change Requests (FCRs) and Modification Change Notices (MCNs) were verified in the field for proper implementation.

Acceptance criteria and background information for these inspections were contained in the following documents:

- Bechtel Specification 13-PM-204, Rev. 15, "Field Fabrication and Installation of Nuclear Piping System."
- Bechtel WPP/QCI 201.1, Rev. 23, "Nuclear Pipe Hangers and Supports Installation."
- ANPP Internal Procedures Manual Procedure IP-5.23, Rev. 2, "Hazards Walkdown."
- ITT Grinnell and Corner & Lada catalogs and engineering specification sheets.
- Applicable design drawings, nonconformance reports and design change documents.

b. Inspection Findings

Pipe support/restraint material and configuration generally conformed to design requirements. Workmanship quality was good. No deficiencies with field implementation of design changes or documentation were identified. See Table III-3 for a summary of inspection observations. However, two types of identified hardware discrepancies and several areas of concern to the NRC CAT are discussed below.

The first discrepancy is in regard to locking or retaining devices. As a result of an earlier regional NRC CAT, QC accepted pipe supports/restraints with bolted connections (struts, snubbers, springs) were reinspected for numerous attributes and related inspection procedures were strengthened. However, the NRC CAT identified numerous instances of loose, missing or ineffective locknuts, cotter pins and locking rings. Special attention to these attributes will be required during final system and area walkdown inspections.

The second discrepancy concerns four instances of undersized beam attachment load pins identified by the NRC CAT (2 on ASME Class 1 supports and 2 on Quality Class "R" supports). Three of the four undersized load pins were identified in the NRC CAT primary sample which only contained nine beam attachments of this type. Of the approximately 15 randomly selected adjacent supports with beam attachments inspected by the NRC CAT, one was found to have an undersize pin. Beam attachment sizes are specified with respect to the diameter of the spring can or hanger rod, not the load pin

diameter. Load pins are 1/8 inch larger in diameter than the hanger rod size. This size designation method may contribute to construction/QC errors for these installations. The NRC CAT considers that due to the large percentage (1/3) of undersize beam attachment pins identified in the primary sample, this attribute needs to be examined in more depth by the licensee.

The NRC CAT review of Bechtel inspection procedures and QC inspection report documentation indicated that tube steel wall thickness is not verified by QC. Due to the use of welded end caps and a lack of vent holes it is not possible to physically measure wall thickness after installation. The NRC CAT considers support/restraint member size to be an important attribute that should be verified by QC prior to final acceptance. The NRC CAT selected a sample of approximately 150 pieces of tube steel on 73 supports/restraints in the Auxiliary and Containment Buildings and the Main Steam Support Structure to be ultrasonically examined to determine the wall thickness. For each piece selected the tube steel wall thickness was found to meet or exceed that required by the design drawings.

During the inspection of support SI-202-H017 the NRC CAT requested to see the design calculation for that support. Bechtel engineering personnel stated that there was no calculation for this support as currently designed. This support design had been modified by an FCR to add a stiffener and an extension plate allowing attachment 5 inches off the web centerline of the W8x24 beam. Bechtel had approved this change without a formal calculation. A calculation was subsequently performed at the request of the NRC CAT which indicated the support was adequate. However, the NRC CAT considers that extensive modifications such as cantilevering relatively high loads (3230 pounds) and adding beam stiffeners should warrant verification calculations at the time of design change approval.

The Bechtel program to identify potential impact of non-Class Q items onto Class Q piping and equipment appeared to be well defined by procedure. Field walkdowns by engineering were completed and walkdown log sheets revealed the identification of numerous potential hazards for further evaluation. The NRC CAT walked down three piping runs in the Containment Building. One section of line RC-004, including hanger RC-004-H016 (Seismic Class III), was installed directly above ASME Class 1 piping and supports, but had not been identified by the hazards walkdown team. Class III supports are not required to be seismically designed to retain structural integrity during and after an SSE to assure preventing collapse and potential damage to safety related equipment and structures. A subsequent review by Bechtel indicated that the Pressurizer Room had not been included in the original walkdown due to access restrictions. A complete walkdown by the seismic hazards walkdown team identified two other 10-inch lines, a 1-inch air line and several electrical conduits as potential safety hazards. Analysis indicated no rework is necessary based on the fact that the involved pipe support will be upgraded to the proper seismic category. A Bechtel review of all areas walked down indicated that this oversight was an isolated case.

The NRC CAT inspectors noted numerous instances of minimal clearance between pipe support members and other structures, especially where snubbers were used. These instances were more numerous than typically observed by the NRC CAT. Engineering evaluation determined in each case that predicted pipe movement was either away from the interference or was not close enough to cause contact. However, two cases discussed in this report did require rework (see Section III.B.1 above). There are no definite quantitative separation criteria specified for craft and QC use. This lack of criteria had been raised by APS QA in 1983 and, after extensive evaluation and debate, Bechtel determined that thermal expansion testing and 79-14 walkdown programs would be adequate to identify and correct interferences that were unacceptable. The NRC CAT notes that relying on final walkdowns and testing to identify and correct improper clearances at a late state of construction can place added pressure on inspection and engineering personnel.

The NRC CAT inspectors raised concerns about the lack of distinction in the Bechtel WPP/QCI 201.1 with regard to acceptance criteria for "zero clearance free-to-slide" and "zero clearance" specifications on certain charging system supports. The NRC CAT inspectors inspected 12 restraints near the charging pumps that Bechtel required to have "zero clearance" (intended to have point contact). One restraint, CH-256-H-00M, did not have the required point contact. Only a small number of supports in the plant were designated to have "zero clearance." The WPP/QCI was revised to clarify the acceptance criteria when "zero clearance" is specified on drawings. The NRC CAT does not consider this to be a significant hardware problem.

c. Conclusions

Pipe supports/restraints were found to be in general conformance with design drawing, design change and procedural requirements. Site engineering and inspection personnel were knowledgeable of procedures, requirements and responsibilities.

Additional attention is necessary with regard to fasteners/locking devices, beam attachment sizes, and pipe/support to structure clearances.

3. Mechanical Equipment

a. Inspection Scope

Thirteen pieces of mechanical equipment including pumps, heat exchangers, and HVAC mechanical components (fans, air handling units and chillers) were inspected for proper orientation, support configuration, foundation bolting/welding, in-place storage maintenance and damage. Installation documentation for the equipment was also examined for completeness, accuracy and conformance to procedures. Table III-4 provides a listing of the mechanical equipment sample.

In addition, inspection of mechanical equipment included evaluation of work in progress for three items:

(1) For the disassembly, modification and reassembly of the Reactor Coolant Pump (RCP) seals, thrust bearings and motor couplings, work activities were observed, and work and inspection planning documents and records for RCP 2A were reviewed.

(2) Cold alignment (pipe strain and coupling alignment) of the Auxiliary Feedwater Pump Turbine were observed, and work and inspection planning documents, and associated welding and Nondestructive Examination (NDE) records were reviewed.

(3) Valve PSI-AV164, disassembled for the Inservice Testing Program, was inspected for proper control and storage of removed material and documentation of work being performed.

The following documents provided the acceptance criteria and background information for these inspections:

° Bechtel Specification 13-MM-510, Rev. 6, "Installation Specification for Mechanical Equipment."

° Bechtel Work Plant Procedure/Quality Control Instruction (WPP/QCI) 150.0, Rev. 7, "Alignment of Drive Couplings on Rotating Equipment."

° Bechtel WPP/QCI 151.0, Rev. 8, "Mechanical Equipment Installation."

° Applicable vendor technical manuals, vendor drawings and Bechtel structural drawings.

b. Inspection Findings

Discrepancies were noted in 8 of 13 pieces of equipment in the NRC CAT primary inspection sample. See Table III-4 for a listing of the discrepancies identified. Minor discrepancies such as documentation irregularities and minor damage were noted on several items. The more significant discrepancies are discussed below.

The mounting conditions of the Train B Control Room Essential Air Handling Unit Fan had numerous discrepancies including incorrect bolting, loose bolts, missing welds, lack of proper weld symbol on the drawing and wrong size angle iron.

During preventive maintenance inspections, the NRC CAT inspectors observed the Diesel Generator A Room Essential Exhaust Fan with loose mounting fasteners and apparently oversized washers (NCR MG-2981). Neither mounting details nor inspection records for torquing of these fasteners was available. The licensee has documented this problem on Corrective Action Report (CAR) S-86-13.

During preventive maintenance inspections, the NRC CAT observed that Diesel Generator (DG) A cooling air intake openings on the engine end of the generator were 75 percent covered with masking tape, apparently remaining from factory painting. NRC CAT review of a completed Design Change Package for all six diesel generators at Units 1, 2 and 3 (DCP 30M-DG-054), generated in response to Deficiency Evaluation Report (DER 84-76), noted that the generator exhaust vents had been modified due to Unit 1 generator overheating problems. Inspection of the Unit 3 Diesel Generator B by the NRC CAT, and of the Unit 1 and 2 Diesel Generators by the licensee, found no evidence of masking tape. It appears that the masking tape found in Unit 3 DG A is an isolated instance of inadequate vendor final inspection at the factory. The removal of the masking tape has been listed on the System Walkdown Punchlist 3DG01, Item 51.

For Containment Spray Pump B, one embedded anchor bolt was found bent approximately seven degrees and no tapered washer was installed. Four of the Containment Spray Pump A foundation bolts also were installed at an angle and had gaps of at least 1/8 inch under one side of the nuts. Site procedures did not address acceptance criteria for anchor bolt angularity or the use of tapered washers. However, the American Institute of Steel Construction (AISC) structural steel Code and standard industry practice dictate that tapered washers be used in these situations. Based on discussions with the NRC CAT, Bechtel will evaluate the acceptability of these installations.

Work in progress observed by the NRC CAT was being well controlled and documented by field engineering and inspection personnel. Instructions and procedures were thorough and documentation for work accomplished was complete. The NRC CAT did observe that the bonnet plate and hinge bracket for valve PSI-AV164 had been left faceup and unprotected on decking near the valve. The NRC CAT considers this observation to be an isolated case of poor maintenance practices.

c. Conclusions

In general mechanical equipment was found to be installed in accordance with design requirements.

4. Preventive Maintenance

a. Inspection Scope

The NRC CAT reviewed maintenance procedures and records, and inspected the following installed equipment. Preventive maintenance during warehouse storage, in-plant storage, and after turnover to Startup, was evaluated.

- 3MECAE01 Essential Chiller
- 3MHDAJ01 DG Room Essential Exhaust Fan
- 3MCFAK01 Auxiliary Feed Pump Turbine

- 3MDGAH01 Diesel Generator
- 3MSPAP01 ESPS Pump
- 3MCHNE02 Letdown Heat Exchanger
- 3MDFAT01 DG Fuel Heat Exchanger
- 3MDFAT05 Spray Chemical Addition Pump
- 3MSIAP03 Containment Spray Pump Motor
- 3MSIAP02 High Pressure Safety Injection (HPSI) Pump Motor
- 3MEWBP01 Essential Cooling Water Pump Motor

The following documents provided the criteria for the evaluation of preventive maintenance activities:

- Bechtel WPP/QCI 28.0, Rev. 15, "Maintenance of Material and Equipment."
- Palo Verde Nuclear Generating Station procedure 30AC0ZZ10, Rev. 0, PCN 1, "Startup Preventive Maintenance."
- Waldinger Procedure FWP 13.2-1, Rev. 1, "Maintenance, Waldinger-Furnished Equipment."

b. Inspection Findings

In general, mechanical equipment preventive maintenance procedures, documentation and the condition of inspected equipment in the field were found to be in conformance with requirements and good maintenance practices, with the exception of the two discrepancies noted below.

For the Diesel Generator Room Essential Exhaust Fan motors (3MHDAJ01 and 3MHDBJ01), the fan manufacturer's operating and maintenance manual required the use of space heaters during outdoor or in-plant storage prior to turnover to Startup. The installing contractor The Waldinger Corporation (TWC) was unable to provide documented evidence of the requirement for, or the maintenance of, energization of the space heaters.

Although required by the manufacturer's site storage instructions, maintenance of the Essential Chiller (3MECAE01) refrigerant side nitrogen purge pressure was not included in the Startup Maintenance Program. However, informal evidence was provided in the form of a "walkdown work sheet" (which is not a quality record), that the startup engineer may be including an inspection of proper purge during weekly walkdowns. This is not specifically part of his checklist.

c. Conclusions

The preventive maintenance program appears generally effective and comprehensive.

5. Heating, Ventilating and Air Conditioning (HVAC)

a. Inspection Scope

Eleven HVAC Class Q and R supports/restraints, three HVAC longitudinal supports/restraints bracing, 25 duct sections, and five fire dampers were selected from Unit 3 at random and inspected in detail.

The supports/restraints and longitudinal bracing were inspected for location, configuration, member size, weld size and connection details. Duct sections and fire dampers were examined for proper configuration, companion angle size, joint makeup and free operation of fire dampers.

In addition, adjacent HVAC hardware, including approximately 10 HVAC supports/restraints and 15 duct sections, was observed for the following attributes: loose or missing fasteners, joint makeup, clearances and angularity, and damaged items.

The Waldinger Change Notices (WCNs), Drawing Change Notices (DCNs) and Subcontract Notices associated with the NRC CAT HVAC hardware samples were verified for conformance to as-built conditions. Thirteen "Inspection Checklists" were reviewed for completeness and accuracy. Five TWC support/restraint drawings were compared to Bechtel HVAC support detail drawings for completeness and accuracy.

Acceptance criteria for these inspections are contained in the following documents:

° TWC Procedure FQCP 10.2-3.1, Rev. 9, "Inspection-Fabrication and Installation of Quality Class Q HVAC Supports."

° TWC Procedure FQCP 10.2-12.1, Rev. 2, "Inspection - Fire Damper Cycling and Frame Dimension Tolerance Verification Field Quality Control Manual."

° TWC Procedure FQCP 10.2-3.2, Rev. 7, "Inspection-Fabrication and Installation of Quality Class "R" HVAC Supports Field Quality Control Manual."

° Bechtel HVAC Specification, Rev. 10, "Subcontract Number 13-MM-598 HVAC Equipment and Installation - Quality Class Q, R, and S."

° Applicable duct support/restraint and layout drawings.

b. Inspection Findings

Approximately 95 percent of the Class Q and R duct sections (3,362) supports/restraints (2,829) and fire dampers (284) had been QC inspected by TWC at the time of the NRC CAT inspection. Workmanship appeared to be good, with the exception of a few minor deficiencies. See Table III-5 for a listing of discrepancies identified.

The design changes such as WCNs, DCNs, and Subcontract Notices associated with the HVAC hardware were reviewed and found to conform to the as-built condition.

The inspection records of thirteen "Inspection Checklists" were reviewed by the NRC CAT and found to be complete and accurate.

Five TWC support/restraint detail drawings compared to Bechtel HVAC support details were found to be complete and contained accurate detail for TWC personnel to fabricate and inspect HVAC supports/restraints.

c. Conclusions

HVAC safety-related supports/restraints, duct sections, longitudinal bracing, and fire dampers generally conformed to design and procedural requirements. The reviewed documentation was complete and accurate.

TABLE III-1

PIPING INSPECTION SAMPLE

Isometric	Diameter (Inches)	Class	Location	Observations
13-P-AFF-133 Sh. 1, Rev. 16	3,6,8	2	MSSS	Acceptable
13-P-AFF-133 Sh. 2, Rev. 16	6	2	MSSS	Acceptable
13-P-CHF-109 Rev. 13	2,3	1,2	CONT	Acceptable
13-P-CHF-207 Sh. 1, Rev. 14	2	2	AUX	Incorrect flange bolting material (SWA/NCR-6631, CAR CA 86-0002).
13-P-CHF-207 Sh. 2, Rev. 14	2,3	2	AUX	Undersize socket weld. (NCR WA-1697)
13-P-EWF-201 Rev. 13	1-20	3	AUX	Acceptable
13-P-PCF-501 Rev. 18	1-16	3	FUEL	Acceptable
13-P-RCF-102 Rev. 13	1,3,4	1	CONT	Acceptable
13-P-SGF-119 Rev. 14	14,28	2	CONT	Acceptable
13-P-SIF-103 Rev. 17	3/4-14	1,2	CONT	Pipe clamp to support steel clearance (NCR PC-12128)
13-P-SIF-207 Sh. 1, Rev. 20 (Sh. 2 not inspected)	10-20	2	AUX	Acceptable

Location:

AUX = Auxiliary Building
CONT = Containment Building
FUEL = Fuel Building
MSSS = Main Steam Supply Structure

TABLE III-2

PIPE SUPPORT/RESTRAINT INSPECTION SAMPLE

S/R Number	Class	Size (Inches)	Type	Location
SG-002-H-014	2	24	Snubber	Containment
SI-002-H-001	2	12	Snubber	Auxiliary
RC-091-H-00E	1	2	Snubber	Containment
RC-062-H-020	1	3	Snubber	Containment
AF-031-H-001	3	4	Snubber	Containment
SI-202-H-017	2	12	Spring	Containment
AF-020-H-002	3	8	Strut	Containment
EW-082-H-003	3	10	Strut	Auxiliary
SI-122-H-001	2	4	Box/Lugs	Auxiliary
AF-011-H-001	3	6	Box	MSSS*
RC-062-H-036	1	3	Springs	Containment
SG-005-H-006	2	24	Snubber	Containment
SF-002-H-011	2	28	Snubber	Containment
RC-017-H-028	1	3	Snubber	Containment
CH-078-H-004	2	3	Strap	Auxiliary
SI-075-H-00D	2	2	Box/Lugs	Auxiliary
SI-107-H-003	2	4	Rod	Auxiliary
CH-040-H-009	2	3	Box	Auxiliary
NC-087-H-021	3	10	Strut	Auxiliary
RC-017-H-029	1	3	Box	Containment
SI-130-H-002	2	10	Strut	Auxiliary
SI-106-H-024	2	3	Strut	Auxiliary
SI-007-H-002	2	5	Box	Containment
EC-063-H-001	3	3	Strap	Auxiliary
RC-028-H-001	1	12	Spring	Containment
NC-116-H-004	R	8	Rod	Containment
NC-120-H-004	R	8	Rod	Containment
NC-126-H-004	R	3	Box	Containment
RC-002-H-028	S	18	Snubber	Containment
RC-006-H-013	S	10	Snubber	Containment
NC-136-H-012	R	8	Rod	Containment
NC-136-H-005	R	10	Strut	Containment
NC-001-H-015	R	24	U-bolt	CWST Tunnel**
EW-102-H-020	R	14	Strut	Auxiliary
EW-EWB-H-001	S	Tank	Anchor	Auxiliary
NC-138-H-007	R	10	Strut	Containment
NC-036-H-014	R	14	Rod	Auxiliary
EW-102-H-015	R	14	Strut	Auxiliary

* MSSS = Main Steam Support Structure
**CWST = Charging Water Storage Tank

TABLE III-3

PIPE SUPPORT/RESTRAINT INSPECTION OBSERVATIONS

Support/Restraint	Observation (NCR Issued)
Primary Sample	
RC-062-H-020	Drafting error on FCR 79,552P
SI-202-H-017	Formal design calculations do not reflect as-built conditions
SI-122-H-001	Weld length not specified on drawing (NCR PA 12,166)
AF-011-H-001	Existing building structural steel not as shown on support drawing
SI-130-H-002	Loose locknut (NCR PA 12,088)
RC-028-H-001	Undersized beam attachment pin (NCR PC 12,235)
NC-116-H-004 (Class R)	Undersized beam attachment pin
NC-120-H-004 (Class R)	Undersized beam attachment pin
Adjacent Sample	
RC-25-H-00D (Class 1)	Undersized beam attachment pin (NCR PC 12,209)
CH-256-H-00M	Pipe to support frame clearance not per drawing (NCR PA 12,137)
RC-104-H-00T (Class 1)	Unspread cotter pin, loose locknut (NCR PC 12,219)
RC-096-H-00B	Missing locking ring from rear bracket pin (NCR PC 12,234)
SG-048-H-030	Unspread cotter pin
SI-135-H-001	Backed off locknut (NCR PA 12,125)
CH-254-H-00K	Lug to support gap not as specified (NCR PA 12,093)
SI-130-H-002	Loose locknut

TABLE III-4

MECHANICAL EQUIPMENT INSPECTION SAMPLE AND OBSERVATIONS

Primary Sample

Equipment No.	Description	Observations
HJB-J01A	Battery Room Fan	Acceptable
HJA-F04 HJB-F04	Control Room Essential Air Handling Units (AHU's)	1. Missing weld on fan foundation. 2. Undersize angle iron unit foundation feet. 3. Undocumented trimming of angle iron feet reducing weld lengths. 4. Angle iron on fan support not the same size as specified on vendor drawing.
HJA-Z03 HJB-Z03	Control Building ESF Swtichgear Room Essential AHU's	1. Damaged instrumentation tubing. (SWA 7295) 2. Documentation shows motor holddown bolts torqued to two different values on separate installations.
ECA-E01 ECB-E01	Essential Water Chillers	Damage to 2-inch diameter piping elbow (NCR M-T-2974).
SIA-E01 SIB-E01	Shutdown Cooling Heat Exchangers	Acceptable
SIA-P01 SIB-P01	Low Pressure Safety Injection Pump	Minor QC documentation irregularities.
SIA-P03 SIB-P03	Containment Spray Pumps	Bent anchor bolts with no tapered washer. Temporary 3x3 angle iron welded to foundation base plates (both pumps).

TABLE III-4 (Continued)

MECHANICAL EQUIPMENT INSPECTION SAMPLE AND OBSERVATIONS

Other Mechanical Equipment Inspected

Equipment No.	Description	Observations
PSI-AV164	Valve	Bonnet and attached hinge bracket lying face up and unprotected on in-plant decking.
RCP-2A	Pump	Acceptable
AFA-K01	Pump	Acceptable
DGA-H01	Diesel Generator (DG)	Masking tape covering air intake opening screen.
HDA-J01	DG-A Room Essential Exhaust Fan	Loose mounting bolts and lack of mounting details and QC inspection documentation for torquing of fasteners.

TABLE III-5

HVAC INSPECTION SAMPLES AND OBSERVATIONS

(Supports/Restraints)

Support Number	Class	Duct Size (Inches)	Location	Design Change Review	Inspection Record Review	Observation
TWC-202-6V-109 Rev. 0	Q	50x26	AUX	None	Yes	Acceptable
TWC-202-6T-110 Rev. 0	Q	24x24	AUX	None	Yes	Acceptable
TWC-301-24-191 Rev. 0	Q	48 dia	CTL RM	None	Yes	Lock washers (6) missing on bottom mounting bolts. Incorporated into scope of SWA 6569, SWR 3640 per Subcontract Notice 1123.
TWC-202-6T-154 Rev. 0	Q	24x34	AUX	None	Yes	Acceptable
TWC-102-2-11 Rev. 0	R	12 dia	CONT	None	No	Acceptable
TWC-102-C1-11 (Side Brace) Rev. 0	R	12 dia	CONT	Bechtel Dwg 13-E-00C-032 Rev. 4 DCN No. 2	No	Acceptable
TWC-102-2-12 Rev. 0	R	12 dia	CONT	None	No	Acceptable
TWC-102-4T-28 Rev. 0	R	12 dia	CONT	None	No	Acceptable
TWC-102-C4-28 (Side Brace) Rev. 0	R	12 dia	CONT	None	No	Acceptable
TWC-102-5-53 Rev. 0	R	12 dia	CONT	None	No	Acceptable
TWC-102-C4-53 (Side Brace) Rev. 0	R	12 dia	CONT	None	No	Acceptable

TABLE III-5 (Continued)

HVAC INSPECTION SAMPLES AND OBSERVATIONS

(Supports/Restraints)

Support Number	Class	Duct Size (Inches)	Location	Design Change Review	Inspection Record Review	Observation
TWC-202-1-6 Rev. 0	R	22x28	AUX	None	No	Acceptable
TWC-202-124 Rev. 0	R	24x16	AUX	None	No	Acceptable
TWC-202-32T-230 Rev. 2	R	18x20	AUX	WCN No. (4) 202C-5/III	No	Acceptable

(Duct Sections)

Duct Section	Class	Location	Inspection Record Review	Observation
TWC-ZCC-102A Rev. 6 Section #s, 55, 56, 57, 58, 59, 60 and 61	R	CONT	No	Acceptable
TWC-ZCC-102B Rev. 6 Section #s 5, 6, 7 and 8	R	CONT	No	Acceptable
TWC-ZAC-202C Rev. 16 Section #s 14, 14c, 15, 16, 17, 18, 19, 20, and 21	R	AUX	No	Loose Bolt Between Sections 20 & 21; corrective action by SWA 4919, SWR 3593.
TWC-ZJC-301 Rev. 17 Section #s 85, 86, 87, 95 and 96	Q	CTL RM	Yes	Acceptable

TABLE III-5 (Continued)

HVAC INSPECTION SAMPLES AND OBSERVATIONS

(Fire Dampers)

Drawing Number	Fire Damper Number	Location	Class	Design Change Reviewed	Inspection Record Reviewed	Observation
TWC-ZJC-301 Rev. 17	3-M-HJN-M04	CTL RM	R	Subcontract No. 1047-13-MM-598	No	Acceptable
TWC-ZJC-301 Rev. 17	3-M-HJA-M18	CTL RM	Q	Subcontract No. 1047-13-MM-598	Yes	Acceptable
TWC-ZJC-301 Rev. 17	3-M-HJA-M37	CTL RM	Q	Subcontract No. 1047-13-MM-598	Yes	Acceptable
TWC-ZJC-301 Rev. 17	3M-HJB-M29	CTL RM	Q	Subcontract No. 1047-13-MM-598	Yes	Acceptable
TWC-ZJC-301 Rev. 17	3M-HJB-M41	CTL RM	Q	Subcontract No. 1047-13-MM-598	Yes	Acceptable

Location:
AUX = Auxiliary Building
CTL RM = Control Room
CONT = Containment Building

IV. WELDING AND NONDESTRUCTIVE EXAMINATION

A. Objective

The objective of the appraisal of welding and nondestructive examination (NDE) was to determine if quality control accepted work related to welding and NDE activities was controlled and performed in accordance with design requirements, Safety Analysis Report commitments, and applicable codes and specifications.

An additional objective was to determine if personnel involved in welding and NDE activities were trained and qualified in accordance with established performance standards and applicable code requirements.

B. Discussion

To accomplish the above objectives, welds and welding details for piping; pipe supports/restraints; field and shop fabricated tanks; structural steel installations; heating, ventilating and air conditioning (HVAC) installations; electrical supports; and instrumentation and control tubing and supports were inspected. The inspected welds were selected to provide a representative sample of the licensee's contractor welding activities in terms of welding processes used, materials welded and existing weld-joint configurations. Considerations such as physical location, difficulty of welding and limited accessibility were also used in sample selection. Design changes related to welding such as the increase or decrease of weld sizes and a change from one welding process or procedure to another welding process or procedure were also reviewed for technical adequacy.

NDE activities were appraised through the review of radiographs for both field and vendor fabricated welds, the review of NDE procedures and personnel qualifications, the inspection of the calibration status of NDE equipment and the witnessing of in-process NDE activities. The NRC Construction Appraisal Team (CAT) inspectors reviewed a sample of radiographic film in final storage in the vault of the licensee's facility. In addition, a sample of radiographic film and NDE documentation was requested for review which was stored at the facilities of four manufacturers and suppliers of vendor equipment and components.

During the inspection of structural welds in the pipe supports area, the NRC CAT identified welds which did not meet the weld size requirements specified by the architect-engineer, Bechtel Power Corporation (Bechtel). Deficient welds were also identified on instrument racks supplied by Combustion Engineering, Inc. (C-E). Some undersized weld reinforcements were also found in nozzle to shell joints American Society of Mechanical Engineers (ASME) (Code Category D Joints) on tanks and heat exchangers. A detailed discussion concerning these welds is included later in this section.

In the area of NDE, the NRC CAT inspectors reviewed radiographic film for field and shop fabricated pipe welds, film involving equipment and hardware supplied under the C-E nuclear steam supply system (NSSS) scope of supply, and film supplied by various vendors and contractors for the balance of plant. A sample of welds which have been examined under the

scope of the Preservice Examination (PSE) program was also inspected to verify the adequacy of these examinations.

In general the inspected NDE activities were found to comply with the requirements of the governing codes and specifications. However, several deficiencies were identified in vendor procured equipment and hardware. In addition the NRC CAT inspectors identified welds which did not meet the inspection criteria required by the PSE liquid penetrant procedure. The PSE was performed by C-E. A detailed discussion concerning the PSE and other NDE deficiencies is provided later in this section.

The welding and NDE activities were examined in order to ascertain compliance with the governing construction codes and specifications. This effort involved the review and inspection of the following contractors:

Field Activities

1. Bechtel Power Corporation: architect-engineer, piping installation and piping supports/restraints, electrical and instrumentation installations, HVAC installation, structural steel erection, containment liner fabrication, reactor pool and spent fuel fabrication , reactor internals modification and installation.

2. Combustion Engineering: preservice inspection and examination.

3. Viking Fire Protection Company: fire protection installation.

4. The Waldinger Corporation: HVAC installation.

Shop Fabrication

1. Pullman Power Products: shop fabricated piping spools.

2. Borg-Warner Corporation: valve manufacturer.

3. Combustion Engineering: nuclear steam supply system.

4. Anchor/Darling Valve Company: valve manufacturer.

5. W. J. Wooley: containment hatch supplier.

6. Whiting: tank fabricator.

7. Ametek, Inc.: heat exchanger manufacturer.

8. Vacco, Inc.: filter tank supplier.

9. Ecodyne: equipment supplier.

10. Fisher Controls: valve manufacturer.

11. Bingham-Williamette: material supplier.

12. Struthers Wells: heat exchanger manufacturer.

13. Engineering Fabricators Company: heat exchanger manufacturer.

14. PX Engineering: tank fabricators.

15. Ametek Straza: penetrations suppliers.

16. Babcox & Wilcox: valve bodies suppliers.

17. Richmond Engineering: heat exchanger supplier.

18. Greer Hydraulics: pulsation damper supplier.

19. CTI Nuclear: ion exchanger supplier.

20. Cooper Energy Services: tank fabricators.

21. Process Equipment Co.: tank fabricators.

The results of the inspection activities involving each of these areas and contractors are documented as follows:

1. Pipe and Pipe Support Fabrication

a. Inspection Scope

(1) Welding Activities

The NRC CAT inspectors reviewed activities relating to fabrication contracts in the areas of piping system welds, support/restraint welds, welding procedures, welder qualifications, NDE procedures, personnel qualifications, and the review of radiographic film for shop and field fabricated welds. Field welding involving pipe fabrication was performed by Bechtel. Pullman Power Products supplied the shop fabricated piping spools.

The NRC CAT inspected 52 pipe supports/restraints involving approximately 1250 welds to verify conformance of welding to drawing requirements, and to confirm the visual acceptability of welds. Thirty-seven of the pipe supports had been inspected by QC inspectors, and 15 supports were identified as Class R-9 supports which are reviewed by Bechtel Field Engineers and do not require QC inspection except on a random basis. The Class R-9 pipe supports were inspected in order to verify the quality of work performed by craft personnel for supports which are in proximity to Class Q equipment or components. See Table IV-1 for a listing of supports subjected to detailed inspection. Additionally, another 40 supports/restraints involving 950 welds were visually inspected to verify the quality of the completed welds. See Table IV-2 for a listing of additional supports inspected.

The NRC CAT inspection of piping welds consisted of visual inspection during walkdown of piping systems and inspection of pipe welds located near supports/restraints being inspected.

Approximately 45 piping spools involving 1100 ASME Class 1, 2 and 3 welds were inspected. Twelve of those piping spools were subjected to detailed inspection which included the review of pertinent QC documentation while the remaining 33 spools were only visually inspected. Both field and shop welds were inspected in order to assure compliance with the requirements of the ASME Code. See Tables IV-3 and IV-4 for listings of piping spools inspected. In addition, 60 welding filler metal test reports, 30 welder qualification test records and 6 welding procedures were reviewed for compliance with applicable specifications, procedures and the ASME Code requirements.

(2) Nondestructive Examination Activities

The NRC CAT inspection of NDE activities in the pipe fabrication area included the review of 85 shop and 115 field fabricated welds which involved 2104 film. The field welds were fabricated by Bechtel and the shop fabricated pipe spools were supplied by Pullman Power Products. In addition, 3 NDE procedures and 4 NDE personnel qualification records were reviewed in order to verify compliance with the governing codes and specifications. Four NDE technicians were observed while performing inspections and were evaluated for their ability to follow the applicable inspection procedures. Six pieces of NDE equipment were inspected for calibration.

b. Inspection Findings

(1) Welding Activities

In general, the inspected pipe and pipe support/restraint welding activities were found to comply with governing codes and specifications. However, discrepancies were identified involving undersized welds in pipe supports/restraints. See Table IV-1 for details of the discrepancies and the associated Nonconformance Reports (NCRs) which documents the discrepancies.

Specifically, five QC accepted skewed welds were found to be undersized and eleven other fillet welds were also found to be undersized with respect to the specified acceptance criteria. Two beam stiffeners were found to be warped. As a result of these findings the licensee issued Nonconformance Reports and the deficient welds will be reviewed and evaluated by Bechtel.

In the area of Class R-9 pipe support inspections, the NRC CAT inspectors also identified welds which did not conform to the specified acceptance criteria. Eight of the inspected welds in Class R-9 supports were also found to be undersized. As a result of these findings the licensee issued NCRs and the deficient welds will be evaluated by Bechtel.

Special attention was given to skewed connections, which had been an area of concern at other sites. During the NRC CAT inspection, 21 obtuse skewed fillet welds were inspected, 5 of

which were found to be undersized. As a result, Bechtel QC inspectors inspected an additional 179 welds of which 3 were found to be undersized. Twenty-five of the 179 welds were reverified as correct by the NRC CAT inspectors. This indicated that a significant problem does not exist in the area of skewed fillet welds, but that closer attention should be paid to them. One source of error which the NRC CAT inspectors identified was the adjustable gauge which the inspectors used to check skewed welds. This gauge can move during inspection when used as a "go, no-go" gauge, and its adjustable arm has to be moved to read its markings, making it subject to human error during use.

It was further observed that Bechtel's practice is to size the weld by calculating the required weld leg length dimension along the joining members of the skewed connection. This weld leg length dimension is shown on the applicable engineering drawing. The inspectors are then required to convert this weld leg length dimension back to the corresponding weld size in order to measure the size. With the exception of several angle/size combinations, most of the required tables needed for the inspector to make conversions were available at the site. The QC inspectors have been trained to do these conversions, however, this exercise would not be necessary if the drawings show weld sizes rather than weld length dimensions. This practice puts an unnecessary step in the inspection process of skewed connections.

During the inspection of pipe welds the NRC CAT inspectors identified one undersized socket weld in a 2-inch Schedule 160 pipe spool identified as CH 003CCBA. As a result of this finding the licensee issued NCR WA-1697 to document this condition. The NRC CAT inspectors also visually inspected 50 socket welds for proper fitup and gap and no discrepancies were noted.

During the review of six welding procedures used by Bechtel, several items remained unresolved as follows:

(1) During the review of the supporting procedure qualification test records (PQR) for welding procedure specification (WPS) P1-AT-Lh (CVN), it was noted that the procedure when used for the "as welded" condition does not fully meet the qualification requirments for impact testing of the heat affected zone (HAZ) which is required under the rules of NC-4330 of Section III of the ASME Code. Specifically, the rules require that the specimens are tested at a temperature lower than or equal to the lowest service temperature and that the average lateral expansion value of three HAZ specimens be equal to or greater than the average value of the unaffected base metal Charpy V notch (CV) specimen. The test data recorded on PQR #892 indicated a lower average HAZ lateral expansion value than that of the base material for the P1, Group 1 material side of the weld. The test specimens have been tested at a test temperature of 30°F. When the average lateral expansion value for the

HAZ is lower than the average value for the unaffected base material the Code requires that the WPS be requalified or the PQR shall include data which will provide for an increase in the lowest service temperature for the base material for which the welding procedure is being qualified.

Neither the procedure nor the PQR contained any data or explanation which is required to document the use of lower HAZ lateral expansion values for the qualification of WPS P1-AT-Lh (CVN).

Another item of concern to the NCR CAT is that PQR 892 shows the procedure to be qualified for use in materials up to 2 inches thick without post weld heat treatment (PWHT). In this case, the lateral expansion values shown on the PQR for both the base material and the HAZ for P1 Group 2 of the material side of the weld do not meet the requirements of Table NC-2331-1 of Section III of the ASME Code. The specific concern is the use of this procedure for weld repairs in 2 inch thick impact tested materials without PWHT.

The licensee has committed to review and evaluate these concerns.

(2) Peening was not addressed in the procedures. Paragraph NC-4423.2 of ASME Section III of the Code prohibits peening on the internal (root) layer and the final layer of the weld. The NRC CAT could not ascertain that this prohibition has been met at the site.

(3) Section IX of the ASME Code requires that the written welding procedures list both essential and nonessential variables in detail to give guidance to the welder. The NRC CAT noted that welding procedures WPPSP1-AT-Lh (CVN), WPSP1-T, WPSP8-T-Ag, WPSP8-M-PA do not address nonessential variables QW-410.1, QW-410.3 and QW-410.5 as applicable. Variable QW-410.1 requires that the WPS tell the welder whether to use the weave bead or stringer bead technique. The procedure does tell the welder to use the stringer bead technique for horizontal welding, but it is silent on which technique to use for other positions. Variable QW-410.3 requires that the WPS tell the welder what size gas cup is required for GTAW. This variable is not addressed by the procedure. Variable QW-410.5 requires that the method of initial and interpass cleaning be given. Initial cleaning method is given in GWS-FM, paragraph 4.1.3, but none of the referenced paragraphs give acceptable interpass cleaning methods. This variable is incompletely addressed in the procedure.

During review of documentation for the Reactor Coolant piping, it was noted that the simulated post weld heat treatment of the plate test coupons required by ASME Section III, NB-2211 did not appear to have been performed. Although the required heat treatment is described in the body of the Material Test Report, the cover sheet was found to have a hand-written note immediately above the certifying signature which says that the "heat treatment tests were not carried out on the plate." Further review of this item by the licensee revealed that the plate was delivered in "as rolled" condition and the hand written note was written to document this condition. Subsequently, the plate was rolled to form a pipe and the required heat treatment have been properly performed on both test coupons and finished pipe. NCR PC-1293 was issued to document this condition.

During the inspection of piping, the NRC CAT inspectors observed various pipe tees which did not have adequate reinforcement to meet the requirements of NC-3643.3 of Section III of the Code. Further review by the licensee revealed that the tees have been made in accordance with the requirements of ANSI B16.9 which allows reduced reinforcement if the fittings are subjected to burst testing. The NRC CAT reviewed the results of the burst test and found that the fitting have undergone the required testing.

(2) Nondestructive Examination Activities

In general, the inspected NDE activities were found to comply with the applicable codes and specifications. No deficiencies were identified with the inspected field fabricated pipe welds. However, during the review of the radiographic film for shop fabricated welds some deficiencies were identified which involved the following four welds:

- 3-CH-283-S-001 Weld C was found to have a linear indication. NCR WC-1739 was written to document this deficiency.
- 3-SI-030-S-001 Weld A exhibited a distinctively different appearance in an area covered by both view 0-1 and view 1-2. The applicable NDE documentation and reader sheets did not provide any explanation concerning this difference. The NRC CAT concern is whether undocumented repairs may have been performed on Weld A.
- 3-SG-005-S-003 Weld A had a gouge mark located at location 4. This was not documented on the reader sheets. The licensee performed visual examination of the area and the gouge indication was found to be acceptable.
- 3-SI-030-S-001 Weld N had film which showed that the weld was originally identified as Weld P. The radiographer had scratched the film to change the identification of the weld to Weld N without recording this action on the reader

sheet. Further review by the licensee established the correct weld identification to be Weld N.

c. Conclusion

(1) Welding Activities

In general, the inspected welding activities were found to comply with the requirements of the applicable codes and specifications. However, the NRC CAT found structural welds on pipe supports/restraints which did not meet the weld specifications. In addition, one undersized socket weld was found in a 2-inch Schedule 160 piping spool. The reviewed welding procedures did not list some nonessential variables and the code requirement for prohibiting peening of the root and final layer of the weld was not addressed. Also one welding procedure qualification test record requiring impact testing did not fully meet the requirements of Section III of the ASME Code as related to documenting the use of lower average HAZ lateral expansion value than that of the base material.

(2) Nondestructive Examination

In general, the inspected NDE activities were found to comply with the requirements of the governing codes and specifications. However, the NRC CAT found one weld which had linear indications and three other welds had inadequate NDE documentation.

2. Reactor Internals Modification and Installation

a. Inspection Scope

The NRC CAT reviewed the documentation packages for the lower support structure to core support barrel welding, the installation of the flow baffle to reactor vessel welding, and the welding on the control elements assembly shroud package tie rod lock bars. In addition, two welding procedures were also reviewed for technical adequacy. The modification work was performed by Bechtel.

b. Inspection Findings and Conclusions

No problems were identified in the area of inspected welding activities. Activities were found to meet the specified acceptance criteria.

3. Preservice Examination (PSE)

a. Inspection Scope

A total of 8 welds requiring preservice and inservice examinations were reinspected by the NRC CAT in order to verify compliance with the requirements of Section XI of the ASME Code. Seven of these welds were liquid penetrant examined (PT), one weld was magnetic

particle examined (MT) and two welds were ultrasonically examined (UT). The preservice examination activities were performed by C-E.

b. Inspection Findings

No deficiencies were identified during the UT and MT inspections. However, during the inspection of welds using PT examination the NRC CAT inspectors identified indications in four of the seven welds. A comparison between the original results obtained by C-E and the results obtained by the NRC CAT inspectors revealed that C-E had reported indications for only one of the four welds. The PT procedure requires that all indications be reported so that an accurate preservice baseline can be established for use during scheduled inservice inspections. The three unreported welds having indications are identified as follows:

- Weld 03-085-003 was found to contain several indications at the toe of the weld in excess of 1/4 inch in length.
- Welds 03-031-006 and 03-031-010, were found to have an indication in the weld area approximately 1/16 inch in diameter.

c. Conclusions

No problems were identified in the inspected preservice inspection activities involving UT and MT examinations. However, an additional review of the PT examination may be required by the licensee to assess the adequacy of the PT examinations so that an accurate preservice baseline can be established.

4. Electrical Installation and Electrical Supports

a. Inspection Scope

The NRC CAT inspected approximately 200 welds in the area of electrical installation. This involved the inspection of welds on 9 cable tray supports, 2 junction box supports, 9 conduit supports and the installation welds for 2 electrical panels. One welding procedure and the qualification test records for five welders were reviewed. In addition, the personnel qualification test records for four welding inspectors were also reviewed and two inspectors were observed and evaluated for their ability to follow the visual inspection procedures. The welding activities in the electrical area were performed by Bechtel.

b. Inspection Findings

During the inspection of cable tray support H101 on drawing 13-E2JC-007 one weld was found to be undersized with respect to the specified acceptance criteria. As a result of this finding the licensee issued NCR WJ-1700 which indicates that the weld will be reworked to meet the required size. Cable tray support 13-E-2JC-040-15 has a transverse brace welded to an embedment plate. The existing weld joining the brace to the embedment was found to

deviate from the requirements specified on the drawing. Specifically, the drawing required two welds on each side of the brace while the actual condition showed weld on one side and the top of the brace. NCR WJ-1707 was written to document this condition.

Similar weld deficiencies were also identified during the inspection of electrical panel mounting and cable tray connections to structural steel. See Sections II.B.1 and II.B.3 of this report for details.

c. Conclusions

No major problems were identified in the inspected area of welding activities. With the exception of undersized welds and the use of unapproved joint details, the inspected activities were found to comply with the applicable construction codes and specifications.

5. Instrumentation Tubing Installation and Instrumentation Supports

a. Inspection Scope

Approximately 200 welds involving 50 instrumentation supports and the welds on 4 racks and panels, were visually inspected to ascertain compliance with the specified acceptance criteria. Five welding procedures and qualification test records for five welders were reviewed. Visual inspection procedures and the qualification records for four inspectors were also reviewed. Two visual welding inspectors were observed and evaluated for their ability to follow the applicable inspection procedures. The field welding in the instrumentation area was performed by Bechtel. C-E supplied the instrument racks for the project.

b. Inspection Findings

During the inspection of instrument racks several vendor weld discrepancies were identified on C-E supplied transmitter racks 3JSIEA01D, 3JRCEA01B and 3JRCEA02B. The conditions identified included incomplete fusion, weld spatter, missing and undersize welds. The instrument racks did not meet the requirements of the C-E rack drawings N001-12.01-698 and N001-13.01-699. As a result of this finding the licensee has issued Corrective Action Request (CAR) CA 86-007 and C-E has undertaken corrective actions.

No other problems were identified in the area of inspected welding activities.

c. Conclusions

No major problems were identified in the area of inspected welding activities. With the exception of the deficient welds identified on the C-E supplied instrument racks, the inspected activities were found to comply with the applicable construction codes and specifications.

6. Heating, Ventilating and Air Conditioning (HVAC) Installation and Supports

a. Inspection Scope

Approximately 180 welds involving 26 supports were inspected for compliance with the specified acceptance criteria. Five welding procedures and the qualification test records for five welders were reviewed. In addition, five personnel qualification test records were also reviewed and two welding inspectors were observed and evaluated for their ability to follow the visual inspection procedures. The welds on six duct pieces, two air blowers, two air filters and three dampers were also included in this inspection. The welding in the HVAC area was performed by The Waldinger Corporation.

b. Inspection Findings and Conclusions

No problems were identified in the area of inspected welding activities. Activities were found to comply with the applicable construction codes and specifications.

7. Structural Steel Fabrication, Erection and Modification

a. Inspection Scope

Approximately 120 welds comprising 70 field and 50 shop welds involving 25 structural beams and columns were visually inspected in order to ascertain compliance with the specified acceptance criteria.

Two welding procedures and the qualification test records for six welders were reviewed. Visual inspection procedures and the qualification records for four inspectors were also reviewed. Two welding inspectors were observed and evaluated for their ability to follow the visual inspection procedures. The structural steel field welding was performed by Bechtel. Marathon Steel Company supplied the structural steel to the project.

b. Inspection Findings

No deficiencies were identified in the area of inspected shop welding activities. However, during the inspection of columns in the Auxiliary Building undersized welds were found on the flange to plate connection on two columns. As a result of this finding the licensee issued NCR WA-1699, and reinspected four additional columns in the Auxiliary Building. The welded connections were evaluated and accepted by the architect-engineer and determined to be adequate for the intended application.

c. Conclusions

In general, the inspected welding activities were found to comply with the governing code and specifications. With the exception of the deficient undersized flange to plate welds, the inspected

welding activities were found to comply with the specified requirements.

8. Refueling Cavity and Spent Fuel Pool Liner Fabrication

a. Inspection Scope

The NRC CAT visually inspected approximately 200 feet of welded seam on the Spent Fuel Pool and the Reactor Pool Liner. The attachment welds for four brackets, seven embedment plates, two lighting fixtures, and two patch plates were also inspected in order to ascertain compliance with the specified acceptance criteria. Three welding procedures and the qualification test records for six welders were also reviewed for adequacy. The Refueling Cavity and Spent Fuel Pool Liner fabrication was performed by Bechtel.

b. Inspection Findings

No problems were identified in the areas of inspected welding activities involving welding on the Spent Fuel Pool Liner. However, during the inspection of brackets installed in the Reactor Pool for the structure intended to support the neutron shielding, several deficiencies were identified. Specifically, the drawings required a full penetration weld along the horizontal members while the actual weld was found to be fillet weld. Undersized fillet welds were also found on the vertical members of the brackets.

As a result of this finding, the licensee issued NCR CC-5335. The conditions described in the NCR are to be included in calculation No. 13-CC-ZC-125 to ensure that the as-built conditions are accounted in the design for the structure. The embeds and the brackets were supplied by PX Engineering.

c. Conclusions

No major problems were identified in the inspected welding activities. With the exception of the deficient welds involving PX Engineering supplied embedments and brackets, the inspected activities were found to comply with the specified requirements.

9. Containment Liner and Containment Penetration Installation

a. Inspection Scope

The NRC CAT visually inspected approximately 300 feet of liner seam, the welds on four insert plates, twenty-eight plug welds involving vent holes, the welds on five erection clips, the welds on one construction opening, and the attachment welds for two mechanical, two electrical penetrations and one personnel hatch. Two welding procedures and the qualification test records for four welders were also reviewed. In the area of NDE, the NRC CAT reviewed the radiographs for 312 feet of welded seams which involved 314 film. One radiographic examination procedure was also reviewed as a part of this inspection. The containment liner and penetrations were

installed by Bechtel. Southern Boiler supplied the containment penetrations for the project.

b. Inspection Findings

No problems were identified in the area of inspected field welding. However, during the review of film and NDE documentation supplied by Southern Boiler, the following discrepancies were noted:

- Corrections were made to the film identification labels without any authorization and proper documentation of these actions was not reflected in the supporting NDE documentation.
- Reject film was not included in the packages to identify that the weld was repaired.
- The labels on some of the film envelopes did not match the labels of the film contained within the envelope.
- There were no reader sheets in several of the reviewed film envelopes.
- Seam 3MS-2-3 displayed the penetrameter shim in the area of interest and contained an area of incomplete coverage of the weld zone.

As a result of these findings, the licensee issued NCR WC-1745 to address and resolve the above listed discrepancies.

c. Conclusions

No problems were identified in the inspected welding activities. However, in the area of NDE the NRC CAT inspectors identified deficient radiographs and documentation involving hardware supplied by Southern Boiler.

10. Fire Protection System Fabrication and Installation

a. Inspection Scope

Approximately 120 welds involving 15 pipe supports, and 15 pipe welds involving 3 pipe spools were visually inspected. Three welding procedures and the qualification test records for three welders were also reviewed for adequacy. The fire protection installation was done by Viking Fire Protection Company.

b. Inspection Findings

One of the inspected pipe supports was found to be deficient with respect to the requirements stated on the applicable design drawing. Specifically, four plates have been added to the support without obtaining proper design authorization and no evidence was found to document the design or installation/inspection process. As a result of this finding the licensee issued NCR PJ-12103. The added plates

were evaluated and accepted by engineering and determined to be acceptable for the intended application.

c. Conclusion

No major problems were identified in the area of inspected welding activities. With the exception of the four plates which have been added without prior engineering authorization, activities were found to comply with the governing construction codes and specifications.

11. Vendors and Shop Fabricators Other Than Those Previously Addressed

a. Inspection Scope

The NRC CAT visually inspected eight vendor supplied tanks and heat exchangers. See Table IV-5 for inspected vendor supplied equipment. In addition to the welds inspected and listed in Table IV-5, the NRC CAT inspectors reviewed radiographs related to work performed by 15 vendors which have supplied various equipment and hardware to the Palo Verde project. A total of 751 feet of welded seam involving 1115 radiographs and 31 welds involving 212 film were reviewed. The radiographs for 61 valves, pumps and castings involving 245 film were also reviewed for compliance with the governing codes and specifications. See Table IV-6 for NDE inspected vendors and contractors.

b. Inspection Findings

During the inspection of tanks and heat exchanges supplied by the vendors listed in Table IV-5, the NRC CAT found that the size of the nozzle and manway weld reinforcement did not meet the requirements stated in the vendor drawings. In addition, the welds on some of the inspected supports were also found to be undersized. A total of six tanks and heat exchangers were found to have welds which deviate from the required drawing sizes. See Table IV-5 for details. The NRC has issued Information Notice 85-33 on the subject of undersized weld reinforcement in ASME Code nozzle to shell joints. The project has performed an inspection of tanks and heat exchangers prior to the NRC CAT inspection, and similar findings were identified. The licensee has committed to review and evaluate these findings.

During the review of radiographs supplied by various vendors and contractors the NRC CAT inspectors identified several deficiencies involving film artifacts which could mask the area of interest, missing identification marks, one set of radiographs available instead of the required 2 sets, low density and misfiled reader sheets. See Table IV-6 for details. Radiographs supplied by Engineering Fabricators Company and PX Engineering (notes 5 and 6 of Table IV-6) were the ones which were not resolved as of the completion of this inspection.

c. Conclusions

In general, the inspected welding and NDE activities were found to comply with the requirements for the governing codes and specifications. However, six tanks and heat exchangers were found to deviate from the requirements stated in the applicable drawings and specifications. In addition, some radiographs and NDE documentation supplied by vendors were found to be deficient with respect to the required quality.

TABLE IV-1

LIST OF SUPPORTS WHICH WERE INSPECTED AGAINST DRAWING REQUIREMENTS

SI-222-H001	SI-220-H001 (1)	SG-208-H001(14)
SI-223-H002	SI-155-H007 (2)	SI-160-H005
SI-178-H006 (3)	SI-178-H008	SI-178-H007
SI-225-H006	CH-254-H00K	CH-256-H00L
CH-238-H001	CH-151-H009	CH-284-H010
SI-008-H005	SI-008-H004	SI-099-H002
SI-099-H001	SI-100-H034	SI-308-H003
SI-308-H008	CH-425-H008	SI-308-H006
SI-308-H015	CH-425-H001 (4)	SI-194-H006 (5)
SI-106-H003	SI-100-H002 (6)	SI-152-H00B (7)
NC-136-H005 (13)	NC-136-H011 (8) (13)	RC-008-H012 (13)
RC-103-H013 (13)	NC-001-H023	NC-001-H022 (13)
NC-001-H021 (13)	NC-001-H020 (9) (13)	NC-001-H019 (13)
NC-001-H018 (13)	NC-001-H017 (10) (13)	NC-001-H016 (13)
NC-018-H017 (13)	NC-136-H007 (11) (13)	NC-136-H006 (12) (13)
SI-178-H005 (14)	RC-068-H002 (14)	AF-009-H003 (14)
SG-052-H005 (14)	CH-149-H002 (14)	SG-042-H013 (14)
SI-070-H011 (14)		

NOTES:

(1) One skewed fillet weld undersized. This condition was also identified by the licensee. NCR PX-10315 was written in March 1985.

(2) One undersized fillet weld. NCR PC-12081.

(3) Four skewed fillet welds undersized. NCR PC-12092.

(4) Two fillets welds undersized. NCRs PA-12099 and PA-12100.

(5) Four fillet welds undersized. NCR PA-12098.

(6) One fillet weld undersized. NCR-12101.

(7) Three fillet welds undersized, two stiffeners warped 5/16". NCR-12102.

(8) One fillet weld undersized. NCRs WC-1742 and WC-1750.

(9) One fillet weld undersized. NCR WY-1749.

(10) One fillet weld undersized. NCR WY-1740.

(11) Four fillet welds undersized. NCR WC-1696.

(12) One fillet weld undersized. NCR WC-1696.

(13) Indicates R-9 (non-safety, near safety) supports.

(14) Indicates inspection of skewed connections only.

TABLE IV-2

SUPPORTS WHICH WERE VISUALLY INSPECTED

AF-015-H001	SP-059-H041	SG-033-H017
AF-015-H002	SG-033-H015	SG-033-H018
AF-015-H003	SG-033-H016	AF-011-H024
AF-015-H00A	CHN-039-H00A	AF-006-H003
AF-045-H004	CHN-039-H00B	AF-045-H002
AF-026-H001	CHN-039-H00C	AF-016-H002
AF-026-H002	CHN-039-H00F	AF-011-H022
AF-026-H003	CHN-039-H002	AF-011-H021
AF-026-H004	CHN-039-H005	AF-021-H081
AF-026-H005	SG-033-H011	AF-016-H001
SP-058-H001	SG-033-H012	AF-005-H006
SP-058-H030	SG-033-H013	AF-022-H008
SP-059-H002	SG-033-H014	AF-015-H002
CH-003-H049	SI-152-H003	

TABLE IV-3

LIST OF PIPING WHICH WAS VISUALLY INSPECTED

ITEM	DESCRIPTION	PIPE SIZE (IN.)	MATERIAL
SI-308-S-10	Safety Injection	24	Stainless Steel
SI-031-S-001	Safety Injection	10	Stainless Steel
SI-031-S-002	Safety Injection	10	Stainless Steel
SI-114-S-004	Safety Injection	2	Stainless Steel
SI-152-S-001	Safety Injection	1	Stainless Steel
SI-218-S-001	Safety Injection	10	Stainless Steel
CH-906-N00A	Chemical/Volume Control	2	Stainless Steel
CH-246-N00P	Chemical/Volume Control	1	Stainless Steel
CH-246-B00P	Chemical/Volume Control	1	Stainless Steel
SG-428-N00A	Steam Generator	2	Carbon Steel
SG-405-N00H	Steam Generator	2	Carbon Steel
SG-406-N00G	Steam Generator	2	Carbon Steel
SG-406-N00F	Steam Generator	2	Carbon Steel
SG-407-N00F	Steam Generator	2	Carbon Steel
SG-422-N00B	Steam Generator	2	Carbon Steel
CH-003-S025	Chemical/Volume Control	2	Stainless Steel
CH-259-W00J	Chemical/Volume Control	1, 2	Stainless Steel
CH-259-W00E	Chemical/Volume Control	1, 2	Stainless Steel
CH-259-W00L-C	Chemical/Volume Control	1, 2	Stainless Steel
CH-254-W00A	Chemical/Volume Control	1, 2	Stainless Steel
CH-254-W00L	Chemical/Volume Control	1, 2	Stainless Steel
CH-256-W00E	Chemical/Volume Control	1, 2	Stainless Steel
CH-256-W00I	Chemical/Volume Control	1, 2	Stainless Steel
CH-258-W00I	Chemical/Volume Control	1, 2	Stainless Steel
CH-258-W00L	Chemical/Volume Control	1, 2	Stainless Steel
CH-258-W00A	Chemical/Volume Control	1, 2	Stainless Steel
CH-258-W00E	Chemical/Volume Control	1, 2	Stainless Steel
3-AF-015	Auxiliary Feedwater	6	Stainless Steel
3-AF-045	Auxiliary Feedwater	8	Stainless Steel
3-AF-026	Auxiliary Feedwater	8	Stainless Steel
3-SP-058	Essential Cooling Water Spray	4, 14	Stainless Steel
3-SP-059	Essential Cooling Water Spray	24	Stainless Steel
3-SG-033	Main Steam Line	28	Carbon Steel
3-CH-139	Chemical/Volume Control	1, 2	Stainless Steel

TABLE IV-4

PORTIONS OF PIPING SYSTEMS VISUALLY EXAMINED AND FOR WHICH DOCUMENTATION WAS REVIEWED

ITEM	DESCRIPTION	PIPE SIZE (IN.)	MATERIAL
SG-045-S-001	Steam Generator	28	Carbon Steel
SG-045-S-002	Steam Generator	28	Carbon Steel
SG-045-S-003	Steam Generator	28	Carbon Steel
SG-045-S-004	Steam Generator	28	Carbon Steel
SG-045-S-005	Steam Generator	28	Carbon Steel
SG-045-S-006	Steam Generator	28	Carbon Steel
RC-073-S-001	Reactor Coolant	30	Carbon Steel (Clad)
RC-079-S-001	Reactor Coolant	30	Carbon Steel (Clad)
RC-063-S-001	Reactor Coolant	42	Carbon Steel (Clad)
RC-031-S-001	Reactor Coolant	30	Carbon Steel (Clad)
RC-030-S-001	Reactor Coolant	30	Carbon Steel (Clad)
RC-032-S-001	Reactor Coolant	42	Carbon Steel (Clad)

TABLE IV-5

TANKS PRESSURE VESSELS AND HEAT EXCHANGERS
WHICH WERE VISUALLY INSPECTED

ITEM	MANUFACTURER	NOTES
Letdown Heat Exhanger 3M CH-NE02	Richmond Engineering	(1)
Pulsation Bottle 3M CHA X7	Greer Hydraulics	
Deborating Ion Exchanger 3M CH ND02	CTI Nuclear	(2)
Essential Cooling Water Heat Exchanger 3M EWB E01	Struthers Wells	(3)
Diesel Fuel Oil Day Tank 3M DFA T02	Cooper Energy Services	(4)
Essential Cooling Water Surge Tank 3M EWA T01	PX Engineering	(5)
Spray Chemical Storage Tank 3M SIE X03	Process Equipment Co.	(6)
Regenerative Heat Exchanger 3M SIB E01	Ametek, Inc.	

(1) Four nozzle-to-shell reinforcing fillet welds undersized. Support fillet welds undersized. One fillet weld overground at its toe, resulting in minimum wall violation. NCRs NA1844 and NA1845.

(2) Four nozzle-to-shell reinforcing fillet welds undersized. Manway-to-shell fillet weld undersized. Support fillet welds undersized. NCRs NA1842 and NA1843.

(3) Five nozzle-to-shell reinforcing fillet welds undersized. Support wrapper plate-to-shell weld undersized. NCRs MA2953 and MA2954.

(4) Three nozzle-to-shell reinforcing fillet welds undersized. Four feet of pad-to-saddle welds undersized. NCRs MG2956 and MG2957.

(5) Foot pad-to-leg fillet welds undersized. NCR MA2958.

(6) Five nozzle-to-shell reinforcing fillet welds undersized. Skirt-to-bolting ring and skirt-to-vessel welds undersized. NCRs NA1832 and NA1834.

TABLE IV-6

VENDOR RADIOGRAPHS REVIEWED

Contractor	Welds	Castings Valve Pumps	Feet of Welds	Film	Notes
Combustion Engineering			344	487	(1)
W. J. Wooley			175	175	
Whiting			40	40	
Ametek, Inc.			30	60	(2)
Vacco, Inc.	6			24	
Ecodyne	2			6	
Bingham-Williamette	8			16	(3)
Anchor/Darling		52		160	(4)
Fisher Controls		5		40	
Borg-Warner Corp.		4		45	
Struthers Wells			30	66	
Engineering Fab. Co.			175	161	(5)
PX Engineering			63	126	(6)
Babcox & Wilcox	8			96	
Ametek Straza	7			70	

NOTES:

(1) Developing spots noted on several of the film. Appears to be caused by drippage from the automatic processor. However coverage for the area of interest was provided by other films and the weld quality was acceptable.

(2) Density variances through the radiographs of two welds seams were questionable. Ultrasonic thickness measurements were required to verify that the minimum wall thickness was acceptable. Witnessing of the UT measurements and procedure revealed no weld quality or minimum wall problems.

(3) Complexity of the welding geometry necessitated the review of design vendor drawings. This was necessary to assist interpretation of the area of interest. The review identified no weld quality problems.

TABLE IV-6 - (Continued)

VENDOR RADIOGRAPHS REVIEWED

NOTES

(4) One film package contained 2 radiographic (RT) data sheets, one of which did not belong to this package and was improperly filed. However, the review of the correct film package revealed that a copy of the RT sheet was also filed with the correct package.

(5) The reviewed radiographs involved the shutdown heat exchangers serial numbers (S/Ns) 18345 and 18346. Several film quality irregulatiries were noted. As a result of this finding, the licensee issued NCR WA1713. The NCR addresses the following issues:

a. Many views exhibited film scratches and processor artifacts which could mask or be confused with discontinuities in the area of interest. This is violation of Article 2, paragraph T-231.2 of Section V of the ASME code.

b. Many views exhibited densities well below the minimum and above the maximum requirements of Article 2, paragraph T-233 of Section V of the ASME Code. The views with low densities also violated the minus 15% maximum density difference between the penetrameter and area of interest required by Article 2, paragraph T262.3 of Section V.

c. There were several cases of identification numbers and penetrameter shims appearing in the area of interest.

d. In one case on Heat Exchanger S/N 18345 seam 2.701, view of 8-9 was found to be missing from the package.

e. In some cases, areas were repaired and the original film was not available to determine proper coverage of the repair area.

f. There was only one set of radiographs available for review. The vendor has stated that a second set has been shipped with the hardware. To date, the second set of film has not been located by the licensee.

(6) Several irregularities were noted during the review of this item. As a result of this finding, the licensee issued NCR WF1714. The NCR addresses the following issues:

a. Missing identification markers were found involving several views on S/N 553-3 film 3J1, 3J7 and 3J4.

b. Inadequate densities were found on S/N 553-3 film 3J3, 3J5 and 3J6.

c. Film artifacts were found on S/N 553-3 involving views PC1J1, PC2J1, PC1J2, PC2J3, PC3J1, PC3J2 and PC3J3.

d. Markers were found in the area of interest in 4 views on item S/N 553-3 3J6 .

V. CIVIL AND STRUCTURAL CONSTRUCTION

A. Objective

The objective of the appraisal of civil and structural construction was to determine by evaluation and review of quality control (QC) accepted work and documentation whether civil and structural construction areas were completed in accordance with regulatory requirements, Safety Analysis Report commitments, and project specifications, drawings and procedures.

B. Discussion

The specific areas of civil and structural construction evaluated were masonry construction, structural steel installation including high strength bolting for structural steel connections, general concrete surface finish quality, and QC documentation for cadwelds, concrete placements, post-tensioned tendons, and soil compaction.

1. Masonry Construction

a. Inspection Scope

Masonry construction attributes reviewed by the NRC Construction Appraisal Team (CAT) included reinforcing steel existence and location, existence of grout in block wall cells, QC inspection records, design assumptions, and general exterior quality.

The sample inspected was taken from the masonry block walls in the Control Building. Block walls located in three areas were inspected: at elevation 74 which separate the Essential Air Handling Rooms, at elevation 100 which provide fire protection and enclosure for the battery rooms, and at elevations 120 and 140 which provide fire protection for an electrical cable chase.

Although these block walls are classified as non-load bearing, they do provide support for penetrations, Class Q electrical conduits and junction boxes and lateral support for Class Q fans. In addition, these walls are adjacent to safety-related Class Q equipment (such as the station batteries and dc charging system, and remote shutdown panel).

The requirements and acceptance criteria are included in Table V-1 and in the following:

- American Concrete Institute ACI 531R-79, "Commentary on Building Code Requirements for Concrete Masonry Structures (ACI 531-79)," 1978.
- Bechtel Power Corporation Specification AM-014, Rev. 2, "Exhibit D Technical Specification for Concrete Block Masonry," May 1, 1978.
- International Conference of Building Officials UBC, "Uniform Building Code," 1982.

b. Inspection Findings

The masonry block walls were constructed by the licensee as Quality Class S which generally require no special quality requirements. However, the construction specification did specify the documentation of in-process inspections. These block walls are adjacent to and in some cases provide support for Quality Class Q (safety-related) components. Also, as shown in Table V-1, the quality classification described on the four drawings used for the construction of the masonry walls was inconsistent. The three plan drawings were classified as Class S; however, they reference for construction details a Class Q drawing (13-C-ZJS-172, Rev. 7).

In addition, the Bechtel design calculations of the block walls used a set of increased allowable stress values associated with the performance of "special inspections" during construction. However, the licensee was not able to present any documentation showing that in-process block wall construction "special inspections" had been conducted. Also, documentation required by the specification was not provided which adequately demonstrated that the block wall materials (block and mortar) met the specification requirements.

The NRC CAT observed that the reinforcing steel in penetrations and open areas of the block walls had been placed in the middle of the cells. In most cases, the rebar was found bundled in the center of the wall. In a few other cases the rebar was placed close to only one face of the cell walls. However, the NRC CAT review of the design calculations showed the reinforcing steel was assumed to be placed at the outer faces of the block wall cells.

As a result of the NRC CAT findings, the licensee performed a post-construction inspection. The licensee confirmed that rebar visible in penetrations and open areas of the block walls had been placed in the middle of the cells. For rebar in the block walls, which were not exposed, the existence of rebar was verified by using a magnetic rebar locator. The rebar size, number, and location within the cells could not be determined.

Subsequently, Bechtel has reanalyzed the block walls for several design cases. The results of Bechtel's reanalysis indicated that the 12 inch block walls at elevation 74 ft., which separate the Essential Air Handling Rooms, would be overstressed using allowable stresses consistent with "no special inspection" and assuming the rebar was placed in the middle of the cell.

However, Bechtel believes that the design allowables should be consistent with "special inspection", since they have justified the use of higher allowable stresses based on post-construction inspections and review of pertinent documentation. In this case, the rebar was assumed to be in the middle of the cell. Based on this, the block walls would not be overstressed according to Bechtel's computations. In another case investigated, Bechtel used the lower allowable stress values consistent with "no special inspection" and assumed the rebar to be at the outer faces of the block wall cell.

The NRC CAT questions whether Bechtel has analyzed the correct situation. It is known that the as-built condition shows rebar to be located in most cases in the middle of the cells. Some cases have been found in which rebar is located more towards one face of the block wall. In addition, the NRC CAT feels that insufficient evidence has been presented to justify the use of design allowables consistent with "special inspection."

The adequacy of grout fill workmanship has only been demonstrated during limited post-construction inspections of 42 openings in Unit 3. These areas are only a limited portion of the masonry walls. A review of nonconformance reports was done and showed only 1 grout void for Unit 3 block walls; however, the documentation of a grout void was not a formal inspection point but rather a general nonconformance if noticed during drilling or coring activities. The use of a magnetic rebar detector by the NRC CAT and the licensee was useful in providing evidence of the presence of rebar; however, the rebar size, number, or location in the block cell could not be determined. The fact that rebar was not placed in accordance with the design drawings in the block cell and in Unit 2 rebar was identified to be staggered in adjacent block cells lead the NRC CAT to question whether other masonry construction activities (i.e., grouting or laying of mortar) were done in accordance with these specifications and drawings. Based on these findings the NRC CAT believes the walls should be analyzed with the rebar in the middle of the cells and design allowables consistent with no special inspection.

c. Conclusion

The issue of the adequacy of design and construction of the masonry walls will be further reviewed by the NRC.

2. Structural Steel Inspection

a. Inspection Scope

Installed and QC accepted structural steel members and connections were inspected by the NRC CAT. Attributes inspected were member size, configuration, and bolted connections. Bolted friction connections were tested by using a calibrated torque wrench to determine whether the bolts had proper pretension. In addition, the bolts were inspected for proper material and thread engagement of the nut.

The sample used in the structural steel verification for correct member size and configuration is described in Table V-2. A total of 114 structural steel members and 25 connections were inspected.

The bolt size, number and material type for various friction type connections checked for proper pretension are shown in Table V-3. These bolts were sampled from structural steel connections in the Containment Building. Test torque values were established using a Skidmore Whilhelm tension tester to determine the torque-tension relationship.

The requirements and acceptance criteria for structural steel installation are included in the drawings listed in Table V-4 and in the following specification:

° Bechtel Power Corporation Specification 13-CM-320, Rev. 11, "Installation Specification for Erection of Structural and Miscellaneous Steel," September 5, 1985.

b. Inspection Findings

Of the 114 structural steel members and 25 connections inspected for correct member size and configuration, two hardware deficiencies were identified. One deficiency involved a removable beam across the floor opening at containment elevation 100 between column No.'s 3 and 4. Design drawing 13-C-ZCS-530, Rev. 15 required a W18x45, however, a W18x35 was installed. The other deficiency involved the removable beam across the floor opening at containment elevation 120 between column No.'s 3 and 4. The removable beam was specified to be a W14x43 beam (drawing 13-C-ZCS-532, Rev. 14), instead a W14x22 was installed. Nonconformance Report (NCR) CC-5329 was subsequently issued to document these two deficiencies.

A total of 218 7/8-inch diameter A325 bolts were checked for proper torque for structural steel friction type connections. Only one bolt was determined to be installed below the inspection torque of 510 ft-lbs.

In addition, 95 A490 bolts (7/8, 1, 1 1/4, 1 3/8 inch diameter) were checked for proper installed torque. Except for the 1 1/4 inch diameter bolts, no bolts were determined to be installed below the applicable inspection torque value. Twenty-one of the twenty-six 1 1/4-inch diameter A490 bolts were determined by the NRC CAT to be installed below the inspection torque value. All 26 bolts were sampled from containment column splice connections. NCR CC-5327 was issued to document this deficiency and evaluated to be acceptable.

In the review of the licensee's installation activities for sliding connections in structural steel it was determined that Bechtel does not use sliding connections for thermal expansion considerations. Slotted connections are provided for construction fit-up and assembly only. The NRC CAT identified several beams spanning between non-ductile connections (such as embedded plates and short cantilevered members anchored to embedded plates) in the Containment Building. During a loss of coolant accident the structural assemblies (beams, embedded plates, anchor bolts) would experience thermal expansion and, therefore, additional loads. These loads could be significant. Bechtel has stated that for these cases, the thermal loads have been considered to be secondary and self-limiting. Bechtel has considered the thermal loads to be negligible in design calculations. Justification of the thermal loads being negligible was provided to the NRC CAT. This issue is being further reviewed by the NRC.

c. Conclusions

In general, the completed as-built structural steel erection work is in accordance with the design drawings. The mis-installed removable beams for two floor openings in the Containment Building appear to be isolated cases. The high strength A325 and A490 bolts for friction connections were generally determined to have been installed satisfactorily, except for containment column splices.

Thermal loads in the structural steel design were considered negligible by Bechtel, being secondary and self-limiting loads. The NRC CAT questions whether these assumptions have been adequately justified. This issue will be further reviewed by the NRC.

3. Reinforced Concrete Construction

a. Inspection Scope

QC documentation for concrete placements, cadweld splices of reinforcing steel, and containment post-tensioned tendons were reviewed by the NRC CAT. In addition, the general concrete surface finish quality was observed.

The concrete pour packages reviewed are listed in Table V-5. Concrete placement records reviewed included those for concrete pre-placement, placement, post-placement, and compressive strength of test cylinders. The following were reviewed by the NRC CAT: completion of forms by the QC inspectors, existence of Level II QC inspector's stamp, and adequacy of coverage of various inspection attributes.

Cadweld splice QC documentation reviewed included cadweld splice tests, cadwelder qualification records, and cadweld log sheet.

Two forms of QC documentation were reviewed for the containment post-tensioned tendons. These were: (1) the certificate of inspection installation of field anchor head and field button heading, and (2) the certificate of inspection tendon stressing and installation of shims and grease caps.

The requirements and acceptance criteria were included in the drawings listed in Table V-6 and V-7 and in the following specifications and procedures:

° Bechtel Power Corporation (Bechtel) Specification 13-CM-365, Rev. 15, "Installation Specification for Forming, Placing, Finishing and Curing of Concrete," July 29, 1985.

° Bechtel Work Plan Procedure/Quality Control Instruction (WPP/QCI) 52.0, Rev. 14, "Concrete Preplacement," December 28, 1983.

° Bechtel WPP/QCI 53.0, Rev. 9, "Concrete Placement," August 7, 1979.

° Bechtel WPP/QCI 54.0, Rev. 14, "Concrete Post-Placement," October 28, 1983.

° Bechtel WPP/QCI 56.0, Rev. 15, "Cadweld Splicing of Reinforcing Steel," April 29, 1981.

b. Inspection Findings

No concerns were identified with the concrete pour packages reviewed.

Visual inspection records for over 1500 cadweld splices were reviewed. These cadweld splices were performed by 27 cadwelders. All cadwelds were found to have been inspected and accepted after cadweld splice completion. The testing frequency for tensile tests were found to be satisfactory for over 250 cadweld splices performed by three cadwelders. The tensile test results for 589 splices were reviewed and found to be within project requirements with one minor exception. The documentation showed the test results had listed the cadwelder of each splice under the heading "Responsible QC Engineer" which was a misnomer. The NRC CAT was informed that the documentation was for information purposes only. However, it was the only documentation presented to the NRC CAT as evidence that the cadweld splices had satisfied tensile test requirements. The qualification records of three cadwelders were reviewed and found acceptable.

The two forms of containment post-tensioned tendons were found to be adequate. One document for the certificate of inspection tendon stressing and installation of shims and grease caps had not been stamped as original. This was corrected by being stamped subsequently as an original.

No deficiencies were observed with the general concrete surface finish quality.

c. Conclusions

In general, the QC documentation for concrete placements, mechanical splices of rebar, and containment post-tensioned tendons were acceptable.

General concrete surface finish quality was adequate.

4. Structural Backfill

a. Inspection Scope

The daily reports and backfill compaction records for the structural backfill placed in the area of the Containment Building between elevation 50 ft-0 inches and 66 ft-0 inches were reviewed.

The requirements and acceptance criteria are contained in the following specification and procedure:

- Bechtel Specification 13-CM-300, Rev. 11, "Installation Specification for Excavation and Backfill, "October 27, 1982.

- Bechtel WPP/QCI 57.0, Rev. 15, "Placing and Compaction of Earthwork (Backfill)," December 26, 1984.

b. Inspection Findings

Two inspection attributes, percent compaction and existence of QC inspector's stamp for lift thickness verification, were reviewed in the daily reports and backfill records for the area under review. The percent compaction was found to be recorded satisfactorily. No missing QC inspectors' stamps were found.

c. Conclusion

The structural backfill records reviewed by the NRC CAT were found to be acceptable.

TABLE V-1

LIST OF DRAWINGS USED FOR MASONRY CONSTRUCTION INSPECTION

Design Drawing No.	Rev.	Quality Classification	Title
13-A-ZJD-509	11	S	Control Building Concrete Block Plans @ El. 74 ft-0 inches, 100 ft-0 inches and Wall Elev.
13-A-ZJD-510	10	S	Control Building Concrete Block Wall Elevation and Sections
13-A-ZJD-511	3	S	Control Building Concrete Block Plans Sections and Details
13-C-ZJS-172	7	Q	Control Building Concrete Block Walls Sections and Details

TABLE V-2

STRUCTURAL STEEL INSTALLATION INSPECTION SUMMARY

Building/Elevation		Dwg. No.	Beams	Braces	Columns	Connections	Comments
Containment	140 ft.	13-C-ZCS-534 Rev. 22 13-C-ZCS-535 Rev. 19	22	2	6	4	Steel framing acceptable.
	120 ft.	13-C-ZCS-532 Rev. 14	3	0	7	0	Steel framing. One beam found to be different from design drawing requirements.
	100 ft.	13-C-ZCS-530 Rev. 15	37	3	0	0	Steel Framing. One beam found to be different from design drawing requirements.
	165 ft. 6 inches	13-C-ZCS-540 Rev. 6 13-C-ZCS-541 Rev. 6 13-C-ZCS-542 Rev. 3	4	13	4	16	Main steam line support; acceptable.
Main Steam Support Structure	131 ft. 10 3/4 in.	13-C-ZCS-710 Rev. 11	3	0	0	1	Steel framing; acceptable.
	139 ft. 10 3/4 in.	13-C-ZCS-711 Rev. 9 13-C-ZCS-545 Rev. 7	4	0	0	2	Steel framing; acceptable.
Fuel	138 ft. 7 1/2 in.	13-C-ZFS-510 Rev. 12	6	0	0	2	Steel framing; acceptable.

TABLE V-3

HIGH STRENGTH BOLTING INSPECTION SUMMARY

Bolt Type	Bolt Diameter (Inches)	Number of Bolts Checked For Installation Torque	Number of Bolts Not Satisfying Inspection Torque	Comments
A325	7/8	218	1	Inspection torque was 510 ft-lbs.
A490	7/8	19	None	Inspection torque was 683 ft-lbs.
	1	24	None	Inspection torque was 1070 ft-lbs.
	1 1/4	26	21	Inspection torque was 2263 ft-lbs. See Note 1 below. These bolts were for column splices. NCR CC-5327 was issued to evaluate this condition.
	1 3/8	26	None	Inspection torque was 1100 ft-lbs.

Note 1: A multiplier was used in conjunction with a calibrated torque wrench. The value of the multiplier was equivalent to 3.65 according to the licensee. The reading on the Skidmore Wilhelm tension tester was 620 ft-lbs at the required bolt tension. This gave an inspection torque value of 2263 ft-lbs (620 ft-lbs X 3.65).

TABLE V-4

LIST OF DRAWINGS USED FOR STRUCTURAL STEEL INSTALLATION INSPECTION

Bechtel Design Drawing No.	Rev.	Title
13-C-ZFS-510	12	Fuel Building Area F3A & B Structural Steel Framing Plan for El. 140'-0"
13-C-ZCS-530	15	Containment Internals Structural Framing Plan for El. 100'-0" Areas C1A and C1B
13-C-ZCS-532	14	Containment Internals Structural Framing Plan for El. 120'-0" Areas C2A and C2B
13-C-ZCS-534	22	Containment Internals Structural Framing Plan for El. 140'-0" Areas C3A and C3B
13-C-ZCS-535	19	Containment Internals Structural Framing Plan for El. 140'-0" Areas C3C and C3D
13-C-ZCS-540	6	Containment Internals Main Steam Line Structural Steel Support Plans and Sections Sheet 1
13-C-ZCS-541	6	Containment Internals Main Steam Line Structural Steel Support Sections and Details Sheet 2
13-C-ZCS-542	3	Containment Internals Main Steam Line Structural Steel Support Sections and Details Sheet 3
13-C-ZCS-565	7	Containment Internals Structural Steel Column Schedule
13-C-ZCS-710	11	Main Steam Support Structure Structural Steel Framing Plans Areas C1E, C2E, C3E, and C4E
13-C-ZCS-711	9	Main Steam Support Structure Structural Steel Framing Plans Sections and Details, Sheet 1

Marathon Drawing No.	Title
13-10407 C124-340-4	Shop drawing
13-10407 C124-342-5	Shop drawing
13-10407 C124-417-11	Shop drawing

TABLE V-5

LIST OF CONCRETE POUR PACKAGES REVIEWED

Concrete Placement No.
3J012
3J013
3J015A
3J015B
3J016
3J019
3J020
3J021

All concrete pour packages reviewed were for the Control Building.

TABLE V-6

LIST OF DRAWINGS USED FOR REINFORCED CONCRETE CONSTRUCTION INSPECTION

Bechtel Design Drawing No.	Rev.	Title
13-C-00A-001	21	Civil/Structural General Notes
13-C-00A-060	10	Concrete Mix Design Summary Sheet 1
13-C-00A-061	10	Concrete Mix Design Summary Sheet 2

TABLE V-7

LIST OF DRAWINGS USED FOR POST-TENSIONED TENDON INSPECTION

Bechtel Design Drawing No.	Rev.	Title
13-C-ZCS-176	3	Containment Building Prestressing Requirements Dome Plan and Verticle Stretch Schedule
13-C-ZCS-177	1	Containment Building Prestressing Requirements Dome and Wall Cross Sections

VI. MATERIAL TRACEABILITY AND CONTROL

A. Objective

The objective of this portion of the inspection was to examine the traceability of materials and equipment to the specified requirements, and to ascertain the adequacy of the licensee's program in this regard.

B. Discussion

The method utilized to perform the inspection was to select specific pieces of equipment and material installed or planned for installation in the plant. Some installed material items that were not accessible for positive identification, such as cadweld sleeves and reinforcing bars, were selected from concrete placement records. Also, some samples of stockroom materials ready for installation, such as weld filler metals and high-strength bolts, were examined. Most of the selected items were chosen and identification markings taken from installations in the plant.

The following Bechtel Power Corporation documents which provide the bases for material and equipment traceability were reviewed:

- Applicable construction drawings and specifications.
- Applicable drawings and material specification obtained from vendors.
- Bechtel Work Plan Procedure/Quality Control Instruction (WPP/QCI)
- WPP/QCI 3.5, "Field Control of Material and Specification Subcontracts."
- WPP/QCI 4.0, "Receiving Inspection."
- WPP/QCI 5.0, "Non-conforming Materials, Parts and Components."
- WPP/QCI 6.0, "Quality Documentation Control."
- WPP/QCI 7.0, "Calibration and Control of Construction Measuring and Test Equipment."
- WPP/QCI 10.0, "Field Material Requisition Preparation and Approval."
- WPP/QCI 12.0, "Storage Control of Permanent Plant Items."
- WPP/QCI 12.2, "Control of Permanent Plant Spare Parts and Special Tools."
- WPP/QCI 21.0, "Field Acceptance and Approval of Supplier Engineering Documents."
- WPP/QCI 28.0, "Maintenance of Materials and Equipment."
- WPP/QCI 32.1, "Material Transfer Authorization."
- WPP/QCI 100.0, "Weld Filler Material Control."

A total of 142 samples were examined. Table VI-1, "Summary of Items Inspected," indicates the number and type of material and equipment items that made up the sample. The items were selected generally by recording identification numbers/labels on equipment installed in the plant. For weld filler metal and some fasteners, the samples were randomly selected from lots that were in storage and were intended for use in the plant. Traceability to design drawings and specifications, and to the supply source, was performed by reviewing the design documents and by matching material and equipment markings with vendor certifications, heat numbers and other documentation.

1. Material Traceability and Control

a. Inspection Scope

In addition to review of in-place procedures and specifications, the 142 samples of material and equipment were examined for traceability to drawings, specifications, procurement records, Certified Material Test Reports (CMTRs), Certificates of Conformance (C of Cs), heat numbers and charts, or other required documentation. Samples included equipment (electrical, mechanical and instrumentation), pipe, weld joints, structural steel, electrical cables, weld filler metal, fasteners, and other materials as indicated in Table VI-1.

b. Inspection Findings

The following observations were made by the NRC CAT inspector:

(1) Generally for the samples selected the materials were traceable to the applicable documents and demonstrated that items installed were in accordance with the drawings, specifications, or procurement records.

(2) The procedures which govern the Design Document Control Center activities provided for reasonably rapid retrievability of Bechtel and vendor design drawings, specifications, manuals, etc. Organization and labeling of the files in the installation records vault was such that document retrievability there was almost instantaneous. The only area where some difficulty was experienced in locating documents was in the heating, ventilating and air conditioning (HVAC) records which had very recently been turned over to Bechtel from their subcontractor The Waldinger Corporation (TWC). TWC installation and inspection records had not yet been organized and indexed into the Bechtel system at the time of this inspection.

(3) The weld filler metal samples listed in Table VI-1 that were examined were found to be properly marked and segregated, and certified documents were in the files which verified the specified chemical and physical properties.

(4) Embed plates in the walls and floors in the Auxiliary Building which are used for equipment anchoring had no material identification markings. However, all structural steel furnished to the Palo Verde project was from Marathon Steel Company which provided material certifications for bulk A36, 1-inch thick

plate, the material which had been specified by Bechtel. The embed plates were then fabricated in various sizes by Marathon. Since there were no other embed plate materials in the Marathon scope of supply, the inspector concluded that the embed plates were the specified A36 material.

(5) The foundation anchor bolts that were cast in the concrete for the equipment samples selected did not have material identification marks on the exposed ends. In all cases, however, they were the specified diameter and the concrete preplacement inspection reports verified that the specified bolts had been properly positioned in place prior to concrete placement.

(6) In connection with the review of the containment electrical penetrations, the inspector verified the presence in the licensee's files of the seismic and environmental qualification test reports. The reports appeared to cover all components which make up the penetration assemblies.

c. Conclusions

No discrepancies were identified by the NRC CAT for the items in the inspection sample. Traceability procedures are in place and appear to be understood and are being implemented by the appropriate project personnel. Document retrievability was generally very good. Documentation was available to substantiate the acceptability of the installed hardware. The material traceability and control program is considered to be satisfactory.

TABLE VI-1

SUMMARY OF ITEMS INSPECTED

ITEM	NO. OF SAMPLES
Equipment	24
Pipe Spools	2
Weld Joints	10
Weld Filler Metal	5 (Lots)
Type 7018 3/32 inches-Ht. 76970 Type E70S2 1/8 inches-Ht. 14255 Type ER308L 1/8 inches-Ht. 46927 Type ER308L 3/32 inches-Ht. 462656 Type 7018 1/8 inches-Ht. 401N3631	
Hangers/Supports	1
Steel - Structural	4
Steel - Reinforcing Bar (Approx. 200,000 Pounds)	7 (Lots)
Embedments	6
Cadweld Sleeves (Approx. 9,000 Kits)	4 (Lots)
Equipment Foundation Bolts and Nuts	46
Fasteners (Installed)	8 (Sets)
Fasteners (In Storage)	4 (Lots)
Electrical Cables (Installed)	19
Electrical Penetration Mounting Flanges	2
TOTAL	142

VII. DESIGN CHANGE CONTROL

A. Objective

The primary objective of the appraisal of design change control was to determine whether design change activities were conducted in compliance with regulatory requirements, Final Safety Analysis Report (FSAR) commitments and approved licensee, architect-engineer, constructor, and contractor procedures. An additional objective was to determine that hardware modifications prescribed in a sample of design change documents were properly implemented in the field.

B. Discussion

10 CFR 50, Appendix B, Criterion III, "Design Control," and Criterion VI, "Document Control," establish the overall regulatory requirements for design control. These requirements are elaborated in Regulatory Guide (RG) 1.64, Rev. 2, June 1976, "Quality Assurance Requirements for the Design of Nuclear Power Plants," which endorses American National Standards Institute (ANSI) Standard N45.2.11-1974, "Quality Assurance Requirements for the Design of Nuclear Power Plants." The licensee's and engineer's commitments to comply with RG 1.64 are stated in Chapter 17, Sections 17.1A.1.2.2 and 17.1B of the Palo Verde Nuclear Generating Station (PVNGS) FSAR.

The areas of design change control evaluated by the NRC Construction Appraisal Team (CAT) inspectors were control of changes to design documents and control of design changes. In each of these areas, interviews were conducted with personnel responsible for the control of activities, procedures were reviewed, audit and surveillance reports were reviewed, and a sample of the controlled documents was reviewed. In addition, a sample of the design changes which had been inspected and accepted by onsite constructor quality control personnel was verified in the field by the NRC CAT inspectors.

1. Control of Design Documents

The specific aspects of the control of design documents inspected were the availability to the users of the latest approved design documents and design change documents, and the methods of assuring that approved changes not yet incorporated into design documents are provided to the users prior to work being performed.

a. Inspection Scope

(1) The following procedures, related to distribution and control of design documents and design change documents, were reviewed:

- PVNGS Quality Program Procedure 3.0, "Design Control," Rev. 9, October 14, 1985.
- PVNGS Quality Program Procedure 6.0, "Document Control," Rev. 9, July 2, 1984.

- PVNGS Quality Program Procedure 6.2, "Field Control of Documentation," Rev. 4, October 14, 1985.

- PVNGS Work Plan Procedure (WP/P) 3.0, "Field Control of Design Documents," Rev. 20, June 19, 1985.

- PVNGS WP/P 3.8, "Field Generated Drawings/Field Change Notices," Rev. 12, August 22, 1985.

- Arizona Nuclear Power Project (ANPP) Internal Procedures Manual (IP) 4.12, "Project Engineering Drawings and Drawing Change Notices," Rev. 15, August 29, 1985.

- ANPP IP 5.8, "Construction Interface," Rev. 11, August 15, 1983.

- The Waldinger Corporation Field Work Procedure Manual (FWP) 1.2-1, "Document Control," Rev. 8, October 18, 1985.

- The Waldinger Corporation FWP 1.2-1 "Document Control," Rev. 9, January 9, 1986.

(2) The following Project Quality Assurance (QA) audit and surveillance reports concerning design document control were reviewed for findings, trends and corrective actions:

- PVNGS Project QA Audit Report, 2/81/73/74/75/89-S-84-46, September 12, 1984.

- PVNGS Project QA Audit Report, 127-S-85-40, September 5, 1985.

- Various reports of internal surveillances performed by Design Document Control Center (DDCC) personnel.

(3) Arizona Public Service (APS), Bechtel Power Corporation (Bechtel) and contractor document control, engineering, construction and QA personnel were interviewed concerning distribution, control and use of design documents and design change documents.

b. Inspection Findings

Bechtel is the engineer and constructor at PVNGS. Essentially all nuclear safety-related design documents have been and are being prepared, reviewed and approved by Bechtel with the exception of those within the scope of the Nuclear Steam Supply System (NSSS) supplier, Combustion Engineering, Inc. (C-E) and equipment suppliers.

At the present time, Bechtel design documents are issued by letter of transmittal to APS, who reissues them to the Bechtel DDCC. Both APS and DDCC check all design documents received against the transmittal letters. DDCC personnel fill out control register cards which list the document revision and applicable design change

documents, and issue design documents to engineering, construction and contractors in accordance with approved distribution matrices.

Daily Notification Lists (DNLs) are prepared each day from the transmittal letters showing the design documents received. A Field Revision Log (FRL), which is a computer listing, is updated from the DNLs and issued weekly. The DNLs and FRL list the approved unincorporated design change documents applicable to each design document. In general, the users of the design documents are responsible for referring to the FRL and DNLs to verify that the design documents they are using are the latest approved revisions and that they have reviewed all applicable design change documents.

(1) The audit and surveillance reports reviewed indicate that appropriate attributes of the document control system are being periodically verified. In particular, the control register cards are periodically verified against the transmittal letters, and the FRL is periodically verified against the control register cards.

(2) A total of about 150 design drawings were reviewed at two document stations, 7-ANPP and 7-PMS-AXX. The drawings were checked for signatures, date received stamp and control stamp, and legibility. The revision number of each drawing and the posting of Drawing Change Notices (DCNs) was checked against the FRL and DNLs. No discrepancies were observed.

(3) About 200 of the FCRs and DCNs listed in the FRL and DNLs against the design drawings were reviewed to verify that they were filed at the document stations, that they referenced the design drawing, that they were properly stamped, and that appropriate approval signatures were evident. The only discrepancies observed were a missing control stamp on ten Field Change Requests (FCRs) and a missing date stamp on one FCR (drawing 13-E-ZAC-036 at document station 7-ANPP).

(4) Also over 500 FCRs at the two document stations and the DDCC were reviewed for appropriate stamping and signatures. No discrepancies were observed. About 100 FCRs were selected, from the over 700 FCRs reviewed as part of the document control inspection, to be further reviewed in detail as part of the design change control inspection.

c. Conclusion

For the sample inspected, the distribution and control of design documents and design change documents is considered adequate.

2. Control of Design Change

The specific aspects of the control of changes to design inspected by the NRC CAT were the change control systems for DCNs and FCRs, and the implementation and verification of the changes.

a. Inspection Scope

(1) The following procedures relating to the control of design changes were reviewed:

- PVNGS Quality Program Procedure 3.1, "Design Procedures," Rev. 5, July 2, 1984.
- PVNGS Quality Program Procedure 3.5, "Design Verification," Rev. 4, July 2, 1984.
- PVNGS Quality Program Procedure 3.6, "Field Engineering," Rev. 2, May 29, 1979.
- PVNGS Quality Program Procedure 3.7, "Design Change Control," Rev. 4, January 31, 1984.
- Bechtel Engineering Department Procedure (EDP) 4.33, "On-Project Design Review," Rev. 0 Los Angeles Power Division (LAPD), August 25, 1975.
- Bechtel EDP 4.34, "Off-Project Design Review (Design Control Check List and Design Review Notice)," Rev. 4 LAPD, March 30, 1977.
- Bechtel EDP 4.37, "Design Calculations," Rev. 5, August 2, 1985.
- Bechtel EDP 4.46, "Project Drawings," Rev. 0, June 25, 1985.
- Bechtel EDP 4.47, "Drawing Change Notice," Rev. 0, August 1, 1984.
- Bechtel EDP 4.49, "Project Specifications," Rev. 7, November 27, 1984.
- Bechtel EDP 4.62, "Field Change Request (FCR)," Rev. 2 LAPD May 27, 1976.
- PVNGS WP/P 20.0, "Field Change Request," Rev. 22, August 20, 1985.
- PVNGS WP/P 22.0, "Design Change Packages," Rev. 17, September 25, 1985.
- ANPP IP 4.2, "Design Calculations," Rev. 18, November 8, 1985.
- ANPP IP 4.33, "As-Built Records," Rev. 7, April 24, 1984.
- ANPP IP 4.34, "Design Change Package," Rev. 16, October 1, 1985.

- ANPP IP 4.39, "Calculation Change Notice," Rev. 1, November 8, 1985.
- ANPP IP 5.14, "Field Change Request, Subcontractor Change Request, and Client Correction Suggestion," Rev. 13, September 18, 1985.
- ANPP IP 5.17, "Startup Field Reports and Startup Work Authorizations," Rev. 10, July 31, 1985.
- ANPP IP 5.27, "Engineering Evaluation Requests," Rev. 3, July 31, 1985.
- The Waldinger Corporation FWP 1.2-5, "Subcontractor Change Request," Rev. 1, February 12, 1980.
- The Waldinger Corporation FWP 1.2-7, "Field Changes," Rev. 6, October 12, 1984.

(2) The following Project QA audit and surveillance reports concerning design change were reviewed for findings, trends and corrective actions:

- Quality Assurance Audit Report, PVH-89/85-18, June 24, 1985.
- PVNGS Project QA Audit Report, 19-S-85-33, July 29, 1985.
- Quality Assurance Audit Report, PVH 5/85-26, October 4, 1985.

(3) Interviews were conducted with personnel from APS, Bechtel, Combustion Engineering (C-E) and The Waldinger Corporation concerning initiation (origination), review, approval and implementation of design changes.

b. Inspection Findings

Bechtel has about 200 people in their Resident Engineering (RE) site organization. The majority of the engineering and design personnel are engaged in resolving field problems by clarifying design documents and making design changes. In general, design changes are resolved and approved by RE personnel, but are sent to the Bechtel engineering office for final review and approval.

The contractors perform no engineering or design functions. However, some (i.e., The Waldinger Corporation) prepare supplementary drawings/sketches from Bechtel design drawings for use as aids in fabrication and construction.

Design changes at PVNGS are initiated or accomplished through a variety of procedural paths, such as Engineering Evaluation Requests (EERs), Startup Field Reports (SFRs), Startup Work Authorizations (SWAs), Subcontractor Change Requests (SCCRs), Client Correction Suggestions (CCSs), Field Change Notices (FCNs), Modification Change Notices (MCNs), Modification Change Requests (MCRs), Nonconformance

Reports (NCRs), Drawing Change Notices (DCNs), Specification Change Notices (SCNs), Field Change Requests (FCRs) and Design Change Packages (DCPs). In many cases, one type of design change form may be converted to another (e.g., an SFR can become an FCR, DCN, SCN or an NCR; and an FCR can become a DCN). As of January 16, 1986, roughly 60,000 FCRs applicable to PVNGS Unit 3 had been approved (assigned on FCR number).

Design changes for Palo Verde Unit 3 are accomplished mainly through FCRs and DCNs. Most of the design documents at PVNGS are applicable to all three units, and the design documents are generally not revised to reflect design changes peculiar to a single unit. Multi-unit changes generally affect items which have been turned over from construction to startup and test or operations organizations. These changes are processed under the configuration control system, and are generally handled as Design Change Packages (DCPs). This process subjects the changes to significantly more review than is normally given to single-unit FCRs.

(1) The audit and surveillance reports reviewed appeared to the NRC CAT inspector to concentrate on the procedural aspects of the design change control process, and did not generally probe technical aspects of specific changes. It is possible that technical audits are being performed and reported in documents not included in the scope of this inspection.

(2) Several minor procedural inconsistencies were identified:

- Exhibit A of IP 5.14 states that "home office" review and approval of FCRs will be documented by initials placed in Block 13 on the FCR. At present, initials and dates are being placed in the margin of the FCR form generally adjacent to Block 13.

- WP/P 20.0, Appendix I, Paragraphs B.1 and B.8 state that when the quality class of the item affected by the FCR is different than that designated on the design document (and thus specified in Block 2 of the FCR), the quality class of the item will be indicated in Block 8 or 9 of the FCR. This procedural requirement is generally not being followed (Procedure Change Notice 75 to WP/P 20.0, February 12, 1986 deleted this requirement).

- The originals of the FCRs, which are returned from the "home office" to DDCC at the site after review and approval, are generally not used in making copies for distribution.

(3) The justifications for approval of 11 FCRs (Table VII-1), which in general were partial calculations to be incorporated in an overall design calculation, were reviewed for adequacy, accuracy and adherence to applicable procedures. No discrepancies were observed.

(4) A physical verification was performed of the design changes prescribed in 12 FCRs related to various disciplines (Table VII-2). No discrepancies were observed.

Additional physical design changes were verified by NRC CAT inspectors as part of the various discipline-oriented inspections (Tables VII-3, VII-4). These design changes were included in the documents for the hardware which was inspected and were verified by inspection of the hardware. No discrepancies were observed.

(5) A number of minor documentation errors were identified in various FCRs in the group of approximately 100 picked for detailed review (Table VII-5). None of these discrepancies are considered to be significant.

(6) A number of the FCRs reviewed appeared to have an inadequate description of the reason (justification) for the change. As an example, FCR 91,977-M dated June 19, 1985, states in Block 8, "Existing Condition," that "Valves CH V093 & V095 are 3 inch plug valves, not 2" diaphragm." There is no mention that this change was made because the 2-inch diaphragm valves were not available (in the warehouse) and that the 3-inch plug valves were being acquired under the Non-Traditional Acquisition (NTA) program. Entry number 8 in Section B of Appendix I to WPP/P 20.0 states, "Enter a concise description of the existing condition. The FE shall indicate the justification for requesting the change...."

Corrective Action Report (CAR) No. CA-84-0351 dated April 22, 1985, states "In a sample of 100 FCRs, seven (7) were considered to have insufficient justification of change." The corrective action requires training, in which the trainees are to be told that "Individuals responsible for approval of FCRs and NCRs must assure that justification statements contain sufficient information to permit assessment by knowledgeable individuals of other organizations. Responsible individuals are requested to place increased emphasis on the adequacy and accuracy of justification statements." Evidently this training has not been completely successful.

In addition, there are no apparent procedural requirements for cross-referencing related FCRs (or FCRs and other design change documents), and such cross-referencing appears very infrequently. As an example, NCR RX-467 dated June 15, 1985, approves installation of a 3-inch plug valve as 3-PCHNV093 and incorporates DCN 112 to revise drawing 03-P-ZZG-015 Rev. 11, the Valve Designation List. FCRs 91,710-P and 91,977-M, dated June 19, 1985, were issued to revise the piping isometric drawing (ISO) and piping and instrumentation drawing (P&ID) respectively. Neither FCR referenced the NCR, DCN or each other.

(7) A large number (hundreds) of FCRs have been written and approved to attach auxiliary/supplemental steel to building structural beams to support fire protection piping. The FCRs are prepared by Construction Field Engineers, who design the supplementary steel. The FCRs are then reviewed and approved by Resident Engineering, at which time they can be used as the basis for fabrication and installation.

Documentation/justification of the design changes was requested for 13 FCRs related to supplementary steel for fire protection piping (Table VII-6), and was provided for only 2 FCRs. The NRC CAT inspectors were informed that no explicit documentation existed for the other 11 FCRs, but that their design was covered by a generic calculation.

The NRC CAT inspectors requested and received, from the Bechtel "home office", a copy of part of the generic calculation (Calc. No. 13-CC-ZS-035). This calculation was reviewed and determined to be technically adequate, although one minor arithmetic error was observed and brought to the attention of Bechtel personnel. However, the FCRs in question are not explicitly identified in the calculation, and the calculation is not referenced on the FCRs.

The NRC CAT inspectors determined that the Construction Field Engineer preparing the FCRs has no written guidance specific to this task, and does not have access to or use the generic calculation. The Resident Engineering personnel, who review and approve the FCRs, have no specific written guidance and do not have access to or use the generic calculation. The "home office" engineering personnel who provide final review and approval of the FCRs have no specific written guidance, but do have access to the generic calculation.

The system used at PVNGS in making design changes for adding supplementary steel to support Viking fire protection piping makes it impossible to verify the steps taken in design, checking, and approval of the design changes except through the memory of the participants. A similar lack of documented, auditable justification for a design change is identified in Section III.B.2.b of this report regarding pipe support connections to structural steel. The NRC CAT inspectors do acknowledge that signatures and initials are evident on the FCRs sampled which signify that the design changes were performed and reviewed in accordance with applicable PVNGS procedures.

The NRC CAT inspectors believe that the process of making numerous design changes without any written guidance or explicit documentation of the basis for the design changes does not meet the intent of ANSI N45.2.11-1974 for auditability of the design process.

(8) Several instances were identified in which a design change was made and referenced to a specific design document without changes being made to other affected design documents.

- FCRs 91,977-M and 91,948-P were generated to revise the Piping and Instrumentation Drawing (P&ID) and Valve Designation List (VDL) in order to change valve 3-PCHNV095 from a 2-inch diaphram valve to a 3-inch plug valve. No design change document making a valve size change to the piping isometric drawing (ISO) was identified. A 2-inch diaphram valve was finally installed (apparently to the original requirements as still shown on the ISO). No procedural controls could be identified which would void these FCRs and thus return the other design documents (P&ID and VDL) to their original configuration (NCR PA-12187, February 6, 1986, was issued to identify that a discrepancy existed between the installed valve and FCR 91,977-M. FCRs 97,729-P and 97,730-M, February 10, 1986, were issued to revise the VDL and P&ID).

- FCR 64,608-M should have been voided, based on FCR 66,768-P which voided an FCR with the same change as FCR 64,608-M (SFR 3CH-153, February 11, 1986 voided FCR 64,608-M).

- Construction NCR PA-10420 replaced valve 3PCHV337 (2-inch gate valve) with a 2-inch globe valve (note that engineering approval for this design change was accomplished through the NCR). The work listed on the NCR was signed off as complete on July 26, 1985. Startup Field Request (SFR) 3CH-128 was written on January 8, 1986, indicating the globe valve was not what it should be. This SFR was dispositioned as a clarification which stated that the globe valve was correct, but at the same time this SFR changed the valve designation list. On January 30, 1986, FCR 97,618-M was written to change the P&ID and on February 3, 1986, FCR 97,558-P was written to change the ISO. There was a four to five month delay in changing design documents to match the field-installed valve.

Bechtel EDP 4.62 Rev. 2 Section 3.1.d.1 reads, "...and initiate revisions to the affected documents as necessary." Section 3.1.g.3 reads, "Coordinate the FCR with other affected disciplines as deemed necessary." A similar statement is in Section 3.2.b of EDP 4.47 Rev. 0 for DCNs. These were the only statements identifying the nature of the required reviews of FCRs/DCNs for consistency of FCR development to cover all affected documents when one document is changed.

c. Conclusion

For the sample inspected, the control of design changes is generally adequate. However, additional attention should be given to documentation of the basis for design changes and coordination of design changes to assure all affected design documents are also changed.

TABLE VII-1

FCRS FOR WHICH JUSTIFICATION WAS REVIEWED

FCR Number/Date	Calculation	Subject
91,162-C, 5/30/85	13-CC-ZM-260	Notch structural beam
91,615-C, 6/12/85	----	Notch structural beam
77,321-E, 3/21/84	13-CC-ZS-006	Add tray braces
66,704-E, 7/12/83	13-CC-ZS-006	Modify tray hangers
93,205-E, 6/12/85	13-CC-ZS-013	Modify tray hangers
89,156-P, 3/29/85	13-CC-ZS-014	Modify HVAC hangers
91,421-P, 6/6/85	13-CC-ZS-014	Accept welds on HVAC hangers
87,386-E, 12/27/84	13-CC-ZS-013	Add supplementary steel
90,793-C, 5/6/85	13-CC-ZC-019	Notch platform
84,333-C, 9/19/84	13-CC-ZS-035	Add supplementary steel
93,206-E, 6/12/85	13-CC-ZS-013	Attach conduit supports to tray

TABLE VII-2

DESIGN CHANGES VERIFIED BY PHYSICAL INSPECTION

FCR Number/Date	Subject
77,321-E, 3/21/84	Longitudinal tray braces
84,677-C, 10/15/84	Screens on recirculation sumps
64,442-C, 6/29/83	Core drill for embedded conduits
91,162-C, 5/30/85	Cope beam for valve thermal movement
91,615-C, 6/12/85	Cope beam for valve thermal movement
89,527-P, 4/11/85	Valves with socket weld end preps
89,528-P, 4/11/85	Valves with socket weld end preps
96,018-P, 10/22/85	Instrument sense line
95,756-J, 10/25/85	Instrument sense line
93,206-E, 6/12/85	Electrical conduit supports
91,977-M, 6/19/85	Change 2" diaphragm to 3" plug valve
96,822-P, 11/4/85	Valve type change on P&ID

TABLE VII-3

DESIGN CHANGES VERIFIED BY PHYSICAL INSPECTION

MECHANICAL DISCIPLINE

Piping Isometric	FCR	MCR	DCN
13-P-AFF-133, Rev. 16	52,462-P 54,705-P 81,112-P		
13-P-CHF-109, Rev. 13	58,629-P 69,327-P 63,236-P 93,332-P 29,853-P 67,239-P		
13-P-CHF-207, Rev. 14	2,431-P		
13-P-EWF-201, Rev. 13	14,325-P 59,595-P 74,884-P 75,137-P 81,505-P		
13-P-PCF-501, Rev. 18	88,103-P 84,427-P		
13-P-RCF-102, Rev. 13	1,791-W		23
13-P-SGF-119, Rev. 14	6,090-P		
13-P-SIF-103, Rev. 17	87,465-P 94,875-P 97,044-P 16,640-P 73,938-P 79,943-P	64,163-P 64,162-P	26
13-P-SIF-207, Rev. 20	97,194-P 96,867-P 96,690-P 93,423-P 76,853-P 68,941-P 65,292-P 12,651-P		

TABLE VII-3 (Continued)

DESIGN CHANGES VERIFIED BY PHYSICAL INSPECTION

MECHANICAL DISCIPLINE

HVAC Drawing	SCN	DCN	WCN
13-P-ZJC-301	10407-13-MM-598		
TWC-102-L1-11, Rev. 0 (13-C-00C-032, Rev. 4)		2	
TWC-202-32T-230, Rev. 2			4:202C-5/III

TABLE VII-3 (Continued)

DESIGN CHANGES VERIFIED BY PHYSICAL INSPECTION

MECHANICAL DISCIPLINE

Support/Restraint	FCR	MCN
SI-130-H-002	87,565-P 90,411-P	
NC-087-H-021		57,309-H
SI-075-H-00D	91,370-P	
RC-017-H-028	81,800-P 89,001-P	
SG-002-H-011	93,732-P 93,417-P 59,857-P	
RC-062-H-036	62,563-P	
AF-011-H-001	87,913-P 91,625-P 79,789-P	
EW-082-H-003		57,164-H
AF-020-H-002	9,592-P	
SI-202-H-017	48,804-P	57,661-H
AF-031-H-001	89,776-P	
RC-062-H-020	79,552-P	57,387-H
RC-091-H-00E	81,396-P 89,784-P	57,600-H
SI-002-H-001	94,422-P	59,057-H 59,043-H 59,039-H
SG-002-H-014	58,840-P 81,708-P 90,157-P 16,859-P	
NC-126-H-004	83,618-P	
RC-028-H-001		57,166-H 57,692-H

TABLE VII-3 (Continued)

DESIGN CHANGES VERIFIED BY PHYSICAL INSPECTION

MECHANICAL DISCIPLINE

Support/Restraint	FCR	MCN
RC-002-H-028	88,045-P	
SG-005-H-006	89,994-P 4,471-P	
NC-120-H-004	21,205-P	
EW-EWB-H-001	91,011-P	
NC-136-H-005	10,353-P	
RC-006-H-013	90,323-P 93,759-P 93,026-P	
SI-007-H-002	83,007-P 71,578-P	
AF-020-H-002	9,592-P	
SG-002-H-014	58,840-P 81,708-P 90,157-P 16,859-P	

TABLE VII-4

DESIGN CHANGES VERIFIED BY PHYSICAL INSPECTION

ELECTRICAL AND INSTRUMENTATION DISCIPLINE

Document Number	Subject
DCP 3CE-PH038	Motor space heaters
DCP 3CJ-RM011	Main control boards mounting
DCP 3CJ-SI314	Valve operators
FCN 63,476-P	MOV wiring
FCR 11,415-N	Instrument rack mounting
FCR 27,741-E	Cable
FCR 40,441-C	Raceway
FCR 41,768-E	Raceway
FCR 46,598-E	Raceway
FCR 55,778-N	Instrument rack mounting
FCR 72,990-J	Instrument tubing
FCR 75,026-J	Instrument tubing
FCR 75,027-J	Instrument tubing
FCR 80,631-E	Circuit breakers
FCR 82,832-E	Equipment mounting
FCR 94,804-J	Instrument tubing
FCR 95,187-E	Conduit fittings
FCR 95,756-J	Instrument tubing
FCR 95,786-J	Instrument tubing
FCR 96,513-J	Instrument tubing
FCR 96,575-J	Instrument tubing
FCR 96,998-J	Instrument tubing
FCR 97,656-N	Equipment mounting

TABLE VII-5

DOCUMENTATION ERRORS ON FCRs

FCR Number/Date	Description of Discrepancy
89,528-P, April 11, 1985	Vent valve incorrectly numbered; is V853, should be V833. Corrected by SFR 3SI-087, February 11, 1986 (FCR 97,727-P).
91,162-C, May 30, 1985	"Home Office" initials dated June 22, 1985, which preceeds date (August 2, 1985) of supporting calculation 13-CC-ZM-260, Sheet 62C of 86.
91,990-C, June 14, 1985	No date with "home office" initials.
80,829-P, June 11, 1984	Neither "Engineer" or "Supplier" is checked in Block 6 of FCR (see requirement WP/P-20.0, Appendix I, Paragraph B.1, Entry 6).
74,714-C, January 16, 1984	FCR references FCR 44,274-C, should be 44,271-C. Corrected by FCR 97,660-C, February 6, 1986.
96,000-P, November 8, 1985	"Supplier" name is missing in Block 6 of FCR (see requirement WP/P-20.0, Appendix I, Paragraph B.1, Entry 6).
95,822-P, November 4, 1985	References valve 3-P-DFN-V086, should be 3-P-DFB-V086 (per VDL and tag on valve).

TABLE VII-6

FCRs FOR SUPPLEMENTARY STEEL

87,386-E*	December 27, 1984
91,990-C	June 14, 1985
84,811-C	October 20, 1984
86,641-C	December 27, 1984
79,601-C	May 11, 1984
89,879-C	April 20, 1985
94,975-C	September 4, 1985
82,964-C	August 15, 1984
84,103-C	September 20, 1984
57,182-C	March 4, 1983
88,902-C	March 23, 1985
88,901-E	March 25, 1985
84,333-C*	September 19, 1984

*Calculations were available for these FCRs (see Table VII-1).

VIII. CORRECTIVE ACTION SYSTEMS

A. Objective

The objective of this portion of the inspection was to verify that effective measures had been established and were being implemented to assure that nonconformances and other conditions adverse to quality are promptly identified and corrected.

B. Discussion

An examination was made of the licensee's program for identification and control of situations and events which require corrective action. The examination included review of procedures and documents, and followup verifications that identified corrective actions had been accomplished in the plant. Items which formed the bases for the review were:

- Procedures and organizational interfaces
- Audit and surveillance reports
- Nonconformance reports
- Corrective action requests
- Trend analyses
- Deficiency evaluation reports
- Control of material and equipment corrections in the plant

Table VIII-1, "Corrective Action Samples," contains a list of samples that were randomly selected.

The applicable portions of the following procedures pertaining to corrective action were reviewed and provided the acceptance criteria for this examination:

Arizona Public Service Company (APS)

Quality Assurance Manual Directives (QAD)

QAD 15.0, "Nonconforming Materials, Parts and Components."

QAD 16.0, "Corrective Action."

QAD 18.0, "Audits."

Administrative Policies and Procedures

Procedure 6N417.18.00, "Review of Conditions Adverse to Quality for 10 CFR 50.55(E)/10 CFR 21."

Bechtel Power Corporation (Bechtel) (QADP)

Quality Assurance Department Procedures

QADP 7.7, "Handling of Significant Reportable Deficiencies."

QADP 7.10, "Corrective Action."

QADP 7.11, "Project Quality Assurance Surveillance and Corrective Action Reverification."

QADP 7.19, "Quality Trending System."

Project Quality Program Manual (PQP)

PQP 7.0, "Control of Purchases Material, Equipment and Services."

PQP 7.4, "Supplier Audits."

PQP 15.0, "Nonconforming Materials, Parts and Components."

PQP 16.0, "Corrective Action."

PQP 16.1, "Processing Deficiency Evaluation Reports (10 CFR 50.55(E))."

PQP 16.2, "Processing Deficiency Evaluation Reports (10 CFR 21)."

PQP 18.0, "Audits."

PQP 18.7, "Quality Trend Reporting."

1. Corrective Action

a. Inspection Scope

A review was performed of applicable portions of project Quality Assurance (QA) manuals and procedures, and in addition a total of 287 samples of corrective action documents were reviewed. Also, six material/equipment samples in the plant were examined for verification of satisfactory accomplishment of identified corrective action. Table VIII-1, "Corrective Action Samples," lists the number and type of items upon which this evaluation was based.

b. Inspection Findings

The following observations were made by the NRC CAT inspector:

(1) The licensee's corrective action system appears to be well structured and the procedures appear to be comprehensive and thorough. Also, the personnel to whom corrective action requirements are directed appear to be cooperative, based on the identified corrective action and the timeliness of the response to the problem(s).

(2) Nonconformance Reports (NCRs) are issued by Quality Control (QC) inspectors for items or conditions which do not meet specified requirements. The licensee's records show that 5,548 NCRs were issued in 1985. Each NCR on its day of issue is reviewed for 10 CFR 50.55(e) or 10 CFR 21 reportability by a Resident Engineering representative and a Quality Assurance supervisor. If that initial review concludes that the condition may be reportable, a Deficiency Evaluation Report (DER) is

initiated for in-depth engineering evaluation. Each DER is analyzed for "root cause," and remedial action to correct the nonconforming condition and corrective action to prevent recurrence is identified. Remedial work is normally accomplished through issuance of a Procedure Change Notice (PCN) or a Design Change Package (DCP). Followup and closeout of each DER is accomplished by a special Quality Assurance group that is specifically dedicated to that function. The licensee's records show that 88 DERs were issued in 1983, 106 issued in 1984, and 44 issued in 1985. To evaluate the licensee's reportability decisions, the inspector reviewed 20 of the 58 DERs judged not reportable in 1984 and all 27 of the not reportable DERs from 1985. In all cases, the licensee's decision appeared to be logical and reasonable.

(3) The licensee's audit program also appears to be well developed and well organized. Audits are pre-planned through the use of a checklist which requires the auditor to review the previous audit report covering the area to be audited, previously issued Corrective Action Requests (CARs) in that area, and the DER log for problems that may have been identified in the subject area since the last audit was performed. The audit program has a large indexed file of "cookbook" audit checklists for all areas that are routinely audited. A standard Audit Data Collection Sheet is utilized by each auditor for recording observations. Each adverse finding is formally documented on a CAR. During 1985, there were 58 QA audits performed at the Palo Verde site. The reports of 16 of those audits were reviewed by the inspector. All were detailed and comprehensive.

(4) Surveillances are also performed on a scheduled basis but on a less formalized approach than audits. Surveillances are also documented and adverse findings are similarly written up as CARs. The inspector reviewed the reports of 25 surveillances related to construction activities at the site during 1985. For comparison purposes, a tabulation of surveillances performed in the construction related areas during 1985 is shown below:

Discipline	Surveillances	CARs Issued
Construction	375	25
Sub-Contracts	254	6
DER Reverification	508	4
TOTALS	1137	35

(5) The CAR is one of the basic vehicles in the licensee's corrective action system. The CAR form is arranged to record all relevant data and information, including a description of the apparent problem, the requirement that was violated, the corrective action identified by the offender and its acceptance by the originator of the CAR, and the date of the closeout inspection as well as the various required signatures. The licensee has recently developed a CAR Aging Report, updated monthly, to display progress being made in the closeout of open

CARs. The CARs reviewed by the inspector appeared to be written in an understandable manner in accordance with the governing procedures.

(6) The licensee's corrective action program includes a Quality Trending System intended to provide quality trends and quality status indicators that will "identify problems having an adverse impact on safety, quality, cost, or schedule." The trending system, on a monthly basis, examines and evaluates all NCRs, CARs, DERs, and SDDRs that were issued during the previous month. A standard Trend Evaluation Worksheet is used for the analyses. A CAR is issued for each trend that is identified, and the trend status information is included in the various monthly status reports. The inspector reviewed Bechtel's trend evaluation of all NCRs issued in 1985. It was noted that from that effort 13 CARs were issued.

(7) As a result of the relatively large number of discrepancies identified by the NRC Regional CAT inspection in September 1983, particularly in pipe hanger welding, the licensee incorporated a Corrective Action Reverification process in their QA program. The process consists of reverifying the effectiveness of previous corrective action taken for selected quality problems which were: (a) serious enough to have been reported to the NRC, (b) have a history of recurrence, or (c) supplier problems that could be common to other suppliers. The reverification activity got underway in February 1984 using surveillances performed on a monthly basis on accepted pipe hanger work. The program was subsequently expanded to other areas and follows a formal schedule for periodic surveillances. The NRC CAT inspector reviewed the effectiveness of the program by examining the reverification surveillances in the pipe hanger area since February 1984. The surveillances have been routinely performed as scheduled and 4 CARs have been issued from that effort through 1985. From the inspector's review of the log of the other surveillances performed in the program, it appeared that the efforts were producing beneficial results.

(8) The NRC CAT inspector reviewed copies of typical QA reports that are directed to senior supervisory and management personnel. The nature and thrust of these monthly and semi-annual documents can be reduced by referring to their titles as shown in Table VIII-1. It appeared to the NRC CAT inspector from the review of those reports that they contain sufficient information to enable project management to keep abreast of problems and their handling, and to take appropriate action whenever and wherever it may be warranted.

c. Conclusions

This inspection effort concluded that the licensee's corrective action program is founded on a sound philosophy with a low threshold for initiating action. The implementing procedures appear to be well thought out and are understood and utilized by the personnel involved. The sample reviewed by the NRC CAT inspector disclosed

that the program is dynamic and well supported by the personnel implementing it.

TABLE VIII-1

CORRECTIVE ACTION SAMPLES

ITEMS	QUANTITY EXAMINED
Audit Reports	16
Surveillance Reports	25
Nonconformance Reports	65
Corrective Action Requests	70
Corrective Action Requests Aging Report	1
Monthly Quality Indicator Trend Reports	12
Deficiency Evaluation Reports	47
Supplier Deviation Disposition Requests	20
Stop Work Notices	15
Bechtel QA Manager's Monthly Reports	12
*APPS Monthly Quality Monitoring Effectiveness Reports	1
*APS Corrective Action Document Monthly Status Reports	1
**APS Corporate QA/QC Monthly Status Reports	1
***APS Corporate QA Department Semi-Annual Quality Assurance Report (01/01/85 to 06/30/85)	1
TOTAL	287

*Covers all activities at the Palo Verde site, including operations, maintenance, startup, plant services, etc.

**Summary report issued by Corporate QA Director to APS senior management and supervisors.

***Issued by Corporate QA Director to APS Corporate Executives.

A. PERSONS CONTACTED

The following list identifies licensee, architect-engineer and contractor representatives and NRC personnel present at the exit meeting, and licensee discipline coordinators and key individuals contacted during the inspection for each area.

1. Exit Meeting (February 14, 1986)

Arizona Nuclear Power Project

J. Bynum
R. Butler
D. Canady
D. Fasnacht
J. Haynes
W. Ide
J. Kirby
S. Penick
C. Russo
T. Shriver
E. Van Brunt

Bechtel Power Corporation

W. Bingham
H. Foster
D. Hawkinson
G. Hierzer
J. Houchen
C. Lacey

Combustion-Engineering, Inc.

C. Ferguson
V. Krecicki

El-Paso Electric Co.

R. Waugh

NRC and Consultants

J. Ball
S. Baron
R. Compton
D. Ford
G. Georgiev
R. Heishman
G. Hernandez
K. Hooks
O. Mallon
W. Marini
E. Martindale
T. McLellan
L. Miller
J. Nemoto
W. Sperko
S. Stein
L. Vorderbrueggen
H. Wong
P. Wu
R. Zimmerman

2. Licensee Coordinators and Contacts

Area	Contact
Team Leader	C. Russo S. Penick
Electrical and Instrumentation	W. Montefour B. Churchill B. Stone

Mechanical	K. Daley B. Queen J. Jackson
Welding and NDE	B. Love P. Moore J. Bayless H. Green S. Mehta
Civil and Structural	D. LeBoeuf E. Dutton
Material Traceability/Corrective Action Systems	B. Hegedus
Design Change Controls	D. Webster

In addition to the above personnel, numerous other inspectors, engineers and supervisors were also contacted.

B. DOCUMENTS REVIEWED

The types of documents listed below were reviewed by the NRC CAT members to the extent necessary to satisfy the inspection objectives stated in Section I of this report. There are additional references within the body of the report to specific procedures, instructions, specifications and drawings.

1. Final Safety Analysis Report and Safety Evaluation Report
2. Quality Assurance manual
3. Quality Assurance procedures and instructions
4. Quality Control procedures and instructions
5. Administrative procedures
6. General electrical installation procedures and specifications
7. General instrumentation installation procedures and specifications
8. General piping and pipe support installation procedures and specifications
9. General mechanical equipment installation procedures and specifications
10. General concrete specifications
11. As-built drawings

12. Welding and NDE procedures
13. Personnel qualification records
14. Material traceability procedures
15. Procedures for processing design changes
16. Procedures for document control
17. Procedures for controlling as-built drawings
18. Procedures for processing nonconformances

ATTACHMENT B

GLOSSARY OF ABBREVIATIONS

ACI - American Concrete Institute
A-E - Architect-Engineer
AISC - American Institute of Steel Construction
ANSI - American National Standards Institute
ANPP - Arizona Nuclear Power Project
APS - Arizona Public Service
ASME - American Society of Mechanical Engineers
ASTM - American Society for Testing and Materials
AWG - American Wire Gauge
AWS - American Welding Society
Bechtel - Bechtel Power Corporation
CAR - Corrective Action Report
CAT - Construction Appraisal Team (NRC)
C of C - Certificate of Conformance
CCS - Client Correction Suggestions
C-E - Combustion Engineering, Inc.
CMTR - Certified Material Test Report
CV - Charpy V Notch Test
DC - direct current
DCN - Design Change Notice
DCP - Design Change Package
DDCC - Design Document Control Center
DER - Deficiency Evaluation Report
DG - diesel generator
DNL - Daily Notification List
EDP - Engineering Department Procedure
EER - Engineering Evaluation Request
FCN - Field Change Notice
FCR - Field Change Request
FRL - Field Revision Log
FSAR - Final Safety Analysis Report
HAZ - heat affected zone
HVAC - heating, ventilating and air conditioning
IE - Office of Inspection and Enforcement (NRC)
IEEE - Institute of Electrical and Electronic Engineers
IP - inspection procedure
IPCEA - Insulated Power Cable Engineers Association
MAC - Maintenance Activity Cards
MCM - thousand circular mils
MCN - Modification Change Notice
MCR - Modification Change Request
MOV - Motor Operated Valve
MSSS - Main Steam Support Structure
MT - Magnetic Particle Examination
NCR - Nonconformance Report
NDE - Nondestructive Examination
NEMA - National Electric Manufacturers Association
NRR - Office of Nuclear Reactor Regulation (NRC)

NRC - U.S. Nuclear Regulatory Commission
NSSS - Nuclear Steam Supply System
P&ID - Piping and Instrumentation Drawing
PQP - Project Quality Program Manual
PQR - Procedure Qualification Test Records
PSAR - Preliminary Safety Evaluation Report
PSE - Preservice Examination
PT - Liquid Penetrant Examination
PVNGS - Palo Verde Nuclear Generating Station
PWHT - Post Weld Heat Treatment
QA - Quality Assurance
QAD - Quality Assurance Manual Directives
QADP - Quality Assurance Department Procedures
QC - Quality Control
QCE - Quality Control Engineer
QCI - Quality Control Instruction
QSPDS - Qualified Safety Parameter Display System
RE - Resident Engineer
RG - Regulatory Guide (NRC)
SAR - Safety Analysis Report
SCCR - Subcontractor Change Request
SCIP - Special Construction Inspection Plan
SFR - Startup Field Report
SWA - Startup Work Authorization
TWC - The Waldinger Corporation
UBC - Uniform Building Code
UT - Ultrasonic Examination
V - volt
VDL - Valve Designation List
WP - Work Procedure
WPP - Work Plan Procedure
WPS - Welding Procedure Specification