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Facility Name: Millstone Nuclear Power Station, Unit 3

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I. INSPECTION SCOPE AND OBJECTIVES

The objective of this inspection was to evaluate the adequacy of construction at the Millstone Nuclear Power Station, Unit 3. 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. In addition, the scope and significance of identified problems were 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?
- Are systems turned over to the startup organization in operable condition and are they being properly maintained?

II. ELECTRICAL AND INSTRUMENTATION CONSTRUCTION

A. Objective

The primary objective of the appraisal of electrical and instrumentation construction was to determine whether components and systems were installed in accordance with regulatory requirements, Safety Analysis Report (SAR) 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 electric cable, raceways, raceway supports, electrical equipment, and instrumentation 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 licensee and Stone & Webster Engineering Corporation (SWEC) as a result of observations made by the NRC Construction Appraisal Team (CAT) inspectors during electrical and instrumentation inspection. Several are referenced in this report and are listed in Table II-1.

1. Electrical Raceway Installation

a. Inspection Scope

Fifty-two segments of installed Class 1E cable tray, representing a total length of about 1,300 feet, were selected from various plant areas for detailed examination by the NRC CAT. These segments were inspected for comp iance 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 1,200 feet, were inspected for compliance to specified requirements such as routing, location, separation, bend radii, support spacing and associated fittings.

A sample of nine raceways (five conduits and four cable tray sections) were selected by the NRC CAT inspectors for comparison of the actual quantity of cables installed with the quantity specified to be present by the SWEC computerized system of scheduling and routing cables, known as the "ECSIS Program."

Over 20 raceway supports were examined in detail for such items as location, material, type, size, anchor spacing, weld quality, bolt torque and installed configuration.

Fifty-two concrete expansion anchors associated with Seismic Category I conduit supports were inspected in detail for compliance with requirements relating to embedded depth, plumbness, spacing and thread engagement. The anchors selected were of various sizes and from several locations in the facility. A calibrated torque wrench was used to determine whether appropriate torque had been applied during installation to ensure proper setting of the wedges, and ultrasonic test equipment was used to determine embedded depth.

See Table II-2 for a listing of cable tray, conduit, concrete anchors and raceway support samples.

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

- SWEC Quality Control Instruction FM3-D10.18-01B, "Seismic Conduit Support, Conduit and Cable Tray Installation."
- SWEC Quality Control Instruction FM3-D10.18-02A, "Cable Tray and Support Installation."
- SWEC Quality Control Instruction FM3-D10.18-040, "Raceway and Cable Separation Inspection."
- SWEC Quality Control Instruction FM3-D10.18-030, "Non-Seismic Field Run Conduit Inspections."
- SWEC Field Construction Procedure 299, "Installation of Drilled-In Expansion Type Concrete Anchors," Rev. 1
- SWEC Specification M924, "Drilled-In Expansion Type Concrete Anchors
- SWEC Specification 2400.000-350, "Electrical Installation," Rev. 7.

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. Important quality attributes such as material type, location, identification and installed configuration were found to be as shown on approved construction drawings. However, several construction deficiencies were identified and are discussed below.

(1) Raceway Separation

The Millstone Unit 3 Final Safety Analysis Report (FSAR) Section 8.3.1.4 "Physical Independence of Redundant Systems" provides the basic criteria for acceptable raceway and cable installations. This section describes requirements for physical arrangement of raceways pertaining to the requirements of Regulatory Guide (RG) 1.75 for independence of redundant systems.

In general, these FSAR criteria specify the physical separation that must be maintained between components of redundant electrical divisions. Additionally, separation is required between components performing Class 1E and Non-Class 1E functions.

The NRC CAT examination of the selected raceway sample disclosed numerous installations where the required physical separation had not been maintained. Many of the identified discrepancies were observed between Class 1E and Non-Class 1E raceway components.

These deficiencies were discussed with the licensee and SWEC personnel. The discussions disclosed that in a number of areas the licensee recently has elected to reassess current commitments to RG 1.75 and establish through test and analysis that lesser degrees of physical separation are acceptable. Justification for this approach is detailed in Section 5.1.1.2 of IEEE Standard 384-1974 which states..."In those areas where the damage potential is limited to failures or faults internal to the electrical equipment or circuits, the minimum separation distance can be established by analysis...."

In connection with physical separation criteria, the NRC CAT inspectors reviewed Engineering Service Scope of Work (ESSOW) No. 2412.000-732. This document established the testing required to demonstrate the acceptability of lesser separation and the use of barriers in lieu of distance to meet physical separation requirements. In general, the objective of the test was to demonstrate that a single enclosure is adequate between Class 1E and Non-Class 1E cable. Additionally, for cable dropouts and perpendicular raceway crossings, a spatial distance of one inch is acceptable instead of the six inches currently required. Several other criteria changes would be implemented based upon successful completion of the test program. In some installations, one barrier would be used instead of the two currently required and for certain conduit installations a minimum of 0.125 inch spatial separation would be allowed. Copies of this document have been provided to the NRC Office of Nuclear Reactor Regulation (NRR) for licensing review.

NRC CAT inspectors also reviewed Engineering Design Coordination Report (E&DCR) FE-40530 which was issued to implement separation criteria changes to the electrical specification based upon preliminary test results provided by Wyle Laboratories. In effect this E&DCR permits many of the separation deficiencies observed by the NRC CAT inspectors. However, this design change is not consistent with current FSAR requirements and thus the status of this issue is considered open pending NRR review of test results and applicable FSAR changes. NRC Region I is aware of this situation and their review of this matter is continuing.

In connection with this issue NRC CAT inspectors also noted that a program to identify and physically tag raceway and cable components requiring installation of fire barriers had been implemented by SWEC personnel. A review of this program indicates that sufficient procedural controls exist to assure that required barriers will be installed and inspected.

(2) Electrical Conduit

The conduit sample inspected conformed to applicable design and installation requirements relative to such attributes as size, routing, identification and supports. Conformance to separation requirements are discussed in Section II.B.1.b.(1), Raceway Separation, above.

(3) Raceway Supports

The examination of raceway supports was accomplished for both conduit and cable tray applications. In general, attributes such as location, material type and size, anchor spacing, welds (location, size and general quality), and installed configuration were found to be in accordance with design requirements. No construction deficiencies were identified in this area.

(4) Concrete Anchors

In the area of concrete expansion anchor installation, most of the anchors inspected were properly installed. However, two isolated discrepancies were identified. Concrete spalling was observed in the vicinity of the lower right anchor behind the attachment plate of conduit support CS-550. As a result of this observation, SWEC QA Inspection Report E5A0 1210 and Nonconformance and Disposition Report (N&D) 11542 were issued to document and disposition this matter. The second discrepancy pertained to anchor location. The top anchor in conduit support ES-1227 was one and three-fourths inches from an embedded plate. Specification 2199.142-924 requires a minimum of six inches from a half-inch anchor to an embedded plate. As a result of this finding, Inspection Report E5A01873 was issued to document this condition.

(5) Raceway Fill

Of the nine raceways selected to determine whether the specified number of cables matched those actually installed, eight raceways contained the quantity specified by the computerized program (ECSIS) used to schedule and route cables. In one raceway, cable tray 3TC4100, 154 cables were physically in the tray, but ECSIS could account for only 150. In order to reconcile this difference it was necessary for the SWEC Site Engineering Group (SEG) to review additional information not presently contained within ECSIS. This additional information was in the form of "Advance Cable Pull Tickets." An Advance Cable Pull Ticket is one manually generated by SEG, issued to

construction for installation, and incorporated into ECSIS at a later date. Although a rather lengthy review of many unincorporated Advance Cable Pull Tickets were involved, the installed quantity of 154 cables in tray 3TC4100 was justified. However, it should be noted that the full intent of the ECSIS program to schedule and route cables cannot always be accomplished properly when many (currently about 300) Advance Cable Pull Tickets are not incorporated into the ECSIS program in a timely manner. It was noted that the Advance Cable Pull Ticket for cable 3MSSAOC043 had been in existence since May 1983 without being incorporated into the ECSIS program.

c. Conclusions

Except as noted, raceway systems have been installed in accordance with applicable design and installation requirements.

Physical separation criteria detailed in the licensee's FSAR have not been maintained in many raceway installations. However, preliminary discussions with NRR and the results of testing indicate that lesser separation may be acceptable. This matter remains open pending NRC final review and evaluation.

2. Electric Cable Installation

a. Inspection Scope

The NRC CAT inspectors selected a sample of installed Class 1E cable runs that had been previously accepted by SWEC Field Quality Control (FQC) inspectors. The sample included high voltage, power, control and instrumentation cables. For each of the cable runs, physical inspection was made to ascertain compliance with applicable design criteria relative to size, type, location/routing, bend radii, protection, separation, identification and support.

Additionally, the NRC CAT inspectors selected approximately 400 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 high voltage and power cables, totaling about 1,600 feet, were selected from different systems, electrical trains and locations:

Cable	Type
3SIHBPH350	3 conductor 4 AWG 4.16KV
3RHSAOH350	3 conductor 4 AWG 4.16KV
3EJBAOK610	2 conductor 8 AWG 125V DC
3HVCAOK075	3 conductor 12 AWG 480V
3RHSNOK001	3 conductor 12 AWG 480V
3SIHNOK095	3 conductor 12 AWG 480V

The following control cables, totaling approximately 1,100 feet, were selected from different systems, electrical trains and locations:

Cable	Type
3EGPBPG455	4 conductor 12 AWG 120V
3ENSAOC453	2 conductor 14 AWG 120V
3GSNNOC602	2 conductor 14 AWG 125V DC
3RCSAPC702	2 conductor 14 AWG 125V DC
3RHSAOC034	2 conductor 12 AWG 120V
3RHSAPC910	5 conductor 10 AWG 125V DC
3SIHAOC005	7 conductor 12 AWG 120V
3SIHBPC010	7 conductor 10 AWG 120V

The following instrument cables, totaling approximately 1,200 feet, were selected from different systems, electrical trains and locations:

Cable	Type
3NMIAOX800	2 conductor 16 AWG
3RPSAOX821	2 conductor 16 AWG
3RPSBPX800	2 conductor 16 AWG
3SIHAOX830	2 conductor 16 AWG
3SIL2PX802	16 Tw/pair 18 AWG
3SIL1OX802	16 Tw/pair 18 AWG

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

- SWEC Quality Assurance Directive QAD-10.18ML, "Raceway and Cable Installation Inspections," Rev. 0
- SWEC Quality Assurance Directive QAD-10.17ML, "Cable Termination and Connection Inspections," Rev. B
- SWEC Quality Control Instruction FM3-D10.18-03A, "Raceway and Cable Separation Inspection"
- SWEC Field Construction Procedure 330, "Installation of Cable In Ducts, Conduits or Trays," Rev. 1
- Northeast Nuclear Energy Co., Millstone Unit 3, "Startup Manual," Rev. 3

b. Inspection Findings

(1) Routing

In general, the routing of Class 1E cables through design designated raceway systems was found to be in accordance with specified criteria. A discrepancy was noted in the routing of cable 3HVCAOK075. The pull ticket issued for this cable shows a "From" destination of cubicle 3M in Motor Control Center 3EHS*MCC1A2. However, the actual routing of the cable is to cubicle 2H of the same Motor Control Center.

Discussions with SWEC engineering personnel disclosed that the cubicle information shown on the cable pull ticket was an "optional entry" and that the cable had been installed correctly in accordance with the applicable conductor termination sheet.

No further discrepancies were observed in this area.

(2) Separation

The inspection of Class 1E cable installations revealed a number of instances in which electrical separation criteria had not been maintained. Examples included Class 1E cable installations which did not maintain adequate spatial separation between redundant divisional cables, from Non-Class 1E cabling or from electrical raceways containing cabling of other divisions. Discrepancies were observed in a number of locations, but these discrepancies were most prominent in the Cable Spreading Room and in areas where cables exit design designated raceways and run free-air.

Although these installations were not in compliance with requirements detailed in Section 8.3 of the Millstone Unit 3 FSAR, discussions with the licensee indicate that alternate criteria have been developed and are being evaluated. A detailed discussion of this issue is presented in Section II.B.1.b of this report.

Section 8.3.1.4.2.18 of the FSAR specifies the minimum separation distance required for cables located inside control panels and cabinets. During examination of the Main Control Boards, the NRC CAT inspectors identified extensive wiring separation discrepancies not meeting the above requirements. The discrepancies observed involved redundant Class 1E wiring which had been installed by the vendor or modified by design or construction activity. Over 70 separation deficiencies were identified, of these more than 20 were installations in which redundant Class 1E wiring or wire bundles were in physical contact with each other. Although a detailed examination was not performed, a number of separation discrepancies involving Non-Class 1E wiring were also identified.

NRC CAT inspectors reviewed applicable inspection procedures to determine whether the procedures had incorporated adequate attributes for inspection of vendor or modified vendor wiring separation in these panels. Project Procedure NEAM 128, "Inspection of Separation," Rev. 1, was also reviewed. NRC CAT inspectors noted that these documents provided for inspection of field installed cables and wiring, but did not specify inspection of vendor installed components. Therefore, it was determined that sufficient procedural controls did not exist to assure that wiring separation discrepancies in the Main Control Boards would be identified and corrected.

As a result of this observation the licensee has issued a Change Notice to include the following requirement in Project Procedure NEAM 128: "Included in this inspection would be any vendor wiring that may have been affected by field modification." Additionally, E&DCR FE-41807 has been issued to assure a 100% inspection of wiring in this equipment.

In general, separation of cables and wiring in other electrical equipment and panels was found to be in accordance with FSAR requirements. Where discrepancies did exist they had been documented by inspection personnel.

(3) Cable Spacing

Power cable installations have been designed in accordance with ICEA Publication P-46-426, "Power Cable Ampacities." The Millstone Unit 3 FSAR Table 8.3-2 details a minimum spacing requirement for power cables installed in cable trays based on rated voltage and applicable derating. In general, this spacing between adjacent cables is equivalent to one quarter of the sum of the overall cable diameters.

NRC CAT inspectors identified several power cable installations in which the requirement for spacing had not been met. The following cable trays contained cables which exhibited this condition:

3TH400O
3TH304P
3TH103P

As a result of this observation, SWEC inspection personnel have issued Inspection Reports E5A01331, E5A01335 and E5A0348 to document and correct this condition.

(4) Cable Identification

One example was identified in which a Class 1E cable had not been properly color coded. Most Class 1E cables have color coded jackets which match the divisional color coding to which they are assigned. Class 1E cables manufactured with black insulation jackets are color coded every 15 feet with adhesive markers. NRC CAT inspectors identified type NHT-40 cables run in Electrical Man Hole 3B for a distance of about 25-30 feet without the required color coding for Class 1E Division "A" cables.

As a result of this observation, SWEC inspection personnel have issued Inspection Report E5A01325 to document and correct this condition. No other deficiencies were identified relative to identification of cables.

In general, the identification of Class 1E cable installations was found to be in accordance with criteria specified in the Millstone Unit 3 FSAR. It was noted, however, that color coding of Class 1E cables every 15 feet, as stated in the FSAR, does not conform to RG 1.75, "Physical Independence of Electric Systems," Regulatory Position 10, which states in part "...at intervals not to exceed 5 feet throughout the entire cable length." Current cable identification practices are to be reviewed by NRR as discussed in Section 8.3.3.2 of NUREG-1031, "Safety Evaluation Report, Millstone Unit 3," dated July 1984. NRC Region I is aware of this matter.

(5) Tray Fill

The Millstone FSAR Section 8.3 sets forth requirements for limiting tray fill to the top of the side rails of the tray. NRC CAT inspectors identified no significant discrepancies in this area.

(6) Terminations

In general, cable termination activities, as performed by construction personnel, conformed to requirements. However, several instances of inadequate design coordination and post turnover wiring discrepancies were observed. These discrepancies are detailed in Table II-4.

Eight discrepancies relate to incomplete implementation of engineering changes required to revise termination configuration. Generally, SWEC/SEG made the necessary drawing revisions when termination changes were required but failed to issue corresponding revised termination tickets. Revised termination tickets are the only approved documents used to initiate physical termination changes and subsequent inspections. Additionally, it was not readily evident or clear what methods have been established to assure that termination tickets are generated for all required termination changes.

Seven discrepancies relate to post-turnover wiring changes. The Millstone Unit 3 Startup Manual requires wiring changes and discrepancies to be documented upon discovery. For this group of discrepancies, the licensee indicated that documentation would be provided later - upon completion of testing rather than when found. This is not in accordance with Section 5 of the Startup Manual.

(7) Bend Radius

During the examination of Class 1E Motor Control Centers (MCCs), NRC CAT inspectors identified several vendor leads within MCC starter cubicles which violate requirements for minimum bend radius. As an example, the lead from the motor starter to phase T-1 of the bus bar in MCC 3EHS*MCC3A2 has a bend radius requirement of 1.4 inches. The installed configuration of this lead resulted in a bend radius of only

0.6 inch. As a result of this observation, SWEC inspection personnel initiated an inspection of vendor leads.

The following list identifies MCCs in which additional bend radius discrepancies were found:

3EHS*MCC3A1-F5H
3EHS*MCC3B1-R6F
3EHS*MCC1A2-3F
3EHS*MCC1B2-3F
3EHS*MCC1B1-4F

As a result of these observations, SWEC inspection personnel have issued N&Ds 11,936 and 11,932.

Bend radius discrepancies were also identified in two field installed cables. Cable 3CESAOC355, located in cubicle 311 of 4.16kv Switchgear 3ENS*SWGA, and cable 3ENSBPC398, located in cubicle 413 of Switchgear 3ENS*SWGB, exhibited unacceptable bend radii. As a result of these observations, SWEC inspection personnel issued N&D reports 11,922 and 11,923 to document and correct this condition.

The instances of bend radius discrepancies in field installed cabling are considered isolated because other cables examined had been installed properly. Regarding discrepancies in vendor wiring, further licensee attention will be required to assure that these components are properly installed.

(8) Receipt of Allegation

During inspection of electrical cable installations, NRC CAT inspectors received an allegation pertaining to installation records. The alleger was informed that the NRC Resident Inspector would contact him and investigate his concerns.

c. Conclusions

In general, cable installation including terminations have been accomplished in accordance with requirements. However, extensive wiring separation discrepancies exist in the Main Control Boards. Further licensee attention is required to assure that these discrepancies are properly identified and corrected.

Some aspects of vendor installed wiring in motor control centers will require additional inspection and evaluation.

One group of termination discrepancies were identified that were due to inadequate control of termination revisions. Revised termination tickets were not issued so that required work could be accomplished.

Another group of termination discrepancies related to post-turnover activities. Some post-turnover wiring changes were not recorded as required by the Millstone Unit 3 Startup Manual Additional

management attention is necessary in the area of procedural controls to assure that final wiring configurations are in accordance with design requirements and are properly documented.

3. Electrical Equipment Installation

a. Inspection Scope

Over 35 pieces of 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 five motors and associated hardware was inspected for such items as location, anchoring, grounding, identification and protection. The motors inspected were:

Safety Injection Pump Motor	3SIH*P1A
Safety Injection Pump Motor	3SIH*P1B
Residual Heat Removal Pump Motor	3RHS*P1A
Charging Pump Motor	3CHS*P1B
Component Cooling Pump Motor	3CCP*P1C

(2) Electrical Penetration Assemblies

The following containment penetration assemblies were inspected:

3RCP*E6V	480V Power
3RCP*E4V	480V Power
3RCP*F8V	Control
3RCP*F1V	Instrumentation
3RCP*F3V	Control

The location, type, mounting and identification of these penetrations were compared with the installation drawings and vendor manual.

(3) Circuit Breakers

Circuit breakers for the following Class 1E motors were examined to determine compliance with design and installation documents for size, type, system interface and maintenance.

Emergency Service Water Pump Motor
Safety Injection Pump Motor

The use of circuit breakers with integral undervoltage trip attachments was also investigated.

(4) Switchgear and Motor Control Centers

The following switchgear and motor control centers were inspected:

Motor Control Center	3EHS*MCC1A4
Motor Control Center	3EHS*MCC3A2
Motor Control Center	3EHS*MCC1A1
Motor Control Center	3EHS*MCC1B5
4160V Switchgear	3ENS*SWG-A
4160V Switchgear	3ENS*SWG-B

(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 installation of the batteries were compared with the applicable requirements and quality records.

125V DC Battery	3BYS*BAT-1
125V DC Battery	3BYS*BAT-2

(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	3BYS*CHGR-1
Battery Charger	3BYS*CHGR-2
Battery Charger	3BYS*CHGR-3
Static Inverter	3VBA*INV-1
Static Inverter	3VBA*INV-2
Distribution Panel	3BYS*PNL-2

(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:

Main Control Board (Reactor Coolant)	3CES*MCB-MB4
Main Control Board (Engineered Safeguards)	3CES*MCB-MB2
Aux Relay Panel	3RPS*RAKOTXB
Aux Relay Panel	3CES*RAKAUXA
Main Control Board (Termination Cabinets)	3CES*TB-MB8P
Aux Shutdown Panel	3RPS*PNLAS

(8) Motor Operated Valves

Three motor operated valves were examined in detail.

3SIH*MV8923A
3SIH*MV8821B
3SIL*MV8804A

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

- SWEC Quality Assurance Directive QAD-10.11ML, "Electrical Equipment Installation Inspections," Rev. 0
- SWEC Quality Standard QS-13.12ML, "Material/Equipment Maintenance," Rev. 0
- SWEC Quality Control Instruction FM3-S10-51-010 "Inspections of Equipment Subjected to NNECO Pre-Turnover Checkout Program."
- SWEC Quality Control Instruction FM-S13.12-01B, "Preventive Maintenance Inspection Schedule."
- SWEC Construction Methods Procedure 1.12-3.79, "Material/Equipment Maintenance."

b. Inspection Findings

(1) Motors

In general, the installation of Class 1E motors was found to be in accordance with applicable design documents. Motors examined were of the size, type and configuration specified and construction maintenance activities had been performed in accordance with approved procedures. However, deficiencies in the areas of motor mountings and post-turnover maintenance activities were identified.

Regarding the mounting of several of the motors examined, NRC CAT inspectors observed that large diameter mounting bolts used to attach motor bases to the associated pump skids did not contain the required material marking. This issue is discussed in detail in Section VI, Material Traceability and Control, of this report.

During the inspection of electrical equipment, it was not evident that adequate maintenance had been performed on some electrical equipment. No formal documentation existed to verify that required maintenance activities have been performed on several pieces of electrical equipment while under NNECO control. Examples include the Class 1E Residual Heat Removal pump motors for which documented evidence of shaft rotation does not exist since the time of construction turnover in March of 1983. This issue is discussed in detail in Section III, Mechanical Construction, of this report.

No other deficiencies were identified relative to the installation of Class 1E motors.

(2) Electrical Penetrations

Penetrations examined were found to have been installed in accordance with applicable design documents. Installation requirements including performance of required maintenance activities had been accomplished in accordance with approved construction procedures.

During the inspection, NRC CAT inspectors identified three penetration assemblies whose integral pressure gauges exhibited zero pressure readings. A review of inspection records indicates that pressure requirements had been maintained during construction. However, additional discussion disclosed that the licensee's position was that positive pressure was not required on these assemblies during plant operation. To augment this position the licensee presented a copy of a telecon with Conax Corporation in which the vendor stated that there were no requirements to maintain penetration pressure during plant operation, but a positive nitrogen pressure of 15 psig was recommended to verify penetration leak tightness. Subsequent to the NRC CAT observation of penetration pressure readings, licensee personnel depressurized all remaining penetration assemblies.

(3) Circuit Breakers

The examination of the selected circuit breakers indicated that they had been purchased, installed and maintained in accordance with the applicable design documents. Important installation attributes such as proper alignment and main contact penetration were verified by physical inspection and review of construction test records. Maintenance records were also reviewed, and they indicate that lubrication and set point verification had been performed.

NRC CAT inspectors also evaluated licensee initiated actions and review of NRC Information Notice 83-18 "Failures of the Undervoltage Trip Function of Reactor Trip System Breakers" and NRC Generic Letter 83-28 "Required Actions Based on Generic Implementations of Salem ATWS Events." NRC CAT inspectors noted that Millstone Unit 3 design will utilize Westinghouse type DS-416 breakers in the Reactor Trip System. The review of supplemental actions to Generic Letter 83-28 indicates that the licensee plans to comply with Westinghouse proposed corrective actions and will ensure that all DS-416 reactor switchgear undervoltage attachments are replaced with a new design and tested prior to the current fuel load date.

(4) Switchgear and Motor Control Centers

In general, the installation of Class 1E 4160V switchgear and motor control centers was found to be in accordance with applicable requirements.

Bolting materials used in the assembly of some motor control centers did not contain identification markings and thus were of indeterminate material type. This issue is discussed in detail in Section VI, Material Traceability and Control of this report.

(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. Access to these areas was controlled by keyed entry, and the appropriate danger signs had been posted to indicate no smoking or open flames.

The 125V batteries were examined in detail and found to be in good condition. Maintenance activities were reviewed and, in general, had been performed in accordance with requirements.

The inspection of the 125V battery racks disclosed that indeterminate bolting material had been used in the assembly process. This issue is discussed in detail in Section VI, Material Traceability and Control, of this report.

(6) 125V DC System

Inspection of components comprising the 125V DC system disclosed no deficiencies relative to the installed configuration of the equipment.

(7) Control Panels

The various control panels examined were installed in accordance with applicable design documents. With the exception of the main control panel wiring separation deficiencies discussed in Section II.B.2.b(2) of this report, no significant deficiencies were noted.

(8) Motor Operated Valves

Motor operated valves examined were installed and maintained in accordance with applicable design documents.

c. Conclusions

The installation of Class 1E equipment and associated hardware at Millstone Unit 3 was generally found to be in accordance with the applicable design documents.

Indeterminate fastening materials have been used in the assembly or mounting of several pieces of electrical equipment for which seismic bolting requirements apply.

It was not evident that adequate maintenance activities had been performed on some electrical equipment after turnover to NNECO.

4. Instrumentation Installation

a. Inspection Scope

The NRC CAT inspectors selected a sample of instrument components from various instrument systems at several plant locations to determine whether installations met applicable design requirements and installation specifications. Additionally, several instrument loops were selected for detailed inspection of signal path routing.

Fourteen instruments were examined for conformance with requirements such as location, mounting details, instrument type and comparison of as-installed ranges with design parameters.

Four instrument racks and nine instrument tubing supports were inspected for such attributes as installed configuration, mounting details, material, location and identification.

Eleven completed runs of instrument tubing, comprising about 800 feet, were examined in detail for such installation requirements as location/routing, supports, support location and physical independence of redundant systems.

The signal paths of six instrument loops were traced from their process connections to their final output devices. In most cases the components inspected for each loop included sensing lines, transducers, signal conditioning and isolating devices, indicating and controlling instruments and the various interconnecting cable, electrical penetrations, panel wiring and terminals along the signal path. Most instrument components were examined for such attributes as type, range, output, identification, qualification, location, mounting and physical separation of redundant components. Interconnecting cable, panel wiring and terminations were inspected also relative to applicable requirements.

Refer to Table II-5 for a listing of the instrumentation sample.

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

- SWEC Specification 2472.800-943, "Instrumentation Installation, Piping, and Tubing," Rev. 9
- SWEC Specification 2400.000-350, "Electrical Installation," Rev. 7

b. Inspection Findings

In general, the installation of instruments, racks, tubing runs and supports conformed to appropriate requirements; however, a few isolated discrepancies were identified. Two instances of bent instrument tubing were noted: the high and low lines for flow transmitter 3CCP*FT67B (approximately 18 inches from the root valves) and a line for flow transmitter 3FWA*FT51A (between supports H009 and H010). Three instances of loose or missing tube block clamps were noted: the top half on support EK-501035-H002 and the top half on support EK-501132-H010 were missing, and the tube block on support EK-50134-H010 was loose. As a result of the above discrepancies, SWEC QA Inspection Reports 15A00543, 15A00544, 15A00545 and 15A00564 were issued to document these identified conditions.

The signal paths through the various instrument components and interconnections in the six instrument loops inspected were as shown on applicable drawings and related installation documents except for a few minor discrepancies. For example, SWEC Drawing EE-3HB, Rev. 3, shows cable 3SIL2PX802 from Protection Set 2 (3RPS*RAKSET2) to the Main Control Board (3CES*MCB-MB2) to be connected to jack 27. The cable was plugged into jack 26. As a result of this observation, Inspection Report E5A01801 was issued to document this condition. In addition, a number of cable and panel wiring separation discrepancies were identified in which the installation did not meet the separation criteria specified in the Millstone Unit 3 FSAR. This matter of separation of electrical circuits is discussed in detail in Section II.B.1 of this report. In general, the installation of the instrument loop components, associated hardware and interconnections selected for inspection was in accordance with applicable design and installation requirements.

c. Conclusions

Instrument components inspected were installed, in general, in conformance with applicable requirements. The signal paths of the instrument loops examined were generally as specified on applicable drawings and installation specifications. The identified discrepancies are considered to be minor.

TABLE II-1

DOCUMENTS ISSUED AS A RESULT OF THE NRC CAT INSPECTION

ELECTRICAL AND INSTRUMENTATION INSPECTION

Document Number*	Subject	Document Number	Subject
IR E5A01335	Cable	IR E5A01325	Cable
IR E5A01331	Cable	N&D 11,936	MCC's
N&D 11,932	MCC's	N&D 11,922	Cable
N&D 11,923	Cable	E&DCR TE-03663	Bolting
IR E5A01809	Cable	IR E5A01843	Bolting
IR E5A0348	Cable	N&D 11,904	Bolting
IR E5A01910	Conduit	E&DCR FE-41807	Separation
N&D 11,905	Bolting	IR E5A01873	Anchors
Change Notice 2 (NEAM 128)	Separation	IR E5A01210	Anchors
IR E5A01801	Cable	N&D 11542	Anchors
DCR 742	Terminations	E&DCR TE-03885	Terminations
TR 19M3112101	Terminations	E&DCR FE-41870	Terminations
TR 19M3112742	Terminations	IR E5A01782	Terminations
IR I5A00545	Instrumentation	E&DCR TE-03766	Terminations
IR I5A00544	Instrumentation	IR E5A01756	Terminations
IR I5A00564	Instrumentation	IR E5A01796	Terminations
IR I5A00543	Instrumentation	IR E5A01808	Terminations

*IR: Inspection Report
N&D: Nonconformance and Disposition Report
E&DCR: Engineering and Design Coordination Report
DCR: Design Change Request
TR: Trouble Report

TABLE II-2

RACEWAY INSPECTION SAMPLE

Cable Tray:

3TC1270	3TC1280	3TC1250	3TC1020	3TC1310
3TC1030	3TC3000	3TC3010	3TC3020	3TC3030
3TC4490	3TC4160	3TC4170	3TC4180	3TC4200
3TC4210	3TL0010	3TL0020	3TL0030	3TL0040
3TC007P	3TC006P	3TC005P	3TC004P	3TC003P
3TC002P	3TC010P	3TC440P	3TC441P	3TC444P
3TC443P	3TC444P	3TC445P	3TC446P	3TC447P
3TC448P	3TC413P	3TC415P	3TC414P	3TC8800
3TC8810	3TC8820	3TK860P	3TK861P	3TK862P
3TK863P	3TK864P	3TK865P	3TK866P	3TK867P
3TH8800	3TH8810			

Cable Tray Supports:

Support No.	Drawing No.	Support No.	Drawing No.
G203-42	34EN-2	G217-5	34EN-2
G400-31	34EM-3	A104-43	34DX-8
A183-65	34DY-8	A169A-40	34DY-10
A201B-25	34DZ-9	C297A-1	34DL-10
C101-188	34DN-10	R260A-36	34EF-8
R254-53	34EF-8		

TABLE II-2 (Continued)

RACEWAY INSPECTION SAMPLE

Conduit Sample:

Conduit No.	Length (Ft)	Conduit No.	Length (Ft)
3CK003PD5	110	3CC003PB1	42
3CL0020A	76	3CX999RF2	22
3CC002PA	70	3CX900BC1	61
3CL1060E	20	3CX1060A5	80
3CL103PB	50	3CC9310K	27
3CC128PB	12	3CC9310C7	28
3CC1000C1	80	3CK926GA	41
3CK9260A	26	3CC4410D5	58
3CK404RB	65	3CC407PE	27
3CC950BB2	61	3CX950BA4	89
3CC4120A	20	3CC864PB	20
3CX926PG2	46	3CC1080G	2

Conduit Support Sample:

CB-1305	MA-939
MA-1060	MA-1245
CS-549	CS-550
CS-1711	MA-518
MA-760	ES-943

Concrete Anchor Sample:

Anchor Size	Aux Bldg	ESF Bldg	Cont Bldg	Total
3/8" dia.	0	2	0	2
1/2" dia.	4	8	12	24
5/8" dia.	4	0	0	4
3/4" dia.	7	9	6	22
TOTAL	15	19	18	52

TABLE II-3

CABLE TERMINATION INSPECTION SAMPLE

Original Sample

Main Control Board 3CES*MCB-MB4, Dwg. EE-3AJH-4, EE-3AJS-2, EE-3AJX-4 and EE-3AKN-4: 19 cables

Termination Cabinet 3CES*TB-MB10, Dwg. EE-3DK-6: 70 cables

Logic Cabinet "A" 3RPS*RAKLOGA, Dwg. EE-3GK-3: 29 cables

Logic Cabinet "B" 3RPS*RAKLOGB, Dwg. EE-3GT-3: 29 cables

Aux Shutdown Panel 3RPS*PNLAS, Dwg. EE-3JA-4: 24 cables

Aux Shutdown Panel 3RCS*PNLAS, Dwg. EE-3JB-5 and EE-3JD-3: 47 cables

Expanded Sample

Termination Cabinet 3CES*TB-MB10, Dwg. EE-3DL-5: 73 cables

Termination Cabinet 3CES*TB-MB1P, Dwg. EE-3DP-5 and EE-3DQ-5: 152 cables

TABLE II-4

CABLE TERMINATION DISCREPANCIES

Engineering Discrepancies

1. Drawing EE-3DP-5 shows the BLK and WHT conductors of cable 3BDGAPC606 as spares. As installed, the BLK wire is on terminal block (TB) 641, pt. 7 and the WHT wire is on TB-641, pt. 11. This configuration is consistent with the original design, but on September 12, 1983, schematic diagram ESK-7BH-8 was revised to "spare" these wires, causing Dwg. EE-3DP to be revised similarly. However, the SWEC site engineering group (SEG) failed to issue revised termination tickets to direct construction forces to perform the revision.

2. Drawing EE-3DP-5 indicates an ORG-BLK wire to be terminated on TB-641, pt. 8, but does not show which cable this wire comes from. The licensee stated that this is a drafting error and that this wire is from cable 3SSRAPC602.

3. Drawing EE-3DP-5 shows the BLK and WHT conductors of cable 3BDGCP606 as spares. As installed, the BLK wire is on TB-642, pt. 27 and the WHT wire is on TB-642, pt. 6. This configuration is consistent with the original design. However, on September 12, 1983, schematic diagram ESK-7BH-8 was revised to "spare" these wires, causing Dwg. EE-3DP to be similarly revised, but SWEC/SEG failed to issue revised termination tickets to direct construction forces to perform the revision.

4. Drawing EE-3DQ-5 shows the RED-BLK and WHT-BLK conductors of cable 3BYS1PB605 as spares. As installed, the RED-BLK wire is on TB-663, pt. 12 and WHT-BLK wire is on TB-662, pt. 26. This configuration is consistent with the original design. On September 12, 1983 schematic diagram ESK-7BK-5 was revised to "spare" these wires, causing drawing EE-3DQ to be similarly revised. However, SWEC/SEG failed to issue revised termination tickets to direct construction forces to perform the revision.

5. Drawing EE-3DL-5 shows a BLK conductor on TB-634, pt. 25 but does not indicate which cable this wire comes from. The licensee stated that this is a drafting error and no wire is needed at this point. This discrepancy reflects incomplete engineering review of design changes prior to issuing revised drawings.

6. Drawing EE-3JA-4 shows the BLK, ORG, WHT-BLK, and BLU conductors of cable 3RCSBOC005 on TB-2T10, pts. 1 through 4, respectively. As installed, these wires are WHT-BLK, BLU, BLK, and ORG on TB-2T10, pts. 1 through 4, respectively. The installed configuration is in accordance with drawing Rev. 1. However, drawing Rev. 3, dated May 9, 1984 revised this configuration, but SWEC/SEG failed to issue revised termination tickets to direct construction forces to perform the revision.

TABLE II-4 (Continued)

CABLE TERMINATION DISCREPANCIES

7. Drawing EE-3GK-3 shows the shield of cable 3ISCAOX800 on TB-517, pt. 1. As installed, this shield is on TB-517, pt. 4. A review of the termination ticket issued by SWEC/SEG to construction and QC shows that TB-517, pt. 4 was erroneously indicated on the ticket.

8. Drawing EE-3AJX-4 shows the WHT-BLK conductor from cable 3EGPAOX403 on the TB-DBF, pt. 9 and the RED-BLK wire on TB-DBF, pt. 10. As installed, pt. 9 has a BLK wire and pt. 10 has a WHT wire from this same cable. This cable is a two-conductor cable containing only BLK and WHT wires. The licensee stated that this is a drafting error and that the as-installed wiring is correct. Drawing errors of this nature reflect inattention to detail during engineering review.

Post-Turnover Discrepancies

9. Drawing EE-3DP-5 requires the WHT-BLK conductor of cable 3LMSBPC002 to be on terminal TB-640, pt. 9. Although the QC inspection record shows this to be acceptable, the WHT-BLK conductor is not presently terminated. The licensee stated that phase one testing of this circuit is not yet complete, and that upon completion of such testing, a design change request would be issued, if necessary, to document this condition. This response is not consistent with the requirements of Section 5 of the Northeast Nuclear Energy Company, "Millstone 3 Startup Manual," Rev. 3 which requires that wiring changes/deficiencies be documented upon discovery.

10. Drawing EE-3DP-5 shows the RED conductor of cable 3CCPBPC350 at TB-648, pt. 18 and the GRN-BLK wire as a spare. As presently installed, the RED wire is spared and the GRN-BLK is at TB-648, pt. 18. Original QC inspection records show these wires to be acceptable per drawing requirements and the RED wire is actually cut shorter than other spares in the vicinity and is the appropriate length to have once been terminated at the required point, indicating that these two wires have been "swapped" subsequent to QC inspection. The licensee stated that, although phase one testing of this circuit is complete, no documentation has yet been issued to document this revision as required in Section 5 of the Startup Manual.

11. Drawing EE-3DP-5 shows the ORG-BLK conductor of cable 3CCPBC615 as a spare, however it is terminated at TB-654, pt. 20. Original QC inspection records show this wire to be acceptable per drawing requirements and the wires in this circuit are tagged to indicate that phase one testing is in progress. The licensee stated that, as phase one testing is not yet complete, a design change request will be issued to document this condition upon test completion, if necessary. This is not in accordance with Section 5 of the Startup Manual.

TABLE II-4 (Continued)

CABLE TERMINATION DISCREPANCIES

12. Drawing EE-2DQ-5 shows the BLK-WHT conductor of cable 3BYS1PC601 on TB-666, pt. 15. This wire is presently on TB-666, pt. 14. The original QC inspection records show this to be acceptable per drawing requirements. The licensee stated that phase one testing of this circuit is not yet complete, and that upon completion of such testing, a design change request would be issued, if necessary, to document this condition. This response is not consistent with the requirements of Section 5 of the Startup Manual, which requires that wiring changes/deficiencies be documented upon discovery.

13. Drawing EE-3DK-6 shows the GRN-BLK conductor of cable 3SWPAOC350 on TB-609, pt. 22 and the WHT-BLK wire on TB-609, pt. 24. The as-installed configuration is exactly opposite of that required. The original QC inspection records indicate that these wires were correctly installed as of March 22, 1984, and the present appearance of the wires indicates that they have been "swapped" subsequent to QC inspection. No documentation was available to justify this change. This is not in accordance with Section 5 of the Startup Manual.

14. Drawing EE-3GK-3 shows the BLK conductor from cable 3RPSAOX812 on TB-506, pt. 4 and the WHT on TB-506, pt. 5. The as-installed configuration is BLK on pt. 5 and WHT on pt. 4. The licensee indicated that, although phase one testing of this circuit is complete and the circuit operates correctly, no documentation had been issued to substantiate the wiring change. This is not in accordance with Section 5 of the Manual.

15. Drawing EE-3GT-3 shows the BLK conductor of cable 3RPSBPX812 on TB-506, pt. 4 and the WHT conductor on TB-506, pt. 5. As installed, the BLK wire is on pt. 5 and the WHT wire is on pt. 4. The licensee indicated that although phase one testing of this circuit has been completed and the circuit operates correctly, no documentation had been initiated to substantiate the wiring change. This is not in accordance with Section 5 of the Startup Manual.

Minor Discrepancies

16. The WHT conductor of cable 3CHSNOC152 (Dwg. EE-3JB-5, TB-3T14, pt. 7) was found with a cut in its jacket.

17. Drawing EE-3AKN-4 shows the shield from cable 3BYS2PX401 on TB-DBW, pt. 22 and the shield from cable 3BYS2PX451 on TB-DBW, pt. 21. As installed, these shields are interchanged. Because these two points are jumpered together on the other side of the terminal strip, there is no functional difference in the circuit between the as-installed and specified conditions. However, design change request 742 has been issued to document this finding.

TABLE II-4 (Continued)

CABLE TERMINATION DISCREPANCIES

18. The BLK and WHT conductors of cables 3WTCBPC621 and 3WTCAOC613 were found to be determinated in panels 3CES*TB-MB1P and 3CES*TB-MB1O. Bypass/jumper tag log sheets 221 and 223, located in the shift supervisor's office, show that only the BLK wires are documented as being temporarily determinated. As a result of this finding, log sheets 221 and 223 have been corrected to indicate that both BLK and WHT wires are determinated. A review of other log sheets for similarly determinated cables shows this to be an isolated case. In addition, it should be noted that these log sheets were initiated in accordance with Procedure ACP-QA-2.06B, "Station Bypass/Jumper Control", Rev. 4 which has already been revised (Rev. 5, February 1, 1985) to include additional procedural controls which should preclude future errors of this nature.

TABLE II-5

INSTRUMENTATION INSPECTION SAMPLE

Instruments:

3MSS*PT515	3LMS*PT936
3CCP*FT67B	3LMS*PT937
3QSS*LT930	3FWA*FT51D
3QSS*LS56A	3FWS*LT519
3QSS*LS54A	3FWS*LT529
3LMS*PT93A	3RCS*FT415
3LMS*PT935	3RCS*FT416

Instrument Racks:

3CES-RK12-04	3CES-RK12-06
3CES-RK12-05	3CES-RK12-07

Instrument Lines:

3MSS*PT515(AW)	30'	3LMS*PT936(BW)	25'
3CCP*FT67B(BP)	64'	3LMS*PT935(CB)	7'
3QSS*LT930(XR)	)	3FWA*FT51D(DO)	81'
3QSS*LS56A(XO)	)17'	3FWS*LT519(AW)	234'
3QSS*LS54A(XO)	)	3FWS*LT529(BR)	219'
3LMS*PT937(AR)	12'	3RCS*FT416(AB)	70'
3LMS*PT934(DY)	21'	3RCS*FT415(AW)	70'

Tubing Supports:

EK-501035-H003	EK-501139-H026
EK-501035-H001	EK-501139-H027
EK-501034-H005	EK-501139-H016
EK-501139-H021	EK-501139-H017
EK-501139-H024	

Instrument Loop Verification:

Steam Pressure

Loop Function: Senses steam generator 1A outlet pressure, provides an input (trip) signal to the reactor protection system (RPS); indicates steam line pressure on the main control board (MCB) and on the auxiliary shutdown panel.

Components: The sample included the sensing line from the steam generator outlet steam line to pressure transmitter 3MSS*PT515, parts of the RPS, pressure indicators 3MSS*PI515A and 3MSS*PI515B, and interconnecting cable, panel wiring and terminals.

TABLE II-5 (Continued)

INSTRUMENTATION INSPECTION SAMPLE

Pressurizer Pressure

Loop Function: Senses pressurizer pressure and provides an input (trip) signal to the RPS, the engineered safety features actuation system and indicates pressurizer pressure on the MCB.

Components: The sample included pressure transmitter 3RCS*PT456, electrical penetration 3RCP*G1, parts of the signal conditioning and logic circuitry (Channel II) of the RPS, pressure indicator 3RCS-PI456A and interconnecting cable, panel wiring and terminals.

Reactor Coolant Loop Flow

Loop Function: Senses reactor coolant loop 1 flow and provides an input (trip) signal to the RPS and indicates loop flow on the MCB.

Components: The sample included the sensing lines from the loop piping elbow taps, flow transmitter 3RCS*FT415, electrical penetration 3RCP*G1, parts of the signal conditioning and logic circuitry (Channel II), flow indicator 3RCS-FI415 and interconnecting cable, panel wiring and terminals.

Reactor Coolant Loop Flow

Loop Function: Redundant to above loop.

Components: Flow transmitter 3RCS*FT416, electrical penetration 3RCP*C6, flow indicator 3RCS*FI416 and associated components similar to the above loop.

RHR Miniflow Recirculation

Loop Function: Senses residual heat removal pump 3RHS*P1A flow, provides a signal to operate valve 3CHS*FCV610 upon high or low flow and indicates valve position on the MCB.

Components: The sample included flow indicator switch 3RHS*FIS610, valve position indicator 3RHS*FCV610 and interconnecting cable, panel wiring and terminals.

Safety Injection Accumulator Vent Valve

Loop Function: Provides signal to position valve in vent line from the accumulator tanks 3SIL*TK1C&D and provides valve position indication on the MCB and the auxiliary shutdown panel.

Components: The sample included valve operator 3SIL*HCV943B, indicating and control instruments 3SIL*HC943B and ZI943B on the MCB, indicating and control instruments 3SIL*HC 943D and ZI943D on the auxiliary shutdown panel, electrical penetration 3RCP*E3 and interconnecting cable, panel wiring and terminals.

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, concrete expansion anchors, mechanical equipment, 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

(1) Piping depicted on the 26 Stone & Webster Engineering Corporation (SWEC) drawings listed in Tables III-1a & b was selected for the inspection sample. The piping encompassed portions of the Chemical & Volume Control, Auxiliary Feedwater, Residual Heat Removal, Quench Spray, Charging Pump Cooling, and Safety Injection Systems. Piping configuration (i.e., layout geometry, orientation and dimensions), component identification and location, valve operator orientation, and pipe support location and type were compared to the results on inspection drawings marked-up by SWEC QC during their inspections. Additional features such as maintenance of inservice inspection clearance criteria and site construction practice affecting installed mechanical components were observed where appropriate. Piping component material specifications were compared to controlled material take-off lists on a random basis. The as-built and stress reconciliation programs were also reviewed.

(2) Hydrostatic test records for 20 piping isometrics were reviewed for completeness, accuracy and content. These isometrics encompassed portions of the Chemical and Volume Control, Safety Injection, Residual Heat Removal, Component Cooling, Quench Spray, Auxiliary Feedwater, and Containment Recirculation Cooling Systems. A listing of the associated piping isometrics are provided in Table III-2a.

(3) Seven piping samples representing approximately 75 feet of pipe were selected to determine whether ASME requirements for pipe wall thickness were met. The measured pipe wall thicknesses were compared against the minimum wall thickness requirement specified by ASME (12.5 percent below nominal thickness). See Table III-2b for the inspection sample and observations.

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

- SWEC Specification M968, "Field Fabrication and Erection of Power Piping," Rev. 7, Add. 5.
- SWEC Procedure NETM 31, "Procedure for Seismic Category I Piping Location Isometric and Tubing Isometric Review and Stress Reconciliation," Rev. 0, through Change Notice No. 3
- SWEC Procedure FCP-337, "Preparing Stress Reconciliation Piping Location Isometrics (PLI's)," Rev. 3
- SWEC Procedure NEAM 122, "As-Built Program," Rev. 0 through Change Notice No. 2
- SWEC Quality Control Instruction (QCI) FM3-S14.2-07C, "ASME III N-5 Inspections"
- SWEC Procedure NEAM 134, "Processing of ASME III Certification," Rev. 0
- SWEC QA Attribute List No. M3-SP-968-15-4232 for PLI Inspection
- SWEC QA Attribute List No. M3-SP-968-18-5052 for ASME III Fabrication/Installation Inspection
- SWEC Procedure MTP-3, "Generic Pressure Test Guidelines for Fluid Systems," Rev. 2
- SWEC Procedure No. 5.7, "Pressure Testing," Rev. 0 through Change Notice No. 6
- Applicable Piping Isometrics

b. Inspection Findings

The selected sample of piping ranged in size from three-fourths to 20 inches, and classifications included all ASME pipe classes as well as class 4 (ANSI B31.1) piping. This sample represented approximately 400 feet of piping two inches or less in diameter and approximately 800 feet of piping greater than two inches in diameter, all of which had been previously inspected and accepted by SWEC Field Quality Control (FQC). Observations associated with specific piping isometric drawings are listed in Table III-1. A summary of the findings are provided below.

(1) During the installation of process piping systems, various inspections by FQC were performed. The Piping Location Isometric (PLI) inspection which verified attributes affecting the as-built effort such as dimensions, was one type of inspection. A "pre N-5" inspection followed the PLI inspection, and was conducted in accordance with QCI S14.2 which directed inspection of certain attributes immediately before the ASME N-5 Code Data Report sign-off.

PLI inspections, which were performed in accordance with Procedure FCP-337, required dimensions to be verified to the Piping Specification M968 tolerance of 0.5 inch. Sixteen dimensional errors ranging from 1.0 to 13.0 inches were detected by the NRC CAT on the 26 drawings inspected. For pre N-5 inspections, QCI S14.2 required reinspection of all "moveable support" location dimensions immediately prior to N-5 sign-off. A moveable support is any support which does not have integrally welded attachments to the process pipe. Of the 16 errors previously noted, four errors which ranged in size from 1.0 to 3.0 inches were detected by the NRC CAT on the 14 drawings which had already undergone the later pre N-5 inspection. The NRC CAT is concerned that the reduced frequency and magnitudes of errors (4) found in the already pre N-5 inspected sample is not truly indicative of the effectiveness of the pre N-5 inspection since most of the errors (16) were not associated with moveable supports, and thus would likely not be detected during the pre N-5 inspection.

During the NRC CAT inspection, SWEC studied the matter of dimensional discrepancies, evaluated most of the discrepancies, and found no resultant unacceptable stress conditions. As a result of the NRC CAT findings, FQC monitored the ongoing pre N-5 inspections for dimensions which were discrepant with those found on the PLI drawings. This monitoring showed a substantially lower error rate than that found by the NRC CAT. Based primarily on the lower incidences of PLI dimensional error found in that sample, FQC concluded that existing QC procedures were adequate to assure the accuracy of piping dimensions. FQC also issued a memorandum to piping inspectors which directed random remeasurement of PLI verified non-moveable support and overall (i.e., straight run total length) dimensions. No additional action was proposed by SWEC regarding this subject.

The NCR CAT is concerned that the FQC sample of PLI dimensional verification was limited to that piping which was inspected for N-5 sign-off during a one week period and was therefore limited in both time and scope. The resultant error rate was not consistent with that found during the same period by the NRC CAT. We are also concerned that the direction to remeasure PLI verified dimensions on a random basis during pre N-5 inspections will not provide FQC with a quantifiable data base with which to conclude the adequacy of dimensional measurement quality control. Although the magnitude of errors detected by the NRC CAT is not extreme, the rate of occurrence warrants additional attention and corrective action.

(2) The PLI for drawing QSS-3 incorrectly identified a support function. Support PSR-063 was identified as a vertical and axial pipe restraint when in fact, the support also restrained the pipe laterally. This error appears to be an isolated instance, and not indicative of the overall QC effort.

Three drafting errors associated with isometric CHS-31 were detected by the NRC CAT. At least two of these errors, one missing dimension and one support for which neither the mark number nor function were identified, would have been detected during completion of the as-built reconciliation effort. The third error was a misorientation of a small pipe angle. These drafting errors appear to represent isolated instances.

A total of three violations to specified clearance criteria were identified in our piping sample. In general, pipe clearance violations between other mechanical and structural components were found to be accurately recorded for disposition by engineering during the as-built stress reconciliation analysis effort.

(3) In conjunction with the NRC CAT review of design change control (Section VII), it was observed that the implementation of E&DCR FP-22607 regarding the addition of a valve to process pipe, was not proper in that a steel plug was used on the Category II end of a valve nipple instead of a nylon plug as specified by the E&DCR. The NRC CAT does not consider this particular discrepancy to be significant in nature, but is nonetheless a condition of noncompliance with respect to the E&DCR. Although Category II piping is not subjected to the same scrutiny of inspection as Category I piping, the licensee should be aware of the potential for misinstallations in non-FQC inspected portions of Category II systems.

(4) In the course of the NRC CAT inspection of welding (Section IV), it was determined that a weld preparation detail which affected piping design was not adequately addressed by SWEC Engineering in that weld joint stress considerations had not been evaluated for the revised configuration. This weld detail required counterboring of the process pipe at the feedwater to steam generator nozzle connections. Resultant stresses were not evaluated for the reduced cross sectional area as a result of the counterboring. In response to NRC questions, SWEC later determined that pipe stresses for these nozzle details met Code stress limits. SWEC also determined that mechanisms to alert SWEC Engineering of such unusual weld preparations were in place and that they had adequately addressed such nozzle details affecting other equipment supplied by the same NSSS vendor. Since this discrepancy appears to be an isolated case, a review of similar circumstances for nozzles supplied by vendors other than the NSSS vendor was not undertaken by SWEC at the time of our inspection and is not contemplated.

Regarding hydrostatic/pneumatic test packages, approximately 34 inspection records were reviewed for the 20 piping isometrics selected. Pressure testing of embedded portions of piping were performed in accordance with Test Procedure MTP-3 by field engineers, and witnessed by FQC. Pressure testing of exposed and completed piping systems were performed in accordance with pressure Test Procedure 5.7, and were generally performed under the direction of the Advisory Operations organization, with FQC performing the

witnessing and documentary functions. The NRC CAT inspector did not identify any deficiencies such as missing or improper records, overpressure or underpressure, or conflicting information in the record packages kept by SWEC Construction FQC. Record packages for pressure tests that were either stored in the vault or kept by the Advisory Operations organization were not reviewed.

The NRC CAT did note, however, that on many of the associated inspection reports which listed the applicable weld identification numbers within the particular test boundary, various welds were deleted from the test boundary after the date of the test. These welds were then included within the test boundaries of other pressure test isometrics which were to have been performed at a later time.

Conversations with FQC personnel indicate that the FQC inspector(s) who witnesses the pressure tests does not perform a point by point weld identification comparison with the isometric drawing(s) when walking down a pipe run. Rather, the welds are implicitly identified; it is assumed by the FQC inspector(s) that all welds which are inspected between two reference points correspond to the weld numbers listed in the inspection report by virtue of their physical existence.

The NRC CAT is concerned that these types of inspection and documentation approaches are potential sources for errors such as omitting an inspection of a weld, giving inadvertent inspection credit for welds, and the failure to detect unauthorized or undocumented weld joints.

With regard to the seven piping samples selected for minimum wall thickness verification, none of the samples were found to be below the specified minimum values. Only one sample was within three mils of the minimum will thickness limit. The various samples ranged in diameter from one inch to 12 inches, and were specified to meet the ASME Boiler and Pressure Vessel Code, Section III, Class 1, 2, and 3 requirements (as appropriate). Pipe wall thickness was measured using ultrasonic methods, with personnel and equipment provided by the licensee. Circumferential measurements were taken at the ends and the center of the samples; other measurements along the length of the pipe were also obtained for those samples in which a potential for violating minimum wall thickness requirements appeared likely.

c. Conclusions

No significant hardware discrepancies were observed in installed piping systems. Site engineering and inspection personnel were knowledgeable of procedures, requirements and responsibilities. The NRC CAT observed evidence of effort to protect installed hardware during ongoing construction activities and observed no significant problems regarding construction practice. However, we are concerned about the number of erroneous measured dimensions identified. We are also concerned that the results of the one time sampling of dimensioning by SWEC as a result of the NRC CAT findings, which

contradicted the results of our sampling, may not be sufficient to conclude the adequacy of as-built measurements. As such, additional attention with respect to implementation and/or procedures in this area appears warranted.

2. Pipe Supports/Restraints

a. Inspection Scope

Twenty-eight ASME Class 1, 2 or 3 and five Class 4 pipe supports/restraints which represented a variety of types, sizes, systems and locations were selected for detailed inspection. All but four supports had been QC inspected and accepted. These supports/restraints were inspected for proper configuration, clearances, member size, location, weld size, fasteners, and damage. See Table III-3 for a listing of the inspection sample. In addition, approximately 75 other supports/restraints were observed at random in the field for obvious deficiencies such as loose or missing fasteners, improper clearances or angularity, improper locking devices, disassembled items, damage and improper concrete expansion anchor spacing.

The FQC inspection reports for four supports were examined and compared with drawings and current document revision cards to verify that the required attributes were inspected and that inspections were performed to the latest design documents. This review was conducted for QSS-1-PSR-146, QSS-1-PSA-140, QSS-1-PSR-126 and CCP-2-PSA-078.

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

- SWEC Specification M968, "Field Fabrication and Erection of Power Piping," Rev. 7, Addendum 5
- SWEC Quality Control Instruction QCI FM 3-D10.43-01B, "Inspection of Pipe Supports"
- SWEC Quality Standard, QS-10.43ML, "Hanger/Support and Anchor Bolt Installation/Inspection," Rev. 0
- SWEC Quality Assurance Directive (QAD) 10.43, "Hanger and Anchor Bolt Installation Inspection," Rev. A
- SWEC Specification M924, "Drilled-In Expansion Type Concrete Anchors"
- Applicable design drawings and change documents.

b. Inspection Findings

At the time of this inspection approximately 98 percent of the approximately 3800 large bore ASME supports/restraints had been installed and 95 percent had been QC accepted. Approximately 96

percent of the 3600 small bore ASME supports/restraints had been installed, with 86 percent QC accepted.

The inspection and acceptance criteria for aspects of pipe support/restraint installation (e.g, welding, concrete expansion anchors, Richmond inserts, baseplates, general tolerances, locking devices, special inspections for snubber struts and spring hangers) were compiled in a controlled digest called the Inspector's Handbook. This handbook provided the inspector easy access to the many pieces of information needed to perform proper support/restraint inspections, in one concise document.

For the four supports/restraints which received documentation reviews, examination of the inspection reports indicated that they had been inspected for all attributes and were inspected to the latest design drawings. No deficiencies were identified.

However, during our inspection of hardware, a number of discrepancies were identified including improper attachment locations, inadequate integral lug contact, less than full flange width beam stiffeners, loose fasteners/locknuts, missing or improperly installed bearing spacers, and drafting errors. See Table III-4 for a listing of inspection observations. Although the majority of these discrepancies noted were generally minor in nature, and would not likely affect structural integrity, several rather significant discrepancies were identified. They are discussed as follows:

(1) Five instances were noted where support attachment locations were not as shown on design drawings. Discrepancies were noted on attachment points to embedded plates, structural beams and tube steel support members. Three cases involved lateral positioning, one case involved axial positioning, and one case involved attachment location on an embedded plate. The causes of these discrepancies appear to include inadequate attention to detail by QC inspectors, lack of specific dimensional location requirements on drawings, and confusion between Engineering and FQC as to the allowable tolerance for attachment locations. FQC personnel indicated they had been applying a plus or minus one inch piping location tolerance to support attachment locations. The discrepancies observed by the NRC CAT exceeded the one inch tolerance.

    In addition, FQC stated that they had utilized the support location tolerances shown on the support location sketch, which was depicted on the BZ (support design) drawing. This support location tolerance, which was as much as two feet in some cases, was based on pipe stress analysis considerations - not on support design considerations. SWEC Engineering indicated that the standard dimensional measurement tolerance of plus or minus one-eighth inch was assumed to have been used by FQC, unless otherwise stated.

The BZ drawing support location sketch for SWP-4-PSST-117 showed allowable relocation (from a pipe stress standpoint) of 24 inches. The attachment point for this support had been moved the full 24 inches from the design location on the axis of a tube steel beam, and had subsequently been accepted by FQC. When the NRC CAT questioned the application of this tolerance for this support, FQC and Engineering responded that the condition was acceptable. However, when the NRC CAT inspector reviewed the support design calculation, it was determined that a three inch tolerance to the specified location had been used.

Preliminary calculations indicated that based upon original design location and configuration an overstressed condition existed. Subsequent analysis by SWEC Engineering confirmed that stress allowables had been exceeded. However, a reevaluation utilizing as-built weld sizes and loading configurations showed the support to be not overstressed, and in fact, to be within acceptable limits. Prior to the conclusion of the NRC CAT inspection, a "Report of a Problem" had been generated by SWEC Engineering to address the one-eighth vs. one inch tolerance question.

In addition, the NRC CAT is concerned that wide location changes have not been generically accounted for in support/restraint design calculations. The NRC CAT inspectors consider that the clarity of attachment location tolerances and the adequacy of FQC inspections need to be comprehensively evaluated. Clear acceptance criteria for these situations need to be established with reanalysis and reinspection performed as required.

(2) In the case of axial restraints on pipe risers utilizing welded lugs or trunnions, FQC inspection criteria required that only one lug or trunnion be in contact with the restraint member. However, the calculation for a spring support on a riser, 3-MSS-1-PSSH-128, reflected the assumption that the load was shared by two lugs. At the request of the NRC CAT, SWEC Engineering researched and identified a total of 45 cases of conflicting load sharing assumptions on spring supports on risers. The cause of this problem apparently came from a general relaxation of the inspection criteria from two lugs to one lug in contact, when in fact the design guide for spring hangers indicated load sharing by two lugs. Where more than one lug contact was assumed or required by calculations, the designer did not specify the required additional contact on the design drawing for QC to verify. An earlier special support design review initiated and conducted by SWEC Engineering which included an evaluation of integral welded attachment assumptions, failed to identify this discrepancy with regard to spring supports.

Subsequent to the NRC CAT identification of this item, an evaluation of loading dynamics by SWEC designers indicated that single lug contact would be adequate for spring supports. When

requested to determine the applicability of this problem to rigid axial restraints, it was determined that all but the RHS system had been or would be included in the aforementioned special design review. A review of the RHS system requested by the NRC CAT revealed that two of the nine supports/restraints of the type in question had been designed assuming load sharing by more than one lug. E&DCRs were issued to have FQC verify the required contact and/or add shims as necessary.

(3) The NRC CAT inspectors identified an occurrence where stiffener plates for a wide flange beam did not span the width of the beam. Support CCP-1-PSR-154 had beam stiffener plates which were 5/8 inch short in span. After this was identified, SWEC FQC performed a random field inspection of stiffener installations. Of 290 plates installed on 119 supports/restraints, six plates on three supports were also found to be undersized (five were 1/2 inch short and one was 5/8 inch short). FQC personnel were apparently applying a "cut to suit" note on design drawings to allow deviations in excess of the plus or minus 1/8 inch allowed by design. FQC personnel were subsequently reinstructed on the requirements for beam stiffener plate installation.

(4) With regard to the number of NRC CAT observations regarding loose fasteners, locking devices and other hardware on accepted installations, these deficiencies indicate a need to perform a final inspection for these features after construction activities are essentially completed. This concern applies to Class 4 supports (non-safety system supports erected in seismic buildings in proximity to ASME piping/components) as well as ASME supports. Discussions with SWEC and NUSCO personnel indicated several walkdowns were to be performed prior to plant operation which could identify and correct many of these deficiencies. NUSCO further committed to include an inspection for loose hardware in the ASME Section XI preservice inspection program. The NRC CAT considers this an excellent approach, but considers that Class 4 supports/restraints in proximity to safety-related systems should also receive an equivalent inspection.

The NRC CAT inspectors also examined the licensee's program for assuring conformance to NRC Regulatory Guide 1.29, "Seismic Design Classification," for Class 4 (Non ASME) piping and supports in proximity to safety-related items. The attachment welds to Seismic Category I structures and/or the expansion anchor spacing on surface mounted plates are inspected by SWEC FQC on all Class 4 supports/restraints. Until terminated in August 1984, inspections essentially identical to those used for ASME supports were performed on 20 percent of Class 4 supports/restraints. A "hazards analysis" program consisting of safety-related area walkdowns by a single design engineer is currently being used to identify and evaluate potential hazards. The criteria used for the evaluation is based on a study of seismic interaction experience at other industrial facilities (non-nuclear) primarily in California. The NRC CAT

inspectors' primary concern in this area relates to the adequacy of installation of these Class 4 supports. The NRC CAT requested SWEC to perform an evaluation of inspection report results to justify the conclusion that the 20 percent sample program provided adequate assurance of proper installation. The licensee has not yet completed this evaluation. The small number of Class 4 supports/restraints inspected by the NRC CAT exhibited no major installation deficiencies. However, as previously noted, we consider that loose hardware and locking devices on Class 4 supports/restraints need additional attention.

In conjunction with the NRC CAT review of design change control (Section VII), it was observed that the implementation and the FQC inspection acceptance of E&DCR No. T-J-01036 regarding the attachment of support identification tags to their respective supports were not proper in that the component support nameplates which were attached to the supports did not conform to the labeling description as required by the E&DCR. Although the NRC CAT does not consider this discrepancy to be of major significance, it is an additional example of a lack of attention to detail by FQC.

c. Conclusions

In general, pipe supports and restraints were found to be in conformance to design documents. However, problems noted with attachment locations and beam stiffener sizes indicates a need for clarification of acceptance criteria by SWEC Engineering and more attention to detail by SWEC FQC inspectors. The integrally welded attachment contact problem indicates that SWEC Engineering evaluations are not as complete as may be necessary to ensure that potentially generic concerns are identified and resolved for all systems and/or applications. The licensee is preparing an evaluation to demonstrate the adequacy of Class 4 support installations which may impact seismically designed components. Loose hardware, fasteners and locking devices need to be addressed in post-construction inspections. The observed drafting errors are considered to be examples of human error.

3. Concrete Expansion Anchors

a. Inspection Scope

Ninety-nine concrete expansion anchors on 25 pipe supports/restraints and 40 anchors on 10 HVAC restraints were inspected for proper diameter, length stamp, embedment, edge distance, damage, washers and residual torque (an indication of anchor preload). In addition, the length of pipe support expansion anchors were verified by ultrasonic testing. The anchors inspected were selected at random on a variety of systems and ranged in diameter from one-half to one inch. Anchors were torqued to the SWEC specified post installation test torque (80 percent of the minimum installation torque). Table III-5 provides a listing of the anchors inspected.

Acceptance criteria for the field inspections were contained in the following documents:

- SWEC Specification M924, "Drilled-In Expansion Type Concrete Anchors"
- SWEC Quality Standard, QS-10.43 ML, "Hanger and Anchor Bolt Installation/Inspection," Rev. 0
- SWEC Quality Assurance Directive QAD-10.43, "Hangers and Anchor Bolt Installation Inspection," Rev. A

b. Inspection Findings

Richmond inserts have been extensively used, thereby minimizing the number of concrete expansion anchors. Pipe support/restraint expansion anchors were installed by SWEC, and HVAC restraint anchors were installed by the HVAC subcontractor, Northeast Ventilating Company (NEVCO). Expansion anchor installations were inspected by SWEC FQC and included either witnessing of installation torquing or application of a subsequent test torque. Acceptance criteria of the Specifications required that, if the anchor nut rotated at less than the test torque, the full installation torque must be achieved within one turn of the nut for the installation to be acceptable.

For 19 anchors on pipe supports/restraints and 12 anchors on HVAC restraints, nut rotation was observed at less than the test torque. Four anchors on the pipe supports/restraints required more than one turn to reach minimum installation torque (1-1/2, 1-2/3, 2 and 2-1/4 turns). All other characteristics examined were either within tolerance or had been previously identified and evaluated by SWEC.

c. Conclusions

In general, the concrete expansion anchors inspected by the NRC CAT were installed in accordance with design and procedural requirements. The results of the torque tests are considered typical of normal wedge type expansion anchor installations and do not indicate significant installation deficiencies.

4. Heating, Ventilating and Air Condition (HVAC)

a. Inspection Scope

Twelve HVAC seismic restraints were selected at random and inspected for location, configuration, member size, weld size and connection details. Duct pieces adjacent to the restraints and others selected at random were examined for proper attachment to anchors, companion angle size and joint makeup. HVAC mechanical equipment and concrete expansion anchor installation are discussed in other portions of this section. See Table III-6 for a listing of HVAC restraints inspected.

The following documents provided the acceptance criteria for the inspection of HVAC hardware installations:

- SWEC Specification M565, "Installation of Ventilation and Air Conditioning Systems," Rev. 7
- SWEC QAD-11.5 ML, "Duct Work Inspection," Rev. A
- NEVCO Duct Brochure
- Applicable design drawings and change documents

b. Inspection Findings

Approximately 99 percent of all HVAC restraint (approximately 3100) had been installed and approximately 90 percent had been QC accepted.

In general, inspected HVAC seismic restraints conformed to design documents and procedural requirements for the NRC CAT selected inspection attributes. A minor brace angle discrepancy (two degrees out of tolerance) and one minor dimensional discrepancy were noted. Duct segments examined were tight, properly attached and otherwise conformed to requirements.

It was noted that the licensee has committed to test Category I, II, and III fire dampers under design flow conditions, as discussed in letters to the NRC dated February 22, 1985 and March 20, 1985. As such, fire dampers were not reviewed during this inspection.

In conjunction with the NRC CAT review of design change control (Section VII), it was observed that the implementation and FQC inspection/acceptance of E&DCR FB-33829 regarding the installation of a moisture element to ducting were not proper in that the overall as-built plate dimensions did not conform to the specified dimensions, and that conflicting fastening instructions existed in the E&DCR. This discrepancy is considered to be an example of inadequate inspection by FQC.

c. Conclusion

HVAC restraints and duct segments generally conformed to design and procedural requirements.

5. Mechanical Equipment

a. Inspection Scope

Twenty-nine pieces of equipment for ten systems (Chemical & Volume Control, Auxiliary Feedwater, Quench Spray, Safety Injection, Safety Injection Pump Cooling, Component Cooling, Charging Pump Cooling, Service Water, Control Building Air Conditioning and Control Building Chilled Water) were inspected for proper configuration, location, condition and bolt size. Installation documentation for these components were also reviewed for content, clarity, consistency and thoroughness. Equipment examined included the Component Cooling Water Heat Exchangers, Auxiliary Feedwater Pumps and the Chemical and Volume Control Charging Pumps. Table III-7 provides a listing

of inspected items.

The licensee's Preventive Maintenance Program was also reviewed. Equipment whose maintenance records were examined for this review are listed in Table III-8.

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

- SWEC Specification M914, "Mechanical Equipment Erection," Rev. 2, Addendum 3
- SWEC Field QC, "Mechanical Equipment Installation Handbook"
- NNECO Procedure MP3704A, "Preventive Maintenance Program," Rev. 0
- SWEC Quality Standard QS-13.12ML, "Material Equipment Maintenance," Rev. 0
- Applicable equipment details and foundation drawings

b. Inspection Findings

Installation inspection reports exhibited proper sequencing of inspection. The NRC CAT inspector examined documentation for components which were considered to be completely installed, and those which were still in-process. Equipment which had received final alignment and/or whose foundation anchor bolts had been tensioned or torqued were considered to have been completely installed.

Of the 29 components for which installation documentation was reviewed, all had been inspected and found acceptable by FQC for those attributes examined by the NRC CAT inspector. Of these components, the NRC CAT identified discrepancies between installation requirements and as-installed conditions for 19 components.

1. The following components did not possess documentation which indicated that their foundation bolting was torqued to the requisite values specified by the vendor drawing:

° Quench Spray (QSS) Pumps	(P3A, P3B)
° Charging Pump Cooling (CCE) Pumps	(P1A, P1B)
° Safety Injection Pump Cooling (CCI) Pumps	(P1A, P1B)
° Service Water (SWP) MCC & Rod Area Booster Pumps	(P3A, P3B)
° Control Building Chilled Water (HVK) Pumps	(P1A, P1B)

2. The following components were missing washers at all foundation anchor locations, contrary to drawing and Specification requirements:

° Chemical & Volume Control (CHS) Charging Pumps (P3A, P3B, P3C)
° Auxiliary Feedwater (FWA) Pumps (P1A, P1B, P2)
° Quench Spray (QSS) Pump (P3A)
° Safety Injection Pump Cooling (CCI) Pump (P1A)
° Service Water (SWP) MCC & Rod Area Booster Pumps (P3A, P3B)
° Control Building Chilled Water (HVK) Pumps (P1A, P1B)

Boric Acid Transfer Pump CHS*P2A was observed to be missing two washers and CHS*P2B was missing one washer at their respective foundation anchor attachments.

3. The following components were installed without the specified double nut arrangement on the foundation anchor bolts:

° Safety Injection (SIH) Pumps (P1A, P1B)
° Quench Spray (QSS) Pumps (P3A, P3B)
° Auxiliary Feedwater (FWA) Pumps (P1A, P1B, P2)

4. Boric Acid Tank CHS*TK5B was found to have nearly all of its foundation anchor nuts loose, despite a SWEC FQC inspection report verifying their tightness. It was learned that this component had been transferred to NNECO responsibility. However, NNECO at the time did not possess documentation authorizing work on this component, nor were they aware of the component's condition. NNECO did not have a formalized procedure in place which verified the acceptability of equipment conditions, protective measures, and surroundings. As a result of the NRC CAT observations, the licensee performed a reinspection of approximately 80 Seismic Category I components (all mechanical equipment including HVAC) in order to verify compliance to specified anchorage criteria. Several additional discrepancies were identified. All discrepancies whether identified by the NRC CAT or by the licensee were documented on UNSAT Inspection Reports with corrective actions to be implemented.

Eight components were found to have been installed to the specified requirements, and are appropriately noted in Table III-7.

The NRC CAT inspectors also reviewed the seismic analyses for the Auxiliary Feedwater Motor Driven and Turbine Driven Pumps, Quench Spray Pumps, Safety Injection Pump Cooling Pumps, Charging Pump Cooling Pumps and the Service Water MCC and Rod Area Booster Pumps for consistency between the foundation anchor bolt material type assumed in the analyses, and the as-installed material. No discrepancies were identified. The seismic analyses for components supplied through Westinghouse, e.g., CVCS Charging Pumps and Safety Injection Pumps were not available for review.

With regard to the review of the Preventive Maintenance Program, formal maintenance records for the 25 components selected for this review were available and complete until the time the components were turned over to NNECO from SWEC. No discrepancies were identi-

fied in the SWEC maintenance records. However, formal records of mechanical related activities for 23 components did not exist for the time period between "turnover" and Phase 1 preoperational testing (the exceptions being the periodic maintenance performed on the Service Water Pumps). The NRC CAT was concerned that preventive maintenance activities had not been performed on those pieces of equipment which experienced extended delays between turnover and Phase 1 testing, and that if maintenance activities had occurred, a means of verifying the performance of activities through formal documentation had not been established. This similar concern had been expressed in a December 28, 1984 NUSCO QA Audit A-40958.

In response to our concerns, NNECO proposed changes to Maintenance Procedure 3704A, "Preventive Maintenance," which would include formalized review and implementation guidelines regarding storage preventive maintenance activities, and an evaluation of the effects of missed maintenance activities over two or more periods. Maintenance Procedure 3719MB, "Mechanical Equipment General Inspections" was to be written also to document inspection criteria for mechanical equipment. In addition, equipment which have already been turned over to NNECO will be reviewed for inclusion into the Preventive Maintenance Program in accordance with the revised procedures. These proposed changes, when implemented, will adequately resolve the concerns of the NRC CAT.

c. Conclusions

No major hardware discrepancies were noted during the inspection of mechanical equipment. However, the NRC CAT inspectors are concerned that final configurations for foundation anchor attachments are not receiving adequate inspection to ensure their conformance to specified requirements. Although the licensee has performed a reinspection of all Category I mechanical components, additional attention in the programmatic and procedural areas is warranted since future inspections resulting from modifications, rework, and maintenance to these components will likely be necessary.

The NNECO Preventive Maintenance Program was deficient in that formal measures were not implemented to ensure continued maintenance activities for components prior to preoperational testing. Changes to the program have been proposed to resolve this deficiency.

TABLE III-1a

PIPING INSPECTION SAMPLE (Large Bore)

System	Drawing Number	Diameter (Inches)	Pipe Class	Observations	Notes
CHS	CHS-11 Sheet 2 Issue 7	3	2	None	1, 2
CHS	CHS-31 Sheet 3 Issue 5	3/4, 3, 4	2	Clearance violation (7/8") at pipe sleeve not identified	
				Drafting errors at PLI include: omitted dimension, omitted support function and identification, and incorrect pipe orientation angle (4°)	4
CHS	CHS-32 Sheet 3 Issue 6	3/4, 3, 4	2	5'4-13/16" design dimension measured approx. 4'7"	3
				1'2-9/16" design dimension measured approx. 12"	3
CHS	CHS-45 Sheet 3 Issue 6	3	3	9'4-7/16" design dimension measured approx. 9'3"	1
				7'6-1/16" design dimension measured approx. 7'7/12"	
FWA	FWA-1A Sheet 3 Issue 3	10	3	2'2-1/2" design dimension measured 2'5-1/2"	
				Support PSR 193 design location is 4-1/16" north of branch to valve V954; Actual location is 3-1/2" south of the branch	3, 5

TABLE III-1a (Continued)

PIPING INSPECTION SAMPLE (Large Bore)

System	Drawing Number	Diameter (Inches)	Pipe Class	Observations	Notes
FWA	FWA-2 Sheet 3 Issue 2	8	3	2'2-15/16" design dimension measured approx. 2'7" 3'11-1/8" design dimension measured approx. 3'9" 3'3 15/16" design dimension measured approx. 3'0.	
FWA	FWA-2 Sheet 4 Issue 2	8	3	1'11-11/16" design dimension measured approx. 2'11"	3
FWA	FWA-3 Sheet 4 Issue 4	10	3	None	
FWS	FWS-13 Sheet 4 Issue 3	16, 18, 20	2, 3	None	
FWS	FWS-13 Sheet 5 Issue 3	8, 18, 20	2	None	
RHS	RHS-1 Sheet 5 Issue 5	8, 10	2	None	2
RHS	RHS-1 Sheet 6 Issue 5	10	2	None	2
RHS	RHS-501 Sheet 3 Issue 7	1, 4, 12	1, 2	1'2-13/16" design dimension measured approx. 12"	1, 2
RHS	RHS-501 Sheet 4 Issue 7	12	1		1

TABLE III-1a (Continued)

PIPING INSPECTION SAMPLE (Large Bore)

System	Drawing Number	Diameter (Inches)	Pipe Class	Observations	Notes
QSS	QSS-3 Sheet 4 Issue 4	6, 8, 12	2	3'6-7/8" design dimension measured approx. 2'6"	
				Support (PSR-063) identified as vertical and axial restraint only. Also provides lateral restraint	
				3'8 5/8" design dimension measured approx. 3'6"	
				4'2-1/4" design dimension measured approx. 3'6"	
SIL	SIL-8 Sheet 5 Issue 6	8	2	Clearance violation (3/4") between valve and adjacent pipe no. 3-DGS-002-62-4 not identified	1

CHS - Chemical & Volume Control
FWA - Auxiliary Feedwater
FWS - Feedwater
QSS - Quench Spray
RHS - Residual Heat Removal
SIL - Low Pressure Safety Injection

TABLE III-1b

PIPING INSPECTION SAMPLE (Small Bore)

System	Drawing Number	Diameter (Inches)	Pipe Class	Observations	Notes
SWP	319702 Sheet 3 Issue 5	2	4	None	1
SWP	319703 Sheet 4 Issue 5	2	3	None	1
SWP	319722 Sheet 3 Issue 3	1	3	None	1
SWP	319728 Sheet 4 Issue 5	1	3	Clearance violation (5/8") between pipe and adjacent pipe	1
SWP	319729 Sheet 3 Issue 5	1	3	None	1
RHS	371003 Sheet 3 Issue 6	2	2	2'6" design dimension measured 2'8"	
RHS	371702 Sheet 3 Issue 6	3/4	2, 4	None	1
CCE	410100 Sheet 3 Issue 6	1-1/2, 2	3	None	1
CCE	410511 Sheet 3 Issue 6	1-1/2, 2	3	None	1
CCE	410512 Sheet 3 Issue 5	2	3	1'10-7/8" design dimension measured approx. 2'0"	1

CCE - Charging Pump Cooling
RHS - Residual Heat Removal
SWP - Service Water

TABLE III-1b (Continued)

PIPING INSPECTION SAMPLE (Small Bore)

NOTES:

1. Pre N-5 final inspection was complete for this isometric.
2. This piping was partially or completely insulated at the time of the NRC CAT inspection.
3. This dimension was to "moveable" (i.e., other than integrally attached) support and will be remeasured during pre N-5 inspection.
4. This error would likely be detected during the as-built stress reconciliation effort.
5. This error might be detected during the ASME III Fabrication/Installation not yet performed.

TABLE III-2a

HYDROSTATIC/PNEUMATIC TEST PACKAGE SAMPLE

Isometric Package	Isometric Packege
CHS-5	QSS-6
CHS-25	QSS-22A
CHS-54	QSS-30
CCP-151	QSS-800
CCP-269A	QSS-801
FWA-13	QSS-802
FWA-800	QSS-803
SIL-12	QSS-804
SIH-7	RHS-3
SIH-46A	RSS-9

CHS - Chemical & Volume Control

CCP - Component Cooling Water

FWA - Auxiliary Feedwater

SIL - Low Pressure Safety Injection

SIH - High Pressure Safety Injection

QSS - Quench Spray

RHS - Residual Heat Removal

RSS - Containment Recirculation Cooling

TABLE III-2b

PIPE WALL THICKNESS SAMPLE AND OBSERVATIONS

Manufacturer/ (Heat No.)	Pipe Size/ Schedule	ASME Class	Specified Nominal (Minimum) Wall Thickness (Inches)	Minimum Wall Thickness Measured (Inches)
B&W (67292)	6/160	2	0.718 (0.629)	0.730
PSC (62886)	10/XS	2	0.500 (0.438)	0.475
A-T (08169)	1/160	1	0.250 (0.219)	0.232
S (455674)	2/160	1	0.343 (0.300)	0.317
B&W (M4865)	2/80	2	0.218 (0.191)	0.194
B&W (M3890)	8/160	2	0.906 (0.793)	0.898
C-W (2561-1-2)	12/160	1	1.312 (1.148)	1.252

A-T - AL Tech Specialty Steel Corp.

B&W - Babcock & Wilcox Tubular Products Division

C-W - Curtiss-Wright Corp.

PSC - Phoenix Steel Corp.

S - Sandvik Inc.

TABLE III-3

PIPE SUPPORT/RESTRAINT INSPECTION SAMPLE

S/R Number	Type	Pipe Class	Size (Inches)	Location
CDS-1-PSST-227	Strut	4	4	Annulus
CCP-1-PSR-154	Strut	3	4	Annulus
CCP-2-PSRH-175	Rod	4	2 1/2	Aux.
CCP-2-PSR-069	Strut	3	18	Aux.
CHS-2-PSR-324	Box	2	8	Aux.
CHS-2-PSSH-020	Spring	2	4	Aux.
QSS-1-PSSP-407	Snubber	1	12	Cont.
QSS-4-PSSH-050	Spring	4	12	Cont.
QSS-4-PSST-115	Strut	2	14	ESF
RCS-1-PSA-037	Clamp Anchor	1	4	Cont.
RCS-1-PSSP-522	Snubber	1	14	Cont.
RCS-1-PSSH-524	Spring	1	14	Cont.
RCS-1-PSSH-500	Spring	1	8	Cont.
RCS-1-PSR-025	Strut	1	4	Cont.
RHS-1-PSST-009	Strut	1	12	Cont.
RHS-1-PSST-011	Strut	1	12	Cont.
RHS-1-PSR-014	Strut	2	12	Cont.
RHS-1-TPSR-072	Bolted Clamp	1	3/4	Cont.
RHS-4-PSSP-413	Snubber	2	10	ESF
RSS-1-PSA-079	Box	2	10	Cont.
RSS-1-PSR-106	Strut	2	12	Cont.
RSS-1-PSSP-434/435	Snubbers	2	12	Cont.
RSS-4-PSRH-047	Rod	4	10	ESF
RSS-4-PSRH-053	Rod	4	12	Cont.
RSS-4-PSSH-141	Spring	2	10	Cont.
RSS-4-PSST-002	Strut	2	8	Cont.
SIL-1-PSR-358	Strut	1	6	Annulus
SIL-1-PSA-446	Clamp Anchor	1	6	Annulus
SIH-1-PSR-349	Strut	2	4	Annulus
SIH-4-PSST-105	Strut	2	4	ESF
SWP-4-PSST-117	Strut	3	18	ESF
SWP-4-PSA-142	Bolted Anchor	3	8	ESF

Annulus - Containment Building Annulus
Aux. - Auxiliary Building
Cont. - Containment Building
ESF - Engineered Safety Features Building

TABLE III-4

PIPE SUPPORT/RESTRAINT INSPECTION OBSERVATIONS

Primary Sample

Support/Restraint	Observation
QSS-4-PSST-115	Oversized strut installed (N&D 11,574).
	Drafting error-failure to correctly incorporate weld size (N&D 11,506).
SIL-1-PSA-446	Drafting error-failure to correctly incorporate weld symbols (E&DCR T-J-03609).
SIH-1-PSR-349	Strut rod end bearing spacers missing (PLIR 1298).
RCS-1-PSSH-500	Attachment location 1-1/2 inch from location indicated on drawing.
	Weld of Pc. 9 to existing steel not centered as shown on dwg. sect. 2-2.
RCS-1-PSSH-524	Orientation of lugs approx. 30 degrees from that specified on dwg. Note 4. (N&D 11,708).
	Elevation attachment locations of Pc. 8 and 9 to embed 2-1/2 to 3-1/2 inch from that shown on dwg.
	One cotter pin not bent.
RSS-1-PSA-079 (Not yet final QC accepted)	Improper structural bolts installed; removal of stiffener plates required for rework (IR P5A91133).
RSS-1-PSR-106	Loose locknut.
RHS-1-PSST-009	Attachment location 2 inches from that shown on dwg. (IR P5A91143).
	Drafting error-failure to incorporate weld symbols (N&D 11499).
	Loose locknut.
SWP-4-PSST-117	Attachment location 24 inches from that shown on drawing.

TABLE III-4 (Continued)

PIPE SUPPORT/RESTRAINT INSPECTION OBSERVATIONS

Primary Sample

Support/Restraint	Observation
CCP-1-PSR-154	Weld of Pc. 6 to existing steel is welded across the beam flange; Section 2-2 of dwg. shows it welded along the run of the beam (N&D 11,711).
	Stiffener plates lack 5/8 inch from extending full width of flange (N&D 11,900).
	Unspread cotter pin.
RCS-1-PSR-025	Attachment location of Pc. 2 rear bracket 2-1/2 inches from that indicated on dwg. (N&D 11,709).
QSS-4-PSRH-053 (CAT II)	Loose rod
	Lockwasher installed on Hilti anchor (N&D 11,557).
	Anchor spacing violation to adjacent support (that had not yet been QC accepted) (N&D 11,557).

Adjacent Supports/Restraints

Support/Restraint	Observation
RSS-1-PSR-114	Sheared cotter pin, pipe clamp out of adjustment. (IR P3003277).
RCS-1-PSST-429	Clamp and bearing spacers missing.
RHS-4-PSST-001	Strut not tight, tapered bearing washers installed backward.
RHS-4-PSSP-410	Strut locknut backed off.
SIH-1-PSA-342	Clamp anchor loose, missing flat and lock washers, weld undersized and poor quality (IR P549129).

TABLE III-4 (Continued)

PIPE SUPPORT/RESTRAINT INSPECTION OBSERVATIONS

Adjacent Supports/Restraints

Support/Restraint	Observation
DAS-2-PSRH-416 (Cat II)	Loose pipe clamp, loose rods with inadequate thread engagement, riser clamp not in contact with lugs (IR P5A91559).
SFC-1-PSRH-113	Cotter pins not bent.
DFR-4-PSR-001 (Cat II)	Box restraint has zero clearance top and bottom (IR P5A91560).
MSS-1-PSSH-128	Only one lug in contact with riser clamp. Design calculation is based on load being carried by two lugs.

TABLE III-5

CONCRETE EXPANSION ANCHOR SAMPLE

Pipe Supports/Restraints

Pipe Support	Number-Diameter of Anchors Inspected	Pipe Support	Number-Diameter of Anchors Inspected
CP408052-H003	2-3/4"	RSS-4-PSR-190	4-1"
CHS-2-PSSH-209	2-1"	CP41022-H001	2-1"
BDG-1-PSSP-430	3-3/4"	CP319732-H001	2-3/4"
CP408056-H002	4-3/4"	CH-2-PSR-354	4-1"
CP408056-H004	3-3/4"	CCP-2-PSR-125	4-3/4"
CP408056-H005	3-1/2"	CCP-2-PSSP-401	4-3/4"
CP405001-H003	2-3/4"	SIL-2-PSA-287	13-1"
CHS-1-PSR-549	6-1"	SIH-2-PSA-191	4-1"
QSS-4-PSSP-400/407	2-1"	SIL-2-PSR-283	4-3/4"
CCP-4-PSR-113	3-1"	CHS-2-PSSP-468	4-1"
CP394038-H001	4-3/4"	CHS-2-PSA-353	8-1"
CP526022-H002	2-1"	RSS-4-PSSP-412	4-1"
RSS-4-PSST-140	4-1"		

HVAC Restraints

Restraint	Number-Diameter of Anchors Inspected	Restraint	Number-Diameter of Anchors Inspected
DSA-1321	4-1"	DSA-785	2-1"
DSA-1172	6-1"	DSA-948/950	6-1"
DSA-812	4-1"	DSA-1250	2-1"

TABLE III-5 (Continued)

CONCRETE EXPANSION ANCHOR SAMPLE

HVAC Restraints

Restraint	Number-Diameter of Anchors Inspected	Restraint	Number-Diameter of Anchors Inspected
DSA-863	3-1"	DSA-1251	2-1"
DSA-1240	3-5/8" 1-1"	DSA-431	5-1"
DSA-758	2-1"		

TABLE III-6

HVAC INSPECTION SAMPLES AND OBSERVATIONS

Suports/Restraints

Support/Restraint	Location	Observations
DSA 314	Aux. Bldg.	Acceptable
DSA 016	Aux. Bldg.	Acceptable
DSA 1209	Aux. Bldg.	Acceptable
DSA 1210	Aux. Bldg.	Acceptable
DSA 788	Aux. Bldg.	Acceptable
DSA 1211	Aux. Bldg.	Acceptable
DSA 464	Aux. Bldg.	Brace angles exceed dwg. tolerance by 1 and 2 degrees. (No structural significance.)
DSA 1166	Aux. Bldg.	Acceptable
DSA 1167	Aux. Bldg.	Extension of vertical member past brace was 3-1/2 inches. Dwg. shows 1 inch. (No structural significance.)
DSR 277	ESF Bldg.	Acceptable
DSA 278	ESF Bldg.	Acceptable
DSA 403	ESF Bldg.	Acceptable

TABLE III-7

MECHANICAL EQUIPMENT SAMPLE

Equipment		Acceptable*
Chemical & Volume Control Charging Pumps	CHS*P3A, P3B, P3C	
Auxiliary Feedwater Pumps	FWA*P1A, P1B, P2	
Refueling Water Recirculation Pumps	QSS*P1A, P1B	X
Quench Spray Pumps	QSS*P3A, P3B	
Safety Injection (SI) Pumps	SIH*P1A, P1B	
SI Pump Cooling Pumps	CCI*P1A, P1B	
Boric Acid Transfer Pumps	CHS*P2A, P2B	
Volume Control Tank	CHS*TK2	X
Boric Acid Tank	CHS*TK5A	X
Boric Acid Tank	CHS*TK5B	
Component Cooling Heat Exchanger	CCP*E1B	X
Charging Pump Cooling Pumps	CCE*P1A, P1B	
Charging Pump Cooling Surge Tank	CCE*TK1	X
Service Water MCC & Rod Area Booster Pumps	SWP*P3A, P3B	
Engineered Safety Features Air Conditioning Units	HVQ*ACUS-1A, 1B	X
Control Building Chilled Water Pumps	HVK*P1A, P1B	

*Note: All components were observed having installation deficiencies unless stated as "acceptable."

TABLE III-8

PREVENTIVE MAINTENANCE EQUIPMENT SAMPLE

Equipment	
Boric Acid Transfer Pumps	CHS*P2A, P2B
ESF Building Ventilation Fan	HVQ*FN5A
Spent Fuel Cooling Pumps	SFC*P1A, P1B
Quench Spray Pumps	QSS*P3A, P3B
CVCS Charging Pumps	CHS*P3A, P3B
Diesel Generator Building Ventilation Fan	HVP*FN1C
Auxiliary Feedwater Pumps	FWA*P1A, P1B, P2
Residual Heat Removal Pumps	RHS*P1A, P1B
Diesel Generator Fuel Oil Pumps	EGF*P1A, P1B, P1C, P1D
Service Water Pumps	SWP*P1A, P1B
Safety Injection Pumps	SIH*P1A, P1B
Control Building Chilled Water Pumps	HVK*P1A, P1B

IV. WELDING AND NONDESTRUCTIVE EXAMINATION (NDE)

A. Objective

The objective of the subject appraisal was to determine the licensee effectiveness and program adequacy in controlling and performing activities in accordance with the Final Safety Analysis Report (FSAR) commitment, design requirements and applicable codes and standards. An additional objective was to determine if the personnel involved in welding and NDE activities were adequately trained and qualified to perform their duties in accordance with applicable specifications, codes and standards.

B. Discussion

A detailed inspection of welding and NDE activities was conducted. This inspection included welds in both ASME Code and AWS Code related areas. The ASME Code area included piping, pipe supports, and pressure vessels. The AWS area included electrical, instrumentation and HVAC supports, structural beam clip welds, component cooler beam stiffener support welds, refueling cavity liner welds, fire protection pipe support welds, HVAC duct welds, and refueling cavity support stand welds. The NDE portion of the inspection included review of site and vendor radiographs, NDE procedures, observation of FQC inspectors in the course of NDE examinations and review of NDE equipment calibrations.

The inspected welds were representative of the licensee's site welding and vendor supplied equipment in terms of welding processes used, materials welded, various welding craft conducting welding operations and existing weld-joint configurations.

During the inspection of NDE activities, the NRC Construction Appraisal Team (CAT) inspectors reviewed samples of current radiographic film and radiographic film in final storage in the vault at the licensee's facility. In addition, the NRC CAT inspectors reviewed samples of film which was stored at vendor facilities which was made available for this inspection. No significant problems were identified in the area of field and shop welding and NDE activities. However, several discrepancies were identified in the areas of field and vendor NDE, and detailed discussion concerning these discrepancies is included 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 areas and contractors:

Field Fabrication and Contractors

Field fabrication of piping and pipe supports (Main Steam, Reactor Coolant, Feedwater, and Safety Injection) - Stone and Webster Engineering Corporation (SWEC)

Electrical install tion and electrical supports - SWEC

Instrumentation tubing installation and instrumentation supports - SWEC

Heating, Ventilation and Air Conditioning installation and supports - Northeast Ventilation Company (NEVCO)

Structural steel fabrication and erection - SWEC

Fuel storage pool and refueling cavity liner fabrication - PX Engineering shop fabrication and SWEC installation

Mechanical equipment installation - SWEC

Fire protection system fabrication and installation - SWEC

1. Piping

a. Inspection Scope

The NRC CAT reviewed activities related to fabrication and SWEC installation of piping fabricated by TUBECO and Southwest Fabricating and Welding. These activities included visual inspection of welds, welding procedures and welder qualifications documentation.

b. Inspection Findings

Detailed visual inspection was performed on portions of the Reactor Coolant loop piping, Feedwater, Main Steam, Safety Injection and other seismically designed piping. Approximately 800 large diameter butt welds and 600 small diameter socket welds were inspected. See Tables IV-1 and IV-2 for details. In addition to visual inspection, the items listed in Table IV-2 were reviewed for correctness and completeness of documentation. During this review, special attention was given to verifying that the required nondestructive examination had been performed, that the materials used met tensile and impact test requirements, and that SWEC welders were properly qualified at the time the welds were made. In addition, six SWEC welding procedures which were widely used on piping systems were reviewed.

During the visual inspection of the piping welds, no unacceptable welds were observed. During the review of documentation of those items listed on Table IV-2, it was observed that one butt weld had been allowed to cool at a rate in excess of that permitted by Code. N&D 11791 was generated to address this finding. It was also observed that there were code-related editorial errors on three of the Welding Procedure Specifications which were reviewed. E&DCRs 41852, 41853 and 41854 were generated to address these observations.

During documentation review, the NRC CAT reviewed approximately 180 welder qualification records for eighteen welders, and verified that each welder had remained qualified from the date of his original qualification to the date that he welded, as recorded in the documentation.

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

c. Conclusions

With the exception of the editorial errors in three welding procedures and excessive cool down rate involving one weld, the inspected piping welds were found to comply with the applicable codes and standards.

2. Tanks, Pressure Vessels and Heat Exchangers

a. Inspection Scope

The NRC CAT reviewed activities related to the fabrication of twelve tanks, pressure vessels and heat exchangers manufactured by various vendors as shown in Table IV-3. These activities included visual inspection of completed welds, including ASME pressure boundary and support welds.

b. Inspection Findings

Of the twelve, one tank was found to be acceptable, three had undersized welds on supports only, eight had undersized welds on nozzles, manways and supports, and one had an unacceptable weld surface condition. These items were identified for resolution by the N&Ds listed on Table IV-3.

Based on the NRC CAT findings regarding the support welds, a Report of a Problem (ROAP) 85012 was issued and an additional 52 vendor supplied Category I tanks, pressure vessels and heat exchangers were inspected by SWEC. Of these, 32 had fillet welds undersized by one-sixteenth to one-eighth inch. N&Ds were written to cover 14 of these items prior to the end of the inspection. SWEC indicated that they would inspect all nozzle and manway joint configuration fillet welds on Category I tanks, pressure vessels and heat exchangers and issued ROAP 85008 to accomplish this task.

c. Conclusions

With the exception of the identified deficiencies involving undersized fillet welds in supports, in nozzles and manways on ASME Code fabricated tanks and heat exchangers, the tank and heat exchanger welds were found to comply with applicable codes and standards.

3. Piping Supports and Restraints

a. Inspection Scope

The NRC CAT reviewed activities related to fabrication and installation of piping supports and restraints manufactured by Corner and Lada and supporting steel installed by SWEC. These activities included inspection of welds and general configuration of supports and restraints.

b. Inspection Findings

A sample of 35 supports and restraints was selected based on configurations whose complexities provided fabrication difficulties. These supports were then visually inspected for weld size and appearance to determine conformance to engineering drawing requirements. The supports examined are shown in Table IV-4 and included approximately 400 welds. A large number of skewed joint fillet welds were found by the NRC CAT inspectors to be undersized on the obtuse angle side of the connection. No undersized welds were discovered on the acute side of such connections. A second problem was observed when the skewed angle exceed 135°. In this case the engineering drawings required that the toe of one of the members being joined be cut back so that the required fillet weld size could be obtained. Two cases were identified in which the member had been inadaquately cut back and did not produce the required fillet weld size. As a result of the NRC CAT findings, SWEC inspected 80 additional skewed configuration supports and found 41 supports which had undersized fillet welds on the obtuse angle side.

SWEC analyzed the skewed connections generically for connections welded on the heel (acute angle side) and two sides, taking no credit for any weld which might be on the toe of the connection. Calculation 12179-NP(F)-4046-ZC demonstrated that as the connection angle becomes more obtuse, the strength of the joint increases due to an increase in length of the two side welds, and that at angles of greater than 130°, the skewed connection made with only the two side welds will be stronger than a three-sided weld connection at 90°. Based on the above review of the as-built condition, connections which were welded on either three or four sides were found to be acceptable by SWEC engineering evaluation.

SWEC review of skewed connections welded only on the toe and heel side of the connection indicated that these connections would have to be inspected and evaluated on a individual basis. This evaluation will also include evaluation of possible insufficient cut back on connections made at angles greater than 135°.

In addition to the undersized welds found on skewed connections, 16 other undersized welds were observed. These items were identified and either repaired or evaluated by engineering for disposition as noted in Table IV-4. Of these welds, one type was observed to have generic implications. The others were found to be isolated cases. Support SIH-1PSR-581 consisted of a U-shaped steel flat bar wrapped around the pipe. This support was found not to have the required full penetration weld, and several similar supports were observed on the SIH (High Pressure Safety Injection) system. Investigation indicated that this support design was unique to one design group and only 21 supports of this type had been detailed. None of these supports had the required full penetration weld. N&D's listed in Table IV-4 were generated for these nonconformances.

In addition to the above supports and restraints, an additional 60 supports with approximately 800 welds were visually examined. No significant defects were found. See Table IV-5 for details.

c. Conclusions

With the exception of those items previously discussed piping supports and restraint welds were found to comply with the applicable codes and standards. No other problems were identified in the area of inspected welding activities.

4. Reactor Internals

a. Inspection Scope

Approximately 140 welds made by the vendor (Westinghouse-Pensacola) and at the site by SWEC under Westinghouse supervision were visually inspected. These welds represented four joint configurations. The site welder qualifications were reviewed. A special mock up test assembly used for further welder training and determination of actual throat dimensions was reviewed. The applicable site weld procedure specification (WPS) was reviewed as were typical site filler metal issue slips.

b. Inspection Findings and Conclusions

No problems were identified in the area of inspected welding activities which were found to meet the applicable requirements.

5. Reactor Internals Support Stands

a. Inspection Scope

A visual inspection was made of this seismically designed QA CAT 2 fabrication which was designed to Appendix G of ASME Section VIII. It was penetrant tested to Section VIII and the final inspection was performed at the vendor's (Portland Engineering) shop. In addition, the SWEC M090 equipment specifications for the supports were reviewed. Random areas were checked magnetically for presence of materials other than austenitic stainless steel and the weld metal was checked for the presence of delta ferrite.

b. Inspection Findings

Visual examinations of the welds indicated weld splatter and an unusual appearance of the GTA welds at the edge of shielded metal arc (SMA) welded joints. The licensee initiated N&D 11,460 which adequately addressed the findings.

c. Conclusions

Except as noted welds met specified acceptance criteria.

6. Refueling Cavity Liner Fabrication

a. Inspection Scope

The refueling cavity liner and spent fuel pool liners were a combination of vendor (PX Engineering) supplied panels and SWEC site

installation. The shop fabrication was in accordance with SWEC M110 which called for radiography of some of the butt welds. Site installation was to SWEC M952 and called for visual inspection and air leak testing of the finished liner. The NRC CAT visually inspected approximately 100 feet of the refueling cavity liner welds, verified the presence of delta ferrite and checked for the presence of non-austenitic materials. The ladder and bolted connections were also checked for use of non-austenitic materials. Review of PX Engineering radiographic film (discussed later) indicated unacceptable film quality, but noted this was previously identified by SWEC vendor inspection on N&D A-006 which was dispositioned to "accept as is" and voided the radiographic examination. Approximately 30 inspection reports indicating the results of the air leak test of the finished fabrication were reviewed.

b. Inspection Findings

The visual inspection of the welds indicated no rejectable indications and the welds contained adequate levels of delta ferrite. Review of N&D A-006 indicated a lack of explicit engineering explanation on the voiding of RT requirements. The licensee responded to this comment with the issuance of E&DCR T-J-03875 which makes the necessary specification changes to M910.

c. Conclusions

Welds met acceptance criteria.

7. Electrical Panel Attachment Welds

a. Inspection Scope

The NRC CAT visually inspected approximately 240 panel attachment welds for compliance with the specified criteria. The applicable WPS document for this fillet welding was reviewed.

b. Inspection Findings

The welds exhibited acceptable size, configuration (shape) and met minimum drawing requirements for length and spacing.

c. Conclusions

Welds met acceptance criteria.

8. Electrical Support Welds

a. Inspection Scope

Approximately 434 electrical support welds were visually inspected for compliance with the specified criteria. The qualification records of 9 welders were reviewed. The applicable WPS documents were also reviewed.

b. Inspection findings

The inspected welds met drawing requirements and exhibited acceptable shape and post weld finishing.

c. Conclusions

Welds met acceptance criteria.

9. Instrumentation Supports

a. Inspection Scope

Approximately 130 welds, involving supports, tubing blocks, instrument stands, and standard wall mounting brackets were visually inspected to ascertain compliance with the specified acceptance criteria. Applicable welding procedures, filler metal issue slips, and welder qualification records for 11 welders were reviewed.

b. Inspection Findings

The welds inspected met the acceptance criteria. In the process of reviewing welder qualifications it was noted that welders required to utilize F43 SMAW filler metal were qualified using F42 filler metal which currently is an unacceptable ASME Section IX practice. However, review of this subject with the licensee and SWEC indicated that the edition of Section IX in force at the time of qualification permitted this practice.

In the process of reviewing the filler metal issue slips it was apparent that designations other than that shown in the WPS documents are used for non-ferrous metals. This lead to an expanded filler metal control inspection which is discussed in paragraph 15 of this section.

c. Conclusions

Welds met acceptance criteria.

10. HVAC Duct and Duct Support Welds

a. Inspection Scope

Approximately 133 HVAC duct and duct support welds made by NEVCO were visually inspected for compliance to welding specification and inspection criteria. Also reviewed were NEVCO welding procedures qualified to AWS D9.1 and their structural welding procedure utilizing AWS D1.1 prequalified procedures. The NEVCO welder performance qualifications records of five welders were reviewed as were QC weld records and filler metal issue slips.

b. Inspection findings

Special efforts were made by the NRC CAT to verify the required removal of the galvanizing for all structural AWS D1.1 HVAC support welds. This was a SWEC specification requirement, but no inspection hold point was setup to check for zinc removal. Removal of zinc was checked in the final QC inspection.

The NRC CAT noted that the GMAW-S sheet metal welding procedures WP-24, WP-28, and WP-29, specified ER80S-D2 (formerly ER70S-1B) weld rod. The utilized amperage and voltage ranges for the filler metal size exceeded the range for the short-circuiting mode of metal transfer. The yield strength of the utilized filler metal (over 95KSI) greatly exceeded the base metal properties. The licensee response to the first concern was that the usability of the ER80S-D2 exceeded that of the unalloyed ER70S-2 or S-3 and that the high strength was not considered detrimental due to the limited loading on the sheet metal welds. The mode of metal transfer question was resolved by discussion with NEVCO personnel who all indicated that the parameters actually utilized were within the short-circuiting range. This was confirmed by visual inspection of completed welds.

c. Conclusions

The inspected welds were found to conform to the applicable specifications, codes and standards, and the filler metal and mode of metal transfer questions were adequately answered.

11. Component Cooler Support Welds

a. Inspection Scope

Design modifications for the subject ASME Section III, NF support (CH-CCP-SPIA) requiring plate beam stiffner welding was underway which permitted visual observations of preweld cleaning, layout, fitup and visual inspection of approximately 100 welds in accordance with Technique Sheet W2N-1. Review was made of the welding procedure, welder qualification records and filler metal issue control.

b. Inspection results

No problems were identified in the area inspected.

c. Conclusions

Welds met acceptance criteria.

12. Fire Protection Piping System

a. Inspection Scope

Visual inspection was made of approximately 30 field welds. Six of which were in a Class 2 piping portion of the system. The inspection records and surveillance records for the inspected welds were also reviewed.

b. Inspection results

No problems were identified in the area inspected

c. Conclusions

Welds met acceptance criteria.

13. Structural Steel Welding

a. Inspection Scope

Approximately 39 beam clip angle welds were visually inspected for conformance to drawings, specifications, and codes and standards requirements.

b. Inspection Findings

The NRC CAT inspectors found that beam clip angle welds for slotted and non-slotted clips did not meet drawing requirments for fillet sizes and number of sides welded, due to a conflict between the "typical connection detail" on drawing ES-31J and special detail "EH" on this drawing. This resulted in issuance of ROAP 85013 and N&D 11973. For additional details see Section V.B.2.

Two fillet welds were also found to be undersized. The licensee issued UNSAT IR's S-5A01208 and S-5A01209 to address the undersized fillet welds on the neutron shield surge tank platform and cubicle "A" platform, respectively.

c. Conclusions

Except as noted, welds met acceptance criteria.

14. Welding Preheat

a. Inspection Scope

In the review of welding specifications and procedures, it was noted that a variety of preheating rules were applied for various seemingly identical structural type weldments. This finding necessitated an in depth study of the methods of specifying and controlling preheat.

b. Inspection Findings

Preheat rules are shown in WPS technique sheets (e.g., W200C-W2N, W31.1-01, and W1.1-01) and in SWEC specification M968. These rules all relate to structural welding. An attempt was made to utilize the complicated rules of B31.1-73 in the W31.1-01 document and the AWS D1.1 rules in W1.1-01. The SWEC rules were found to be unnecessarily confusing to all personnel.

The actual method used in field fabrication was witnessed to be as follows: The welders are given copies of the technique sheets with their filler metal issue slip and at the same time are given Tempilstiks to be used for preheat and maximum interpass temperature checks. The welding supervisors determine which Tempilstiks to be issued. QC does not include preheat as a hold point, but does check preheat as a surveillance inspection (IR) item. The surveillance inspection reports rarely indicated the temperature observed, but rather indicated "S" for satisfactory (meets technique sheet requirements). A large number of IR's were reviewed to verify that preheat is one of the criteria checked.

The B31.1-73 "Rules for Preheat and PWHT", Table 131, permit the preheat for socket, fillet and seal welds to be based on the throat thickness of the weld. This approach is reiterated in W31.1-01 and W200C-W2N. Discussions with site personnel (Welding Engineering, QA, QC, welding supervisors and welders) indicated that they base preheat on the thickest part welded which is the AWS D1.1 approach and the metallurgically sound approach.

Part of the confusion in the preheat rules is the inclusion of materials which are not used or have extremely limited use, such as A572 Grades 55 to 65 and AWS Groups 4 & 5. These materials appeared in W1.1.-01. In this case there are three sets of rules where only one is required. In the case of W200C-W2N there are six sets of rules where only one or two are required and again the rules are based on throat thickness not base metal thickness.

In summary the inspection indicated the following:

1. All interviewed personnel stated that they are committed to use preheat based on the thickness of the thickest part to be welded and not on the throat thickness of the weld.

2. All interviewed personnel indicated that thicknesses over one and one-half inches required a minimum preheat of 175°F.

3. In all cases reviewed, the materials involved were ASME P-1 or AWS D1.1 Groups I, II, or III (Except for a specific case of a pipe whip restraint pad made of A514, but welded with preheat and E7018 filler metal per E&DCR RM-1420S.)

4. In all cases reviewed, the sections requiring preheat were welded with low hydrogen electrodes (E7018) which are kept in portable electrode ovens after issuance for welding.

5. The licensee committed to review the various documents specifying preheat for structural welds, incorporate the M968 preheat requirement into the appropriate technique sheet and verify that only the preheat (1) column is applicable in W1.1-01.

c. Conclusions

The NRC CAT considered this item resolved on the basis of the above commitments and the NRC CAT inspection indicated that 175°F minimum preheat is being used for thicknesses over one and one-half inches. E&DCR FM-41-804 has been initiated to revise WPS W31.1 to specify 200°F preheat.

15. Filler Metal Control

a. Inspection Scope

It was noted by the NRC CAT inspectors that the welding supervision was utilizing filler metal issue slip identification that differed from that shown on the welding technique sheets. The scope of filler metal control inspections was expanded to include review of welding technique sheets, purchase orders, SWEC ME-xxx purchase order specifications, review of CMTR's for filler metal, review of the labeling of filler metal in the rod issue rooms, and cursory review of approximately 18,000 filler metal issue slips.

b. Inspection Findings

The inspection indicated confusion in the use of filler metal nomenclature. The following examples were noted:

- W31.1-72 revised in 1983 specifies RCuNi to ME-110 whereas the correct identification is ERCuNi (which appears on the flag tags).

- Technique Sheets called for "Chromenar 521" with no F number where the proper identification from ME113 is SFA5.28 ER90S-B3L.

- Some purchase orders specified SFA filler metal to military designations.

- The filler metal stock sheets in Receiving QC indicated filler metal by SFA and/or military designations.

- Some filler metal issue slips utilized military designations rather than SFA designations.

- GTAW filler metal is contained in the Rod Issue stations in bins labeled with military designations even though the filler metal in the bins is flag tagged with the proper SFA designations.

The confusion in filler metal designations is basically limited to non-ferrous materials. The filler metal CMTR's reviewed met applicable SWEC and SFA requirements. The filler metal utilized for those items checked met the correct chemistry with the exception of one application. The issue slip M365475 called for ERNiCr-3 filler metal whereas the technique sheet called for ERNiCrMo-3. An N&D was

issued to address this item. The licensee's response to the filler metal designation question was to point out that the tables in the Appendices of the nickel alloy filler metal specifications show the direct comparison of military and SFA designations. The NRC CAT pointed out that this was not the case for SFA 5.7 for copper alloys.

c. Conclusions

This item was resolved on the basis that the correct chemistry filler metal (tested to the correct requirements) was utilized for all weldments except as noted (which is considered to be an isolated case).

16. SWEC NDE Activities

a. Inspection Scope

The NRC CAT reviewed 1663 films representing 90 SWEC field welds. A total of 13 FQC NDE Level II Inspectors were observed and reviewed in the process of conducting various examinations (i.e., penetrant examinations, magnetic particle examinations, visual weld examinations, and ultrasonic thickness determinations). The personnel qualification records of nine inspectors were examined in detail. The system for calibration of NDE equipment was reviewed and verified for 14 pieces of equipment. Table IV-6 lists vendor radiographs reviewed.

b. Inspection Findings

Review of the film for 90 welds indicated that the radiographic review did not identify defects in excess of that permitted by the applicable standard in three of the welds. Although this represents a small percentage of the 1663 films reviewed it represents 3.3% based on number of welded joints. In addition to the finding results indicated in Table IV-7, there were several minor report form irregularities such as failure to check off "accept" or "reject", incorrect dates on some forms and failure to note conditions affecting subsequent radiographic interpretations.

Thirteen FQC NDE Level II personnel which included 2-PT, 2-MT, 3-UT and 6-VT inspectors, were observed and evaluated for level of training, knowledge of SWEC NDE procedures, and conformance to applicable codes and standards rules. The 13 FQC inspectors were judged to be fully trained and cognizant in their area of expertise. Review of personnel qualification record files of 10 FQC NDE inspectors indicated conformance to SNT-TC-1A, ANSI, ASME, and SWEC procedure requirements.

Evaluation of the calibration of NDE equipment indicated acceptability in all cases except for the use of one UT thickness gauge. Ultrasonic procedure, QAD-9.52 Revision C dated 9/12/84 para. 5.2.2, provided for a one point calibration only. It was discovered during a witness check of ultrasonic thickness on production pipe that an error was made during the calibration for the test. The error was

approximately 7% and that could lead to accepting rejectable conditions. The error was detected by the NRC CAT inspector who asked for verification by comparison with a calibrated micrometer. S&W personnel repeated the error and decided to revise the procedure with a two point check to prevent reoccurrence. Due to this finding 24 test records for work performed to the one point procedure were audited. It was discovered that the inspectors had actually used three points to verify their calibrations, in addition SWEC retested 20 welds and the results of the retest were acceptable. QAD-9.52 ML Revision A was issued to require multipoint calibration.

c. Conclusions

The three radiographically rejectable welds and other minor irregularities indicated some inconsistancy involving interpretation and completion of report forms.

17. Vendor NDE Activities

a. Inspection Scope

The NRC CAT visually inspected welds representing pressure vessels supplied by seven vendors as discussed in Section IV.B.2 and shown on Table IV-3. Radiographs representative of 30 vendor supplied items were reviewed as shown in Table IV-6.

b. Inspection Findings

The vendor film review resulted in review of approximately 1735 feet of weld, 21 valves, 14 forgings, six clevises, one support cylinder, one diffuser, one pump body and one pump gland. The film reviewed was satisfactory except as noted. One vendor had film that was rejectable on a film quality basis, but this was dispositioned to represent unneeded and unrequired radiography in E&DCR FJ10978 and TJ03875. One film from one other vendor was rejectable because of film density.

c. Conclusions

The review of vendor radiography indicated acceptable technique and interpretation except as shown in the notes to Table IV-6.

TABLE IV-1
PIPE VISUALLY INSPECTED

PIECE MARK	SYSTEM	PIPE SIZE (inches)	MATERIAL
CDS-15-5-2-2A	CHILLED WATER	8	CARBON STEEL
CHS-4-3-2-3	CHEMICAL & VOLUME	3	STAINLESS STEEL
CHS-44-1-2-2	CHEMICAL & VOLUME	3, 2	STAINLESS STEEL
CHS-001-719-2	CHEMICAL & VOLUME	1	STAINLESS STEEL
CHS-002-198-2	CHEMICAL & VOLUME	8	STAINLESS STEEL
DGS-6-1-1-4	REACTOR GAS DRAIN	4	STAINLESS STEEL
SIL-1-1-3-2	SAFETY INJECTION	8	STAINLESS STEEL
RSS-1-3-4-2	REACTOR COOLANT	12	STAINLESS STEEL
RSS-15-4-4-2	REACTOR COOLANT	12	STAINLESS STEEL
MS-34-1-5-2A	MAIN STEAM	30	CARBON STEEL
SFC-523-4-3-3	FUEL POOL COOLING	10	STAINLESS STEEL
SIL-1-2-3-2	SAFETY INJECTION	8	STAINLESS STEEL
FWS-22-6-1-2	FEEDWATER	16, 20	CARBON STEEL
FWS-22-4-1-2	FEEDWATER	20	CARBON STEEL
FWS-22-1-1-2	FEEDWATER	20	CARBON STEEL
FWS-22-2-1-2	FEEDWATER	20	CARBON STEEL
FWS-22-3-1-2	FEEDWATER	20	CARBON STEEL
RSS-18-3-4-21	REACTOR COOLANT	10	STAINLESS STEEL
CCE-502-1-2-3	COMPONENT COOLING	2	COPPER-NICKEL
CHS-002-208-3(2)	CHEMICAL & VOLUME	2	STAINLESS STEEL
CHS-18-6-2-2	CHEMICAL & VOLUME	4	STAINLESS STEEL

TABLE IV-2

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

ITEM	SYSTEM	PIPE SIZE (Inches)	DESCRIPTION
SIH-507-1-1-1	SAFETY INJECTION	6, 2	STAINLESS STEEL
SIH-507-2-1-1	SAFETY INJECTION	6, 3/4	STAINLESS STEEL
SIH-504-1-1-2	SAFETY INJECTION	4, 3/4	STAINLESS STEEL
SIH-7-1-4-	SAFETY INJECTION	4	STAINLESS STEEL
SIH-7-2-4-2	SAFETY INJECTION	4	STAINLESS STEEL
SIH-7-3-4-2	SAFETY INJECTION	4	STAINLESS STEEL
SIH-7-4-4-2	SAFETY INJECTION	4	STAINLESS STEEL
SIH-7-5-4-2	SAFETY INJECTION	4	STAINLESS STEEL
CI-SIH-507	SAFETY INJECTION	6, 2, 3/4	STAINLESS STEEL
CP-408-500	SAFETY INJECTION	2	STAINLESS STEEL
CP-407-252	SAFETY INJECTION	2	STAINLESS STEEL
CP-407-027	SAFETY INJECTION	2, 3/4, 1/2	STAINLESS STEEL
CI-SIH-504	SAFETY INJECTION	4, 2, 3/4	STAINLESS STEEL
CI-SIH-7	SAFETY INJECTION	4, 3/4	STAINLESS STEEL
MSS-22-2-5-3	MAIN STEAM	30	CARBON STEEL
MSS-22-1-5-3	MAIN STEAM	30	CARBON STEEL
MSS-35-1-5-2A	MAIN STEAM	30	CARBON STEEL
MSS-35-2-5-2	MAIN STEAM	30	CARBON STEEL
MSS-35-1-5-2B	MAIN STEAM	30	CARBON STEEL
MSS-503-1-1-2	MAIN STEAM	30	CARBON STEEL
MSS-503-2-1-2	MAIN STEAM	30	CARBON STEEL
MSS-503-3-1-2A	MAIN STEAM	30	CARBON STEEL

TABLE IV-3

TANKS, PRESSURE VESSELS AND HEAT EXCHANGERS
VISUALLY INSPECTED AGAINST DRAWING REQUIREMENTS

DESCRIPTION OF ITEM INSPECTED	MANUFACTURER	FINDINGS
(CHS-TK2) VOLUME CONTROL TANK	LAMCO INDUSTRIES, INC.	Acceptable
(CHS-E7) LETDOWN REHEAT HEAT EXCHANGER	ATLAS INDUSTRIAL MANUFACTURING	(1)
(CCP-TK1) COMPONENT COOLING SURGE TANK	P.X. ENGINEERING CO. INC.	(2)
(CCE-TK1) CHARGING PUMP COOLING SURGE TANK	P.X. ENGINEERING CO. INC.	(3)
(EGF-TK-2A) GENERATOR FUEL OIL DAY TANK	P.X. ENGINEERING CO. INC.	(4)
(3CHS-E2) VERTICAL LETDOWN HEAT EXCHANGER	JOSEPH OAT CO. INC.	(5)
(CCI-TK1) COMPONENT COOLING SURGE TANK	P.X. ENGINEERING CO. INC.	(6)
(SIL-TK1D) ACCUMULATOR TANK	SOUTHWEST FAB. AND WELDING CO.	(7)
(3SFC-E1A) FUEL POOL COOLING HEAT EXCHANGER	AMETEK, INC.	(8)
(RSS-E1B) RECIRCULATING COOLER HEAT EXCHANGER	JOSEPH OAT CO. INC.	(9)
(RHS-E1B) RESIDUAL HEAT REMOVAL HEAT EXCHANGER	JOSEPH OAT CO. INC.	(10)
(CHS-TK5A)(11) BORIC ACID TANK	RECO INDUSTRIES, INC.	(11)

NOTES

(1) Fillet welds on supports undersized. (N&D 11641-Accept-as-is)
(2) Undersized fillet welds on all nozzles, manways and supports. (N&D 11910)
(3) Undersized fillet welds on manway, one coupling and some supports. (N&D 11912)
(4) Undersized fillet welds on 7 nozzles and portions of supports. (N&D 11914)
(5) Undersized fillet welds on 4 nozzles and on supports. (N&D 11915)
(6) Undersized fillet welds on manway, 5 nozzles and anchor pads. (N&D 11911)
(7) Undersized fillet welds on anchor ring. (N&D 11994)
(8) Undersized fillet welds on supports, overground base metal at one nozzle. (N&D 11913)
(9) Undersized fillet welds on 3 nozzles, 2 saddles, support brackets and unacceptable weld surface condition on one reinforcing pad. (N&D 11918)
(10) Undersized fillet welds on one nozzle reinforcing pad weld and one support bracket. (N&D 11919)
(11) Undersized fillet welds on anchor pads. (N&D 12167)

TABLE IV-4

SUPPORTS EXAMINED IN DETAIL AGAINST DRAWINGS

SUPPORT	FINDINGS	SUPPORT	FINDINGS
MSS-1PSR-122	(1)	SIL-1PSR-028	(2)
RHS-1PSR-014		BDG-1PSR-030	
CHS-2-PSSP-420		CDS-2PSR-001	
CDS-2PSA-003	(3)	CCP-2PSR-062	
RHS-1PSSP-405	(4)	SWP-2PSSP-409/410	(5)
CHS-2PSST-282	(7)	CHS-2PSSP-426/427	(6)
SFC-3PSR-147		SFC-3PSR-126	
FWS-4PSR-003		FWS-4PSR-053	
FWS-4PSR-050	(8)	MSS-3PSR-11	
MSS-4PSR-019	(9)	FWA-4PSR-245	
RSS-4PSST-140		SWP-4PSSH-119	(10)
RSS-4PSST-031		RSS-4PSST-134	
SVV-4PSSP-034	(11)	FWS-4PSR-051	
FWS-4PSR-001		FWS-4PSR-018	(12)
CP-379008-H006		CP-379008-H005	
CP-407018-H002	(13)	RCS-1PSSR-1093	
SIR-1PSR-581	(14)	BRS-2PSSH-006	
QSS-4PSST-115			

TABLE IV-4 (Continued)

SUPPORTS EXAMINED IN DETAIL AGAINST DRAWINGS

NOTES

(1) Seven obtuse skewed fillet welds undersized. (N&D 11527)

(2) Two fillet welds more than 1/16" undersized. (IR# P5A91086)

(3) Two skewed fillet welds undersized. (N&D 11527)

(4) One skewed fillet weld undersized. (N&D 11527)

(5) Two skewed fillet welds undersized. (N&D 11527)

(6) Three 6 inch long welds short by 1/2 inch. (IR# P5A91101-repaired)

(7) One fillet weld undersized. (IR# P5A91101-repaired)

(8) Eight inch long flare bevel weld short by 1/4 inch and weld not filled to flush. (IR# P5A91144 and IR#P5A91115-repaired)

(9) Two welds rotated 90° from location on drawing, one skewed fillet weld undersized. (N&D 11527)

(10) Three skewed fillet welds undersized. (N&D 11527)

(11) Skewed fillet weld undersized. (N&D 12178)

(12) Extra plate on support, 8 seal welds where drawing requires fillet welds. (N&D 11543)

(13) One skewed fillet weld undersized. (N&D 11543)

(14) Full penetration welds required. Partial penetration obtained. (N&D 11652 and 11653-Generic problem with 21 brackets)

TABLE IV-5

SUPPORTS WHICH WERE VISUALLY EXAMINED

SFC-3RSS-123	MSS-4PSSP-401	MSS-4PSSP-400
CCF-1PSR-016	CCP-2PSR-100	CCP-2PSSP-405
CCP-2PSR-003	SIH-2PSSP-012	CCP-3PSR-008
RSS-4PSSH-141-2	SIL-3PSR-051	MSS-4PSSH-128
CCP-2PSA-010	CCP-2PSR-009	CCP-2PSST-024
CCP-2PSA-010	CCP-2PSR-076	CCP-2PSR-070
CCP-2PSST-077	CCP-2PSR-071	CCP-2PSA-019
CHS-3PSR-090	CHS-3PSA-037	CHS-2PSR-091
SFC-2PSA-026	CDS-2PSR-004	CVS-2PSR-091
CP-355700-H004	CP-355700-H007	

TABLE IV-6

VENDOR RADIOGRAPHS REVIEWED

Contractor	Welds	Pumps Valves	Clevices Forgings Castings	Feet of Weld	Film	Results	Notes
Permutit	6	--	--	11	52	A	
Ametek Div. Schutte & Koerting	6	--	--	--	40	A	
Bingham-Williamette	5	--	--	--	108	A	
RECO	6	--	--	--	39	A	
Walworth	--	3 valves	--	--	142	A	
Graver	--	--	--	1089	206	A	
Joseph Oat	7	--	--	20	40	--	(1)
PX Engrg.	12		--	134	75	--	(2)
IIT/Grinnel	--	2	--	--	38	A	
Wisconsin Centrifugal	--	--	1	--	36	A	
Dresser Industries	5	--	--	--	19	A	
Gould Pumps		1 body	1 gland	--	43	A	
Anchor Darling	--	2 valves	--	--	110	A	
Tubeco	17	--	--	--	180	A	
Southwest Welding	60	--	--	--	750	--	(3)
YUBA Heat Transfer	--	--	--	100	100	A	
LAMCO	--	--	6	--	118	A	
Rotterdam	--	--	--	80	60	A	
Gary Tool	--	--	14	--	28	A	
Texas Pipe	--	--	--	15	13	A	

TABLE IV-6 (Continued)

VENDOR RADIOGRAPHS REVIEWED

Contractor	Welds	Pumps Valves	Clevices Forgings Castings	Feet of Weld	Film	Results	Notes
Pro Fab	--	--	--	100	93	--	(4)
Rockwell	15	--	--	--	143	--	(5)
Westinghouse (Cheswick)	--	1 valve	--	--	48	A	
Haywood Tyler	--	Diffuser	--	--	9	A	
Pacific Valves	--	2 valves	--	--	14	A	
Henry Pratt	--	24" Disc	--	--	40	A	
Sulzer	1	MSIV	--	15	12	A	
Reco-Koch	8	--	--	6	4	A	
Fisher Controls	--	1 valve	--	--	25	A	
Leslie Co.	--	1 valve	--	--	100	A	
Carrier	--	--	--	--	--	--	(6)

NOTES

A - Acceptable - meets Codes and Standards requirement

(1) - View 2 of nozzle "A" on the Letdown Heat Exchanger showed a linear indication 1/2 to 3/4 inch long which was not recorded on the reader sheet.

(2) - Reader sheets for acid tank and caustic tank were in the wrong film packets; unsatisfactory radiographs on the pool liner and the storage liner were determined by engineering to be unnecessary and were deleted from the specification by E&DCR number F-J-10978 and number T-J-03875.

(3) - Several radiographs displayed indications requiring re-radiographing or visual examination to confirm acceptability, i.e., weld 3, SW-4 - an indication with a cracklike appearance was re-radiographed at various angles and found to be a surface condition.

(4) - Many film above 4.0 density causing interpretation difficulties even with high intensity viewing. N&D 11,953 was issued to correct this condition.

TABLE IV-6 (Continued)

VENDOR RADIOGRAPHS REVIEWED

(5) - Indication noted on one film: Re-radiography using special technique determined that the indication is an ID surface condition. Acceptable.

(6)- Film not available for review. Paper work found to be acceptable.

TABLE IV-7

SWEC RADIOGRAPHIC FILM REVIEW RESULTS

A. Of the 90 field fabricated welds reviewed the following radiographic concerns were noted:

1. Weld 3-HVU-042-3-2 CI HVO-1, FW-1: aligned porosity view 56-70. I.R. P5A01490 was issued for repair welding.

2. Weld CI-RCS-513, FW 1: rejected for linear indication in excess of code in one area. N&D 11,743 was issued; repair.

3. Weld CI-RSS-501, FW-66. rejected for linear indications in three areas - 0-10, 20-30 and 30-0. N&D 11,470 was issued; repair.

4. One weld, 3 HS-00252-2 CP-407009, FW-1, was withheld for further review by CAT inspector due to incorrect view being re-radiographed. The original view 3-4 was rejected by SWEC for film quality The re-radiographed area in the package was 2-3 rather than 3-4. SWEC re-radiographed the area and completed the package with 100% coverage and the correct view.

5. Welds CP-374-019, FW15 and (GE 843E740) MSS-5843 Line #1, FW2: Pentrameter in weld area preventing adequate interpretation. Acceptable on re-radiography.

6. Weld CJ-RSS-9, FW4: Film artifacts on both films in the same area. Re-review of film verified original disposition as acceptable.

V. CIVIL AND STRUCTURAL CONSTRUCTION

A. Objective

The objective of the appraisal of civil and structural construction was to determine by evaluation of completed work and by review of documentation whether work, inspection, and test activities relative to civil and structural construction areas were accomplished in accordance with regulatory requirements, Safety Analysis Report (SAR) commitments, and project specifications, drawings and procedures.

B. Discussion

The specific areas of civil and structural construction evaluated were: concrete, reinforcing steel configuration, cadwelds, structural steel installation and bolting, masonry walls, the concrete expansion anchor bolt qualification program and building settlement.

For concrete, reinforcing steel configuration, structural steel installation and bolting, and masonry walls, a physical or hardware inspection of previously inspected and accepted work and a Quality Control (QC) documentation and field procedures review were conducted. A review of QC documentation and field procedures was performed for cadwelds, the concrete expansion anchor bolt qualification program and building settlement.

1. Concrete Activities

a. Inspection Scope

The reinforced concrete activities reviewed by the NRC Construction Appraisal Team (CAT) inspectors included two construction openings, two removable hatches and one area in which the concrete was removed for repair. These areas were reviewed for conformance of rebar placement with the design drawings (see Table V-1), specifications and associated design changes.

Three concrete placements were reviewed and general concrete quality was also examined from surrounding areas for conformance to site specification requirements. Records associated with the concrete placements were also reviewed. This review included the concrete placement reports, concrete placement checklists and the field inspection reports for reinforcing steel.

Concrete placements for Containment Building removable slabs RS-F and RS-B and dome vent pour back were observed by the NRC CAT inspectors. The in-process concrete tests were compared with the limits shown in SWEC Specificiation 281, Revision 1 "Mixing and Delivering Concrete" for slump, air, temperature, unit weight, truck revolutions and water/cement ratio.

The cadweld splice performance records were reviewed to determine adequacy of the production and sister splices testing frequency. Documentation and requirements for cadwelder qualification and requalification procedures were reviewed. The qualifications of

three cadwelders were checked to see if they met visual and tensile test requirements.

b. Inspection Findings

In the five concrete areas inspected one area was identified where the rebar was not placed in accordance with the design drawings. In this area (cubical D of the Containment Building), the NRC CAT inspectors reviewed a void in the grout placement for wall attachment plate 3RCS-PRRG. SWEC Field Quality Control (FQC) had issued Nonconformance Disposition (N&D) Report 11,544 on September 25, 1984 to document the grouting deficiency. It was noted by the NRC CAT inspectors that several vertical #11 rebar were visible in the area and were in a bundled condition. The design drawings (EC-51P Rev. 4 and EC-51G Rev. 5) did not call for vertical bundled bars in this area. The N&D was revised to include the bundled #11 rebar. The N&D was dispositioned "use as is" and the supporting calculation 12179-SEO-C51.3 Rev. 0 was reviewed and found acceptable.

The 16 cubic yards of concrete placed were observed to be in accordance with Specification 281, Revision 1. The in-process concrete test results for the Containment Building dome cap concrete placement were compared with the specification and found to be acceptable. SWEC FQC rejected 3 cubic yards of concrete when after initial samples were obtained additional water was added to the truck mixer making the water/cement ratio indeterminate. Based on FQC actions and the in-process test results, no discrepancies were noted.

Concrete truck mixer uniformity tests for truck number 77 at the Soneco Service Batch plant in Groton, Connecticut was observed by the NRC CAT inspectors. The Standard Specification for Ready-Mixed Concrete (ASTM-C-94) was used as the basis for conducting truck mixer uniformity tests. Appendix XI entitled "Concrete Uniformity Requirements" provide the acceptance criteria for determining truck-mixed concrete uniformity.

The test variations at approximately 15% and 85% of the load were compared for air content, slump, concrete unit weight, mortar unit weight, weight of aggregate and compressive strength. The NRC CAT inspectors observed the slump, air content and unit weight test associated with the truck uniformity tests. The tests observed were found to be in accordance with the specified test requirements and the test equipment, when required, was in calibration.

During the inspection of general plant structures, it was noted by the NRC CAT inspectors that the rattle space between the Reactor Containment Building and the Main Steam Valve Building (MSVB) was less than that specified in the FSAR Section 3.8.5.1. The FSAR required a four inch space between these two buildings. The existing space was found to be approximately three inches. The licensee stated that the FSAR will be revised to show a minimum space of two inches between these buildings. The NRC CAT also noted that debris and concrete were present in the rattle space between the Reactor Containment Building and the Main Steam Valve Building.

The debris was subsequently removed. An evaluation was to be performed by SWEC Engineering in order to determine whether the concrete could be left in place.

No problems were identified with the qualification of the three cadwelders that were reviewed.

c. Conclusions

The concrete quality was found to be acceptable and rebar was placed in accordance with the design drawings for those areas inspected. The concrete material certification and testing records reviewed indicated conformance to the construction specifications and regulatory commitments. Concrete chipping and rebar cutting inspected was performed in a controlled manner.

The failure to identify a rattle space smaller than committed to in the FSAR and concrete in the rattle space between the Containment Building and the Main Steam Valve Building is indicative of inadequate inspection in these areas. This condition should be evaluated and additional inspections performed if interferences in the rattle spaces are found to be unacceptable.

2. Structural Steel Installation

a. Inspection Scope

Installed and QC accepted structural steel was inspected for member size, configuration, and conformance of bolted connections to the design drawings (see Table V-2), specifications, and associated design changes.

Structural steel bolts were tested using a calibrated torque wrench to determine whether the bolts had been properly tightened. The inspection sample was selected randomly from structural steel installed in the Reactor Containment Building, Main Steam Valve Building and the Control Building.

Structural steel installations inspected included 34 members and 36 connections for proper sizes, dimensions and configuration, and 297 high strength bolts for torque. The licensee inspected an additional 692 high strength bolts for torque during the NRC CAT inspection.

The bolts tested included seven-eighths inch and one inch diameter A325 bolts. The site used load indicating washers (LIWs) in the structural steel connections. These were inspected on the basis of measurement of the gap adjacent to the LIW. Test torques were obtained by the NRC CAT inspectors using a Skidmore-Wilhelm tension tester in which bolt tension and torque values were measured.

b. Inspection Findings

No discrepancies were identified between the 34 installed structural steel members inspected and the design drawings.

Nine structural steel connections in the Main Steam Valve Building were found with incorrect bolting and welding configuration. Of the nine, five slotted structural steel connections were found not to meet the installation requirements. Four of the slotted connections were found with bolt torques in excess of 450 ft-lbs, while the design detail required the bolts to be finger tight. The fifth slotted bolt connection was found without any hardened washers as required by AISC.

Four other structural connections did not comply with the clip angle to embed weld detail as shown on drawing ES-31J, Revision 3. This detail required a seven-sixteenths inch fillet weld on all three sides of the clip angle, but in the actual installation only one side of the clip angle had been welded. Additionally, the detail on ES-31J, Revision 3 requires a seven-sixteenths inch weld but the actual field weld was five-sixteenths inch. Based on these concerns, SWEC FQC reinspected all structural connections in the MSVB. Inspection Report (IR) S5A01205 was issued which describes 70 slotted connections that were not finger tight, had peened threads and were missing plate washers. N&D 11,973 identified 96 fixed end connections that did not meet the welding requirements for Typical End Connection detail on ES-31J Rev. 3. Based on the connection problems, SWEC issued a Report of a Problem (ROAP) on March 22, 1985 to determine the generic and reportability implications of these connections.

In discussions with licensee personnel regarding the use of LIWs, it was noted by the NRC CAT inspectors that SWEC Engineering did not perform any on-site testing to independently verify the performance of the LIWs. SWEC relied on a report on LIWs by the AISC Research Council on Riveted and Bolted Structural Joints as the basis for acceptance and use of LIWs. As additional verification, the SWEC specification for structural steel required the supplier to test 3 LIWs from each lot. Several examples of these tests performed by Thames Valley Steel Corporation (TVS) were provided to the NRC CAT inspectors. From the TVS test report it was not clear how TVS conducted the test. In addition, SWEC Engineering was unable to provide specific information as to how TVS conducts the LIW acceptance test. Also, there was no information available in the manufacturer's test data to correlate bolt tension to the 0.005 inch LIW gap acceptance criteria.

Based on SWEC Engineering's response to the NRC CAT inspector's questions regarding the use and acceptability of LIWs, it was apparent that SWEC Engineering did not adequately investigate the parameters important and essential to the LIW's performance.

To determine bolt torque-tension relationship and verify performance of the LIWs, 21 tests using the Skidmore-Wilhelm tension tester were performed on-site at the request of the NRC CAT inspectors. A total of eight of the 21 LIWs tested did not meet the minimum bolt tension as required by Table 1.23.5 in AISC specifications for the Design, Fabrication and Erection of Structural Steel for Buildings.

Bolts were found in testing to be as low as 34.5 kips in tension

versus the minimum requirement of 39 kips and had met the LIW gap acceptance criteria. The eight failed LIWs consisted of six manufactured by Cooper-Turner and two by Bethlehem Steel. The LIW gaps appear to give an apparent acceptable result but actually the bolt did not meet the minimum required tension. SWEC issued a Report of a Problem (ROAP) regarding the Cooper-Turner washers. The NRC CAT inspectors did not agree that the scope of LIW performance concerns was limited to only Cooper-Turner washers based on the limited testing and test results for LIWs conducted on site.

In the Main Steam Valve Building, the Containment Building, the ESF Building and the Auxiliary Building, structural steel connections containing seven-eighths inch and one inch A-325 high strength bolts were torque tested to 425 ft-lbs and 700 ft-lbs respectively. Approximately 256 seven-eighths inch diameter A-325 bolts were torque tested to 425 ft-lbs with only four bolts not achieving the minimum torque. Approximately 41 one inch diameter A-325 bolts were torque tested to 700 ft-lbs with all bolts achieving the minimum torque. As a result of the concern with the performance of the LIWs the licensee tested an additional sample of 692 seven-eighths inch diameter A-325 bolts with only six failing to meet minimum torque.

c. Conclusions

In general, the structural steel installation activities for member size and configuration were found to be in conformance with the design drawings and specifications. However, deficiencies were identified in the following areas:

A significant number of discrepancies were identified by the NRC CAT inspectors in structural steel connections in the Main Steam Valve Building. Based on the NRC CAT inspectors finding, the licensee inspected all the connections in the Main Steam Valve Building. The deficiencies were identified on inspection reports on the 70 slotted connections and an N&D was issued on the 96 welded connections. The ROAP issued March 22, 1985 by SWEC was to initiate action to determine genenic and reportability aspects of structural connections at the site.

A total of 989 bolts were torque tested by the NRC CAT and the licensee with only 10 failing to achieve the minimum inspection torques. The high strengths bolts installed in the Class I structures appeared to be properly installed.

3. Masonry Walls

a. Inspection Scope

In the area of masonry wall construction, the NRC CAT inspectors reviewed specifications and completed block walls. For the block walls, the inspection concentrated on the bracing modifications. All masonry work reviewed was in the Control Building (See Table V-3).

b. Inspection Findings

The masonry wall seismic bracing modification installations were compared to the design drawings and, in general, found to conform with design drawings and specifications. The structural steel trusses used to brace the concrete block walls were reviewed as part of the structural steel sample.

During the NRC CAT inspection it was determined that walls were not constructed as safety-related structures. However, the bracing was constructed as Seismic Category I structures.

c. Conclusions

In general, masonry wall activities were found to be acceptable.

4. Concrete Expansion Anchor Bolts

a. Inspection Scope

The qualification test report for the wedge type concrete expansion anchors used at the site was reviewed for technical adequacy, conformance to the project specifications and demonstration of satisfactory anchor performance.

b. Inspection Findings

The qualification test report was found to be consistent with the specifications and procedures for installation and inspection.

c. Conclusions

The concrete expansion bolt qualification test program was found to be acceptable.

5. Building Settlement

a. Inspection Scope

The surveying data for Seismic Category I structures were reviewed by the NRC CAT inspectors and compared with the predicted maximum settlement values shown in Table 2.5.4 - 49 of the Millstone Unit 3 FSAR.

b. Inspection Findings

The building benchmarks are surveyed by SWEC annually for foundations on bedrock and semiannually for foundations on structural backfill. The NRC CAT inspectors reviewed the settlement surveys conducted and found the survey frequency to be generally in com-

pliance with the field construction procedure. It was noted that Auxiliary Building benchmark 16 had been destroyed in late 1982 and had not been re-established. The licensee has committed to establish a benchmark in the area of Auxiliary Building benchmark 16.

The Main Steam Valve Building, Containment Building and the Fuel Building survey data showed that, although these buildings were founded on rock, the actual experienced building settlements had exceeded the FSAR predicted maximum values. SWEC geotechnical engineers indicated the values are not indicative of actual settlements but represent an accumulation of survey errors. This magnitude of survey error is reasonable and is well below levels of structural movement that would cause concern to either buildings or interconnecting piping.

c. Conclusion

The discrepancies between the recorded building settlements and the predicted building settlements in the FSAR are probably survey errors. Even if the measurements were correct, the settlements were below levels of structural movement that would cause concern to either buildings or interconnected piping.

TABLE V-1

CONCRETE DRAWINGS

Drawing No.	Revision	Subject
EC-10G	7	Control Building - Wall at Line 55 and Elevation 46'-8"
EC-49P	5	Dome Details Sh #2 Containment Structure E&T
EC-50E	2	Details Elev. 514 Sh #1 Containment Structure Intermediate Concrete
EC-50V	7	Plan Elev. 51'-4 Outline Containment Structure Intermediate Concrete
EC-50Z	2	Removable Concrete Shielding Plugs (RS-F, RS-B)
EC-51G	5	North Walls Elev. and Details Sh #1 Containment Structure Intermediate Concrete
EC-51J	6	North Walls Elev. and Details Sh #3 Containment Structure Intermediate Concrete
EC-51P	4	Refueling Cavity Walls Sh #1 Containment Structure Intermediate Concrete
EC-750E	7	Embedment Penetrations and Openings Floor EL 51'-4 Containment Structure
EC-751B	6	Embedment Penetrations and Openings Containment Structure Walls Sh #2
EC-751L	3	Embedment Details Containment Structure Walls Sh #4

TALBE V-2

STRUCTURAL STEEL DRAWINGS

Drawing No.	Revision	Subject
EC-731H	2	Embedments, Penetrations and Openings Details Main Steam Valve Building
EC-751L	3	Embedment Details Containment Structure Walls Sh #4
ES-3A	10	Operating Floor Framing Sh #1 Turbine Building (General Notes)
ES-31H	3	Framing Plans and Details Main Steam Valve Building
ES-31J	3	Framing Plans and Details Main Steam Valve Building
ES-31X	1	Framing Plans and Details Main Steam Valve Building
ES-50B	7	Annulus Platform Elev. 24'-6 Containment Structure
ES-50AD	2	Reactor Containment Shield Door Framing and Details Elev. 3'-8
EV-56D	3	Pipe Break Restraints FDW Bypass Main Steam Valve Building Sh #1
EV-56E	3	Pipe Break Restraints FDW Bypass Main Steam Valve Building Sh #2
EV-132D	4	Intermediate Structure Steam Generator Cubicle. Cubicle D Plan 28'-6
EV-132E	5	Intermediate Structure Steam Generator Cubicle Connection Details Sh #1
EV-132F	4	Intermediate Structure Steam Generator Cubicle Connection Details on SH #2
EV-132G	4	Intermediate Structure Steam Generator Cubicle Connection Details Sh #3

TALBE V-2 (Continued)

STRUCTURAL STEEL DRAWINGS

Drawing No.	Revision	Subject
EV-132H	4	Intermediate Structure Steam Generator Cubicle Connection Details Sh #4
EV-132J	3	Intermediate Structure Steam Generator Cubicle Connection Details Sh #5
EV-132K	3	Intermediate Structure Steam Generator Cubicle Restraint Structure Details
EV-132L	3	Intermediate Structure Steam Generator Cubicle Restraint Miscellaneous Details
EV-132M	3	Intermediate Structure Steam Generator Cubicle Connection Details Sh #6

TABLE V-3

CONCRETE BLOCK WALL DRAWINGS

Drawing No.	Revision	Subject
EA-1F	12	Floor Plan Elev. 47'-6 Control Building Sh #2
EA-1E	11	Floor Plan Elev. 4'-6 Control Building Sh #1
EA-9D	6	Masonry Details @ Elev. 47'-6 Control Building
ES-60F	2	Block Wall Bracing Elev. 47'-6 Control Building Sh #1
ES-60G	2	Block Wall Bracking Elev. 47'-6 Control Building Sh #2
ES-60H	2	Block Wall Bracing Elev. 47'-6 Control Building Sh #3
ES-60J	2	Block Wall Bracing Elev. 47'-6 Control Building Sh #1
ES-60K	1	Block Wall Bracing Elev. 47'-6 Control Building Sh #2
ES-60L	2	Block Wall Bracing Elev. 47'-6 Control Building Sh #3

VI. MATERIAL TRACEABILITY AND CONTROL

A. Objective

The objective of this portion of the inspection was to examine traceability and control of material and equipment, and to determine the adequacy of the licensee's program relative to these activities.

B. Discussion

The approach to perform the inspection was to identify and select samples of various types of installed material and equipment for examination. Some samples of installed material, such as rebar, that were not accessible were selected from records. Also, some samples of delivered material, such as protective coating materials, not yet installed, but inspected in warehouses or shops, were included. A total of 297 samples were examined to varying extents.

Applicable organizations and procedures for various activities were reviewed. The following Stone & Webster Engineering Corporation (SWEC) procedures were reviewed:

- NEAM 3, Rev. 10, Specification Inquiry and Purchase Procedure, Change No. 3
- CMP No. 1.12, Rev. 3.79, Material/Equipment Maintenance
- P-CMP 1.2, Rev. 0, Receiving Material and Equipment
- P-CMP 1.3, Rev. 3.79, Material/Equipment Storage, Change No. 3
- QS-7.1ML, Rev. 0, Receiving Inspection, Change No. 3
- QCI No. FM3-S7.1-070, Traceability Requirements
- FCP-121, Rev. 5, Equipment Storage History Card
- FCP-354, Rev. 0, Transfer of Traceability Markings on Plates and Shapes

An inspection of installed material and equipment was conducted in the plant to select and verify markings on various samples, such as equipment (mechanical, electrical and instrumentation), pipe, supports/restraints and weld joints. Other samples were inspected in warehouses or shops. Table VI-1, "Summary of Samples," indicates the types and quantities of materials examined. Table VI-2, "Weld Filler Material Compliance," contains a list of the 39 weld filler material samples selected.

1. Material Traceability and Control

a. Inspection Scope

A total of 297 samples were selected and examined for traceability to applicable drawings, specifications, procurement records, certified material test reports (CMTRs), certificates of compliance (C of Cs), heat numbers or other required documentation.

b. Inspection Findings

In general, it was found that satisfactory procedures were in place for material traceability and for control of material at the site. Except for a lack of traceability for certain fastener materials, the material traceability program was found to be generally acceptable. The following observations were made by the NRC CAT inspector:

(1) Manual and computerized records were used to help control the identification and status of material and equipment at the site.

(2) Thirty-nine samples of weld filler materials listed in Table VI-2 were examined for traceability and compliance with specifications and codes, and were found to be acceptable. Twenty-five weld filler material holding ovens in two issue stations were examined and found to meet requirements for temperature control and thermometer calibration records.

(3) NRC IE Information Notice No. 85-15 described a problem regarding the identification and marking of ASTM A-36 steel plate material supplied by Interstate Steel Supply Company and noted that this firm had supplied material to Millstone Unit 3. The NRC CAT inspector inquired as to the control of Interstate Steel as an approved vendor, the quantity of material supplied, applications of the material, and the status of the licensee's action relative to this matter.

An interim response from SWEC to Northeast Utilities Service Company (NUSCO) dated March 8, 1985 stated that 175,347 lbs. of A-36 plate (cut pieces) had been furnished by Interstate Steel. It was noted that early orders were for Category II applications, but that one order (P.O.08766 dated October 4, 1979) was for Category I applications. A review of the status of Interstate Steel as an approved vendor revealed that a February 1980 evaluation resulted in removing this firm from the approved list for Category I material because of material identification and documentation problems. Interstate Steel was reinstated as an approved vendor for Category I material as a result of a survey in March 1980, and subsequent surveys resulted in retaining this firm on the approved list.

Only one piece of A-36 steel plate material supplied by Interstate Steel that had not been installed could be located. This sample was found in the pipe hanger fabrication shop. The

markings stamped on this sample were traceable to the appropriate certified material test report. No discrepancies were noted.

SWEC representatives stated that their review and examination of records related to NRC IE Information Notice No. 85-15 was continuing.

(4) Material and equipment listed in Table VI-1 were examined for traceability and control. Most items examined were found to have the required material traceability; however, some deficiencies were found regarding the traceability and control for large motor mounting bolts and other fastener materials as follows:

(a) Equipment mounting bolts for 10 of 49 fastener installations examined were found to have unmarked bolts and thus the bolt material was indeterminate. The 10 instances of unmarked mounting bolts were for motors for the following pumps:

° Quench Spray Pumps (3QSS-P3A, B)
° Safety Injection Pump (3SIH-P1B)
° Chemical Volume Control Pumps (3CHS-P1A, B;-P3A, B, C)
° Component Cooling Charging Pumps (3CCE-P1A, B)

As a result of these CAT findings, the licensee issued Nonconformance and Disposition Reports (N&Ds) 11765, 11767, 11904, 11905 and an UNSAT Inspection Report (IR) M5A51085 to initiate corrective actions. Also, a Report of a Problem (ROAP), "Unidentified Bolting Material on Vendor Supplied Equipment," was issued March 14, 1985, to initiate reviews for generic and reportability aspects.

(b) Battery rack assembly bolts (specified to be ASTM A-307 in the seismic qualification report) in the five battery rooms in the Control Building were inspected. It was found that 282 of 700 bolts (approximately 40%) were unmarked (not meeting ASTM A-307 requirements) and thus were of indeterminate material.

As a result of this finding, the licensee issued N&D 11498 for corrective action. Subsequently, the licensee selected samples of unmarked bolts from each battery room for testing by Bridgeport Testing Laboratory. Testing showed all 97 bolts tested to conform to ASTM A-307 material specifications. N&D 11498 was dispositioned "Accept as is."

(c) For four motor control center (MCC) interconnections examined, all four had unmarked bolts for connecting adjacent cabinets and thus were of indeterminate material. It was noted that 20 such cabinets were furnished by Gould, Inc. The specified bolting material was SAE Grade 2 which requires at least the manufacturer's identification marking.

As a result of this finding, the applicant issued E&DCR T-E-03663. In reviewing this document, NRC CAT inspectors concluded that the response shows a lack of thoroughness on the part of site engineering, in that the response indicates that the bolting material is SAE Grade 2 without adequate techical justification. Since the bolt markings do not meet the requirements of SAE Grade 2, the material can only be considered to be indeterminate.

NRC CAT inspectors concluded that the use-as-is response indicated on E&DCR T-E-03663, is not adequate to assure that fasteners used in the assembly of MCCs are the specified SAE Grade 2 material, and that further licensee action will be required to resolve this issue.

(d) Bolts for mounting Control Board Termination Cabinet (3CES*TBMB30) were unmarked, and thus material was indeterminate. The applicant issued UNSAT IR E5A01843 to initiate review and corrective action. This appears to be an isolated case.

c. Conclusions

In general, except for certain fastener hardware, the material traceability and control program was considered to be satisfactory.

Significant lack of traceability was found for fastener materials, including bolts for mounting large pump motors, bolts for battery racks and bolts for interconnecting adjacent MCC cabinets.

TABLE VI-1

SUMMARY OF SAMPLES

Item	No. of Samples
Equipment	25
Pipe	22 (L)*
Tubing	9 (L)
Steel-Structural	10 (L)
Steel-Rebar	10 (L)
Steel-Plate	10 (L)
Steel-Tube	10 (L)
Hangers/Supports/Restraints	3
Embedments	4
Inserts (Richmond)	4 (L)
Insert Studs (For Richmond Inserts)	4 (L)
Weld Filler Material	39 (L)
Weld Joints	25
Electrical Cables (Reels)	27 (L)
Fasteners (Sets)	49 (L)
Cadweld Sleeves	28 (L)
Coatings	5 (L)
Unistrut	5 (L)
Raceway	3 (L)
Shims	5 (L)
TOTAL	297

*(L) = Lots

TABLE VI-2

WELD FILLER MATERIAL COMPLIANCE

Material Designation	Heat No./ Material ID	Compliance Comments
E10018D2 1/8	Lot 5043A49144	Acceptable
ENiCu-7 3/32	8M12C Mix 23	Acceptable
806-9N10 1/8	8K22B Mix 14	Acceptable
ENiCu-7 1/8	10678-1-3	Acceptable
E308-16 1/8	5E17B Mix 7	Acceptable
E7018 3/32	411A0952	Acceptable
ENiCrFe3 1/8	Lot 10748-1	Acceptable
E309-15 1/8	Lot 11501-1	Acceptable
E309-15 1/8	Lot 11631-1	Acceptable
E7018 1/8	8215	Acceptable
E316L-16 1/8	782860	Acceptable
E308L-16 1/8	782815	Acceptable
E308L-16 3/32	761127	Acceptable
E316L-16 3/32	743528	Acceptable
E309-16 3/32	743202	Acceptable
E309-16 1/8	743880	Acceptable
E316-15 1/8	Lot 10499-1-1	Acceptable
E316-15 3/32	Lot 50148-1	Acceptable
E308-16 3/32	Lot 5K13A Mix 29	Acceptable
E308-16 3/32	Lot 5M2A Mix 29	Acceptable
E316-16 3/32	Lot 5F7A Mix 28	Acceptable
E8018G 1/8	48348	Acceptable
E8018G 3/32	48429	Acceptable

TABLE VI-2 (Continued)

WELD FILLER MATERIAL COMPLIANCE

Material Designation	Heat No./ Material ID	Compliance Comments
E308-16 1/8	Lot 5K9B Mix 10	Acceptable
E308-16 3/32	Lot 5G16A Mix 19	Acceptable
E309-16 1/8	Lot CX	Acceptable
E309-16 3/32	Lot 90151-1	Acceptable
E7018 3/32	411X4302	Acceptable
E9018-B3 1/8	22768	Acceptable
E9018-B3 3/32	39586	Acceptable
E9018-B3 3/32	39610	Acceptable
E8018-C1 1/8	421T2133	Acceptable
E8018-C1 3/32	421T2133	Acceptable
ER309 3/32	Lot C2970E308	Acceptable
EB Weld Insert 308L 5/32	Lot E2267-308L	Acceptable
E308-16 1/8	Lot 5E17B	Acceptable
E7018 3/32	411A0952	Acceptable
NiCrFe-3 3/32	Lot 50225-1	Acceptable
E7018 3/32	402A9061	Acceptable

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, Safety Analysis Report (SAR) commitments and licensee, architect-engineer, and constructor procedures. An additional objective was to determine that hardware modifications described 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 change control. These requirements are elaborated in Regulatory Guide (RG) 1.64 "Quality Assurance Requirements for the Design of Nuclear Power Plants" and American National Standards Institute (ANSI) Standard N45.2.11-1974 "Quality Assurance Requirements for the Design of Nuclear Power Plants." The licensee's commitment to comply with RG 1.64 is stated in Appendix D of the Northeast Utilities Quality Assurance Program (NUQAP) Topical Report. Stone and Webster Engineering Corporation's (SWEC) commitment to RG 1.64 is stated in Appendix VII of the Quality Assurance Program Manual for Millstone Nuclear Power Station Unit 3 for construction activities.

The areas of design change control evaluated in this inspection were control of 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, and a sample of controlled documents was reviewed. In addition, a sample of the completed structures and hardware which had been inspected and accepted by Field Quality Control (FQC) personnel was verified in the field for compliance to design change document requirements.

1. Control of Design Documents

The key aspects of this inspection were to determine if sufficient site controls existed to assure that the latest design documents and design change documents were available for field use in a timely manner, and that the latest documents were actually available in the field.

a. Inspection Scope

(1) Design document control for drawings, installation/erection specifications and Operating, Installation and Maintenance (OIM) manuals was evaluated from the point of engineering issue to the point where these documents were considered working documents for field construction and FQC acceptance. Control of Engineering and Design Coordination Reports (E&DCRs) and availability of E&DCRs, Nonconformance and Disposition (N&D) reports and Vendor Information Requests (VIRs) at selected drawing stations were also evaluated. The major

emphasis was to determine if the correct revision of documents including applicable changes were available in the field based on the master records. Document Record Cards (DRCs) for 69 design documents and some of the associated E&DCRs/N&Ds/VIRs were reviewed at six site drawing stations. Sixty-seven DRCs were also reviewed at the FQC drawing station. In addition, control of 10 specifications and 12 OIMs was reviewed.

(2) Document control audit plans, attributes, reports and responses, surveillance reports as well as Interoffice Office Memorandums discussing document control findings were reviewed. These documents were evaluated for relevancy of attributes, sample sizes, proper audit methods, trends, frequency, and corrective actions for assurance that the latest design documents were being used for field work and QC acceptance. Six FQC monthly drawing station audits (each covering 100% of change documents issued for one week out of each month), 5 weekly FQC drawing station surveillances, and 4 Boston Quality Assurance Auditing Division (QAAD) audits of site document control were reviewed.

(3) SWEC Engineering and Construction Document Control, FQC, and Boston QAAD personnel were interviewed concerning distribution, control and use of design and design change documents, and document control audits and surveillances.

(4) The following procedures relating to control and distribution of design documents were reviewed:

- SWEC Engineering Assurance Procedure (EAP) 4.13, "Processing of Project Specifications," Rev. 0, Change 6,
- SWEC EAP 5.4, "Review and Approval of Project Production Drawings," Rev. 3, Change 7
- SWEC EAP 6.1, "Document Control," Rev. 1, Change 5
- SWEC EAP 5.8, "Review of Supplier Drawings," Rev. 1, Change 2
- SWEC EAP 6.5, "Preparation, Review, Approval and Control of Engineering and Design Coordination Reports (E&DCRs) - Computerized Logging and Tracking System," Rev. 0, Change 1
- SWEC EAP 9.2, "Review and Approval of Supplier Technical Documents," Rev. 4, Change 6
- SWEC Construction Methods Procedure (CMP) 11.1, "Job Site Document Control," Rev. D
- SWEC NEAM 3, "Specification Inquiry and Purchase Procedure," Rev. 10, Change 4
- SWEC NEAM 5, "Supplier Document Handling System - IS 249," Rev. 9, Change 1

- SWEC NEAM 19, "Handling, Review and Distribution of SWEC Production Drawings," Rev. 11, Change 0

- SWEC NEAM 32, "Supplier Technical Document Review and Distribution Millstone 3 - NUSCO," Rev. 9, Change 0

- SWEC NEAM 38, "Authorization of Engineering and Design Changes," Rev. 8, Change 4

- SWEC Quality Control Instruction (QCI) FM3-S14.2-06, "Site QA Program Monitoring," Rev. A

- SWEC QCI FM3-S6.1-04, "Drawing Control Verification," Rev. 0

b. Inspection Findings

(1) A random sample of 69 DRCs obtained from the master DRC file in construction document control was taken to drawing stations 12, 33, 34, 62, 138, and 143 and compared to the documents filed at each station. A DRC exists for every plant drawing and lists all applicable E&DCRs, N&Ds and VIRs for each drawing as well as showing the latest drawing revision. The DRC, drawing, E&DCRs, N&Ds and VIRs are required to be checked by construction personnel for correct drawing revision and applicability of outstanding E&DCRs, N&Ds and VIRs to the specific work area prior to construction work. CMP 11.1 is the governing procedure for site drawing station controls. Associated with the 69 DRCs reviewed, 69 drawings, 79 E&DCRs and 37 N&Ds were also checked at the stations. Fifty-one document control errors contrary to CMP 11.1 requirements were noted as follows:

- 3 DRCs not current
- 1 missing DRC
- 11 missing E&DCRs
- 7 missing N&Ds
- 4 missing drawings
- 2 drawings at same station had 2 different revisions
- 3 improper voidings of E&DCR or DRC
- 20 DRCs with missing descriptive summaries

See Table VII-1 for specific drawing numbers and summary.

(2) FQC has its own drawing station (number 31) which is continuously staffed with an attendant unlike the field drawing stations used by the crafts. Because of the high error rate noted at other site drawing stations, the FQC drawing station was looked at separately for non-current and missing DRCs only. Document control errors contrary to CMP 11.1 requirements were found. Out of 67 DRCs checked, 6 were not current and one was missing. This error rate was considered of particular significance since the FQC station provides the documents used for acceptance of plant construction. Table VII-1 lists the DRC numbers checked at station 31.

(3) Included above are two cases in which the back of the DRC copy reflected information which did not apply to the drawing specified on the front. The back sides of the master DRCs were not annotated with the drawing number so applicability of the information on the back could not be verified with the front. Apparently a mixup had occurred in copying of the DRCs. This problem had also been noted previously by document control personnel and the DRCs known to be incorrect were recopied. However, no corrective actions had been taken to identify the back side of DRCs with the document number to preclude undetected copying errors. This is considered to be inadequate corrective actions by Construction Document Control.

(4) Yellow drawings were not being date stamped when copied and provided for use. These drawings are uncontrolled but are used as information copies for construction. The drawings are considered acceptable for use on the day of issue only, unless reverified and initiated by the user. Since the drawings were not date stamped it could not be determined when the drawings were issued and that proper reverification had occurred prior to use. The lack of a requirement for date stamping of yellow drawings when copied is considered to be a procedural weakness in CMP 11.1.

(5) Control of specifications was evaluated for a random sample of ten specifications. One control point for each specification was checked to determine if latest addenda and revisions per the Engineering Document Control Specification Index were received and filed. Numerous errors were noted as follows contrary to NEAM 3 and CMP 11.1 requirements:

- Two cases of the latest specifications revisions and addenda were found not filed in the specification books. The specification revisions were located in a stack of documents to be filed. The superseded specifications, revisions and addenda were filed in the specification books.
- In one case the Engineering Document Control Specification Index did not indicate the latest addenda.
- In one case the entire specification was missing from the file book but was later located.
- Two cases were noted of E&DCRs not being filed. They were also located in a stack of documents to be filed.
- One case was found of E&DCRs being filed by date received and not by E&DCR number such that retrievability of specific E&DCRs was very difficult.
- One case of E&DCR posting errors.

See Table VII-2 for document numbers and summary.

(6) Control of OIMs was evaluated for a random sample of twelve OIMs. The following problems were noted contrary to NEAM 32 and CMP 11.1 requirements:

- The index in Engineering Document Control did not indicate the latest manual revision in one case.

- The record log in Construction Document Control did not have all the applicable E&DCRs posted in two cases.

- The IS-305 system had two data entry errors in one case.

Even though the above problems were identified, all 12 of the manuals on the shelf were the latest revision and had the applicable E&DCRs filed with them. See Table VII-3 for document numbers and summary.

(7) In the area of document control audits, it was found that audits were generally being accomplished in accordance with requirements. In fact, audits and surveillances had been increased within the past year due to the number of errors found at drawing stations by various auditing activities. Just prior to the NRC CAT inspection, a 100 percent audit of all drawing stations was performed by FQC. This audit covered 186,706 drawings and DRCs. However, as the NRC CAT identified discrepancies in document control have shown, the audits did not identify the underlying problems and were considered weak for the following reasons:

- The FQC monthly audits were not using the master DRC or engineering computer data available for determining latest drawing revision numbers or applicable drawing changes.

- There had been no specific audit attention given to specifications or OIMs for the past two years. In view of the errors found in this inspection additional attention is warranted.

- Boston QAAD audit reports were not sufficiently detailed to allow determination of how document control audits were conducted. Audit attributes also lacked sufficient details for conducting thorough, consistent and uniform document control audits.

- Although Construction Document Control had accomplished some self audits at specific stations when errors were identified, there was no formal plan for accomplishing self audits and taking permanent corrective actions on an overall basis. In view of the continuing drawing station errors being identified, Construction Document Control should have been determining and resolving their problems much sooner. This is considered to be inadequate corrective actions by Construction Document Control.

c. Conclusions

Although the basic system framework for design document control appears to be adequate, a large number of errors were found to exist in site document control in spite of increased attention the past year. The actions taken to date have not been effective in properly maintaining drawing stations and improving document control. Audits and surveillances have not been effective in identifying problems and root causes. Considering the above, document control needs special attention to resolve the underlying problems and to reduce the error rate to an acceptable level.

Two cases of inadequate corrective actions in document control were noted. These are discussed further in Section VIII-B.1.b(4).

2. Control of Design Changes

The specific aspects of this inspection were to determine if effective measures were present for control of design changes, that these measures were being followed and design changes were properly implemented in the field in accordance with design change requirements.

a. Inspection Scope

(1) The principle method of accomplishing design changes is by E&DCR. Other methods not included in this inspection were use of N&Ds and VIRs or direct design document revision. Approximately 45,000 E&DCRs have been issued for construction at Millstone 3. About 200 random E&DCRs were reviewed in this inspection for conformance to site procedures including need for the E&DCR, need for design change, clarity of problem desciption and solution, reasonableness of solution, technical justification for design changes, appropriate reviews and approvals, and reference to calculations when appropriate.

(2) Supporting calculations associated with eight E&DCRs were reviewed for conformance to site procedures including retrievability, clarity, cross referencing between the calculation and E&DCR, general neatness and basic approach. Also, calculation controls were reviewed.

(3) Incorporation of design changes by E&DCR into parent documents was evaluated for conformance to site procedures. Forty-six design documents (i.e. drawings, specifications or OIMs) designated to be changed because of E&DCRs were reviewed to determine if each document had been revised to incorporate E&DCR requirements or was within the control system for eventual incorporation of E&DCR requirements. At the time of the NRC CAT inspection the site requirement was to revise drawings within four months after the sixth "to be incorporated" change document was issued.

(4) The Project Change Request (PCR) and Westinghouse Field Change Notice (FCN) systems were evaluated for conformance to site procedures including proper control of design changes implemented via PCR or FCN. Site procedures require that design changes initiated by either PCR or FCN be implemented by E&DCR.

(5) Design control audit plans, attributes and reports were reviewed for relevancy of attributes, sample sizes, proper audit methods, trends, frequency and corrective actions for assurance that proper design change control procedures were being followed. Three SWEC Engineering Assurance (EA) design control audits and two EA technical audits were reviewed.

(6) A random sample of 16 E&DCRs for which work was completed and FQC accepted were inspected in the field to assure E&DCR requirements had been implemented.

(7) Various SWEC engineering discipline and principal engineers as well as FQC personnel were interviewed concerning E&DCRs, calculations, audits, programmatic controls and hardware installations.

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

- SWEC EAP 3.1, "Verification of Nuclear Power Plant Designs," Rev. 2, Change 5
- SWEC EAP 5.3, "Preparation and Control of Manual and Computerized Calculations (Nuclear Projects)," Rev. 3, Change 3
- SWEC EAP 5.4, "Review and Approval of Project Production Drawings," Rev. 3, Change 7
- SWEC EAP 6.5, "Preparation, Review, Approval and Control of E&CDRs - Computerized Logging and Tracking System," Rev. 0, Change 1
- SWEC NEAM 38, "Authorization of Engineering and Design Changes," Rev. 8, Change 4
- SWEC NEAM 41, "Processing of Calculations," Rev. 6, Change 9
- SWEC NEAM 68, "Handling of Nonconformance and Disposition Reports by Engineering and Design," Rev. 6, Change 0
- SWEC NEAM 83, "Vendor Information Request," Rev. 3, Change 3

b. Inspection Findings

(1) In general E&DCRs appear to be used as intended by site procedures. Review of a random sample of approximately 200 E&DCRs identified the following discrepancies:

- No technical justifications were provided for five E&DCRs (FP 35766, FB 39126, FC 39127, FE 35758, FE 33638) as required by Revision 8 to NEAM 38.

- F.1 17774 was not dated by the Project Engineer when signed as required by NEAM 38.

(2) A significant number of design documents were found to be overdue for updating by the 6 and 4 rule as required by NEAM 38. Forty-six design documents associated with E&DCR changes were reviewed to see if they had been revised or were in the tracking system. The results were as follows:

- All 46 were being tracked in the IS-305 system.

- Eight had already been revised and listed the E&DCR numbers in the revision columns.

- Nine of the 46 had more than 6 E&DCRs and 4 of those were overdue for revision (i.e. overdue by 6 and 4 rule).

- Upon additional review of all plant drawings with "to be incorporated" E&DCRs outstanding, it was found that 421 drawings had reached the 6 and 4 requirement and 35 percent of those were at least one month overdue.

- It was noted that in October 1983 there were approximately 40 documents overdue for revision, in December 1984 there were about 80 overdue and in March 1985 about 150. Eventhough a list of drawings that had reached the 6 and 4 requirement was published monthly and subsequently discussed at management meetings, the number of overdue documents continued to increase. This appears to be a case of inadequate corrective actions to reduce the number of documents overdue for revision.

(3) A lack of followup and implementation of corrective actions associated with the NRC Region I Construction Team Inspection (CTI) Report 50-423/84-04 of May 30, 1984 was noted. The CTI finding addressed the need to relate implementing E&DCR numbers back to originating PCRs. SWEC had changed the governing procedure (NEAM 117) to accomplish the new process, but the revised procedures had not been implemented. Otherwise, the PCR and FCN processes evaluated in this inspection appeared to be in conformance with site procedures.

(4) Of the eight engineering calculations reviewed in detail, no discrepancies were noted relative to site procedures. The calculations were retrievable, clear and appeared adequate. The logging and control procedures also appeared adequate.

(5) The EA audit program for assessment of site design change control implementation appeared to be quite thorough and was considered satisfactory.

(6) The 16 E&DCRs reviewed in the field were satisfactory from a design change process standpoint. However, three of the 16 checked did have implementation problems from a construction or FQC standpoint. These three (TJ 1036, FP 22607, FB 33829) are discussed in Section III. The other 13 E&DCRs (FE 33638, FC 34777, FJ 34743, FJ 34710, FJ 35220, FJ 34265, TS 1258, TJ 1096, TJ 1021, FE 39121, FJ 35703, FE 39107 and FP 23624) were found to be satisfactory in the field.

c. Conclusions

For the sample inspected, there is adequate control of the design change process with the exception of updating design documents with the latest change information. Considering the number of E&DCRs that are outstanding against design documents, the potential for errors would be significantly reduced if design documents were updated in a timely manner. Management attention needs to be directed in this area.

Two cases of inadequate correction actions in design change control were noted. These are discussed further in Section VIII-B.1.b.(4).

TABLE VII-1

DOCUMENT RECORD CARD AUDIT SUMMARY

DRC/Drawing #	E&DCR #	N&D #	Drawing Station #	Discrepancy
BE-52BC			33,31	
BE-52GC			33,31	missing summary
	FE40552			
	FE39053			
	FE34149			missing @ 33
EB-39P			33, 31	
	FB37429			
	FB36108			
EB-39N			33,31	
	FB36328			missing summary
	FB37429			
	FB36954			DRC voiding error
EE-34L			33,31	DRC not current @ 31 (back to back printing problem); missing summary
EE-34M			33,31	
EE-34N			33,31	DRC not current @ 31 (back to back printing problem); 2 missing summaries
EE-34P			33,31	2 missing summaries
EE-34Q			33,31	
EE-34R			33,31	
EE-51C			33,31	
	FP35373			
	FP33149			
	FE32650			E&DCR not voided
EE-34AV			33,31	
	FE27135			
	FE18930			
	FE6361			

TABLE VII-1 (Continued)

DOCUMENT RECORD CARD AUDIT SUMMARY

DRC/Drawing #	E&DCR #	N&D #	Drawing Station #	Discrepancy
EE-34DL			33	2 revs at station
EE-34JB			33	2 revs at station
EE-34BE			33,31	
	FE29279			missing
	PE7161			E&DCR marked void
EE-34JC			33,31	
		10349		
		9720		
		8070		
EB-15Y			143,31	
	FP39301			
		5904		
	FJ17866			
ES-31B			143,31	DRC not current @ 31
		10631		
		4879		
		4968		
ES-31D			143,31	
		5025		
		4304		
	FS26024			
ES-31E			143,31	
		5904		
	FS23123			
	FJ15645			
BZ-501A-1			143,31	DRC not current @ 143; 4 missing summaries missing
		11078		
	FJ40308			
		9837		
		9230		
	FJ34694			
BZ-515G-1			143,31	DRC missing @ 31
		10925		
		10683		
	CJ3035			

TABLE VII-1 (Continued)

DOCUMENT RECORD CARD AUDIT SUMMARY

DRC/Drawing #	E&DCR #	N&D #	Drawing Station #	Discrepancy
BZ-515K-1			143,31	missing summary
		10934		
	FJ40812			
		10722		
2170.430.565-138			143,31	DRC not current @ 31
	FB39178			missing
	FB38808			
	FB38480			
2170.430.565-144			143,31	DRC not current @ 143; 2 missing summaries
	FB3043			missing
	FB40733			
	FB39302			
	FB38335			
	FB37820			
2170.430.565-147			143,31	DRC not current @ 31; missing summary
		10061		
	FB39723			
	FB39302			
BZ-79C-1			62,31	3 missing summaries
		10763		
		10777		missing
		10654		
		10705		
		10813		
	FJ40581			missing
		10656		
		10655		
	FJ40568			missing
BZ-79C-3			62,31	missing summary
BZ-79C-7			62,31	6 missing summaries
BZ-79C-17			62,31	5 missing summaries
BZ-79C-77			62,31	5 missing summaries
BZ-79C-13			62,31	
BZ-79C-33			62,31	7 missing summaries

TABLE VII-1 (Continued)

DOCUMENT RECORD CARD AUDIT SUMMARY

DRC/Drawing #	E&DCR #	N&D #	Drawing Station #	Discrepancy
BZ-79C-49			62,31	
BZ-79R			62,31	4 missing summaries
		10311		missing
		10690		missing
		10692		
		10691		
	FJ37525			
	FJ36743			
BZ-79R-2			62,31	
BZ-79R-7			62,31	
BZ-79R-17			62,31	4 missing summaries
BZ-82B-1			62,31	DRC not current @ 62
		11252		missing
		11136		missing
		10516		
		10027		
		10519		
	TJ-2078			
	TJ-2044			
	FJ-34317			
BZ-82B-20			62,31	missing summary
EE-3AMX			12,31	
	PE7099			missing
	TC1661			
EE-3QR			12,31	
	FE40194			
	DE233			
EE-9A			138,31	
EE-9B			138,31	
	TE397			
EE-9C			138.31	
	TE372			
	FE21059			
EE-9D			138,31	
	FE34408			
	TE372			

TABLE VII-1 (Continued)

DOCUMENT RECORD CARD AUDIT SUMMARY

DRC/Drawing #	E&DCR #	N&D #	Drawing Station #	Discrepancy
EE-9E			138,31	
	FC21059			
	FE20793			
EE-9AH			138,31	
	PC134			
	FE30057			
	FE29248			
EE-9AL			138,31	
	FE21059			
	FE20793			
EE-9R			138,31	
	FC21059			
	FE20793			
	FE16126			
EE-9W			138,31	missing summary
	TE2347			
	TE1819			
	FE39660			
	FE38584			
EK-501001			138,31	
EK-501002			138,31	
EK-501021sh1			138,31	
EK-501021sh2			138,31	DRC missing @ 138; DRC not current @ 31
EK-501049			138,31	
EK-501050			138,31	
EK-501065			138,31	
EK-501083			138,31	
EK-501084			138,31	
EK-501136			138,31	
EK-501137			138,31	

TABLE VII-1 (Continued)

DOCUMENT RECORD CARD AUDIT SUMMARY

DRC/Drawing #	E&DCR #	N&D #	Drawing Station #	Discrepancy
EP-17G			34,31	drawing missing @ 34
	PP7188			
	FP36330			missing
	FP35795			
EP-71A			34,31	drawing missing @ 34
		9736		
	FS38804			
		4700		missing
EP-72G			34,31	drawing missing @ 34
	PR6335			
	PR6221			
	PP5420			
EP-72J			34,31	drawing missing @ 34
EP-72T			34,31	2 missing summaries
	FP35921			
		8191		
	FP37554			missing
EP-74P			34,31	
	TP2830			missing
	TP2334			
	FP38340			
EP-109C			34,31	
	FP31059			missing
	PP5986			missing

TABLE VII-2

SPECIFICATION AUDIT SUMMARY

Specification #	Subject	E&DCR #	N&D #	Discrepancy
2412.100-247	Electrical Penetrations			spec missing from control point
		FE34301		
		FE36450		
		FC37909		posting error (NA to this spec)
		FE39071		
		FE36284		posting error, (not listed on spec Document Control Log)
2400.000-350	Electrical Installation			
		FE41022		
		FE40990		
		TE3090		
2472.210-377	D/P Indicators & Switches			
		TC645		
		TC693		
		FE33550		
2190.371-442	Metal Siding and Roof Decking			
		PS-4198		
		PS-5959		
		PS-6885		
		PS-7247		
2170.430-565	HVAC Installation			
			10439	
			10426	
			10023	
2472.310-683	RTD & Thermowells	PQ5416		
		PC5929		
2282.150-713	2" valves	PP5925		
		PP7333		
		A235		
2200.000-914	Mech. Equip. Erection			latest spec rev not filed; latest E&DCRs not filed

TABLE VII-2 (Continued)

SPECIFICATION AUDIT SUMMARY

Specification #	Subject	E&DCR #	N&D #	Discrepancy
2472.800-943	Instrumentation Installation	FC40336 FC40337 FC40983 TC2414 TC2750		
2280.000-968	Ppg Fab & Erection			E&DCRs not filed properly (at one control point) latest spec rev and addenda not filed; latest E&DCRs not filed (at another control point) Engineering Spec Index did not show latest spec addenda

TABLE VII-3

OIM AUDIT SUMMARY

OIM #	Subject	Discrepancy
109-001A	Personnel Air Lock	
140-001A	Axial Flow Fans	All E&DCRs were not posted in CDC log
154-003A	1500 lb valves	
162-1A	MS Safety Valves	
177-1A	MS Isolation Trip Valve	
190-2A	Orifice Plates	
241-001A	Emergency Diesel Gen.	EDC OIM Index did not show latest rev; all E&DCRs were not posted in CDC log; IS-305 data entry errors
244-001A	Motor Control Center	
261-001A	Static Inverter	
263-001A	AC Dist. Panels	
943-001A	CPI Tube Fitting	
943-25B	Photohelic Press. Sw	

VIII. CORRECTIVE ACTION SYSTEMS

A. Objective

The corrective action systems and related activities were examined to determine whether measures were established and implemented to assure that nonconformances and other conditions adverse to quality were promptly identified and corrected.

B. Discussion

An examination was made of the licensee's program for identification and control of corrective actions, including review of sample documents and inspection of some material/equipment for verification of actual corrective actions in the plant. Items such as the following were reviewed:

- Procedures and organizational interfaces
- Trending
- Audits and surveillances
- Measures for identification and resolution of nonconformances
- Measures to prevent recurrence
- Control of equipment qualification nonconformances
- Tracking of nonconformances
- Stop work process
- Control of actual material and equipment corrections in the plant
- Control of open nonconformances at turnover for testing or operation

The following procedures by Stone & Webster Engineering Corporation (SWEC), Northeast Utilities Service Company (NUSCO) and Northeast Nuclear Energy Company (NNECO) related to corrective action systems were reviewed:

- SWEC "Quality Assurance Program Manual," Rev. H
- NUSCO "Northeast Utilities Quality Assurance Program Topical Report," Rev. 6
- NUSCO/NNECO Nuclear Engineering and Operations Procedure (NEO)

  2.11, "Trend Analysis From Quality-Related Documents," Rev. 1
- SWEC Project Test Program Directive (PTPD)

  5.1, "Control of Nonconformances at Turnover," Rev. 3, Change No. 2

° SWEC Quality Standards (QS):

2.3, Rev. A, Stop Work Action
14.2, Rev. F, Inspection Report System
15.1, Rev. B, Nonconformance & Disposition Report, Change No. 1
15.3, Rev. C, Risk Release of UNSAT/Nonconforming Material/Equipment
16.1, Rev. B, SWEC Problem Reporting System
16.2, Rev. Notifying Clients of Potential 55(e)
16.3, Rev. A, Identifying and Reporting 10 CFR 21
18.1, Rev. B, Quality Audit Program
14.1 ML, Rev. B, Post-Acceptance Work Control

° SWEC Quality Assurance Directives (QAD):

14.1, Rev. D, Inspection Report System
18.1, Rev. C, Quality Assurance Audit System
18.2, Rev. C, Quality Audit Plan
18.11, Rev. F, QA Program Audits of Sellers

° SWEC Quality Control Instructions (QCI):

FM3-S14.2-06, Rev. A, Site QA Program Monitoring
FM3-S14.2-07, Rev. C, ASME N-5 Inspections

° SWEC Northeast Administrative Manual (NEAM):

31, Rev. 7, Handling of Problem Reports, Reports of Problems and Initial Problem Reports
68, Rev. 5, Handling of Nonconformance and Disposition Reports, Change No. 3
114, Rev. 1, Reportable Occurences Reports, 10 CFR 50.55(e) and 10 CFR 21

° SWEC Field Construction Procedures (FCP):

292, Rev. 1, Disassembly/Reassembly of Components/Equipment
335, Rev. 2, Trend Analysis and Corrective Action Committee
337, Rev. 3, Preparing Stress Reconciliation Piping Location Isometrics (PLIs)

° SWEC Quality Assurance and Control Manual, ASME-Section III, Division 1

Section 15, Rev. J, Nonconformances

1. Corrective Action Measures

a. Inspection Scope

A review was performed of applicable portions of the QA program and procedures. A total of 263 corrective action documents were reviewed and 10 material/equipment samples were inspected for verification of corrective actions in the plant. Also, three samples of risk releases were selected for field verification of

control and status of work on material/equipment to correct the deficient condition involved. Table VIII-1, "Corrective Action Samples," contains a summary list of documents and material/equipment samples that were randomly selected and inspected.

b. Inspection Findings

In general, it was found that satisfactory procedures were in place for corrective action systems to identify and correct conditions adverse to quality at the site. Generally, except for concerns discussed below, the corrective action measures were found to be acceptable. The 10 material/equipment samples requiring rework in the plant were inspected and corrective action was verified. The three samples of risk releases were inspected and found to be properly controlled. However, the following observations were made by the NRC CAT inspector:

(1) Nonconformance and Disposition Reports (N&Ds) and UNSAT Inspection Reports (IRs) did not document actions or need for actions to prevent recurrence of nonconformances. SWEC representatives stated that, while no provision was made on N&D and IR forms to document action to prevent recurrence, such actions were provided by other means. It was stated that the trending activities of the project required a review of programmatic Type C IRs, N&Ds and UNSAT Type A IRs to identify nonconformances and negative trends, and that the results of such reviews would bring about action to prevent significant recurrences. Also, SWEC representatives stated that the practices at the site included action by discipline quality control (QC) inspectors as well as construction supervisors, to promptly notify responsible parties by interoffice correspondence, memorandums, or verbally to expedite review/action to avoid recurrence of significant N&Ds and UNSAT IRs.

This response was of concern to the NRC CAT inspector because of these informal practices and delays in the trending program to bring about action to avoid recurrence of significent nonconformances.

This matter requires additional management attention to assure that nonconformances requiring action to prevent recurrence are promptly identified and appropriate action is taken.

(2) NUSCO Construction Quality Assurance (CQA) Audit No. A-40958 (conducted 7/9/84-11/28/84) of preventive maintenance and in-place equipment storage documented findings regarding improper preventive maintenance of mechanical and electrical equipment. However, follow-up responses did not address the damage that may have been caused due to improper maintenance. Also, the NRC CAT inspectors found deficiencies (without corrective action) in preventive maintenance of various mechanical and electrical equipments. Refer to Section III.B.5.b for details regarding mechanical equipment, and Section II.B.3.b(1) for details regarding electrical equipment.

(3) Review of Deficiency and Construction Work Permit (CWP) Reports by NNECO revealed an increasing magnitude of open N&Ds, UNSAT IRs, and other deficiencies.

A total of 9,051 open items for approximately 200 system packages (of a total of 245) already turned over to NNECO was noted as of March 21, 1985. Also, the Master Deficiency List included in Deficiency and CWP Report as of March 26, 1985 showed an increase of open items for six reporting periods, from 8,369 as of January 30, 1985 to 9,021 as of March 16, 1985.

The concern is the increasing magnitude of open deficiencies to be resolved after turnover to NNECO, with rework activities proceeding under different controls and conditions, may result in decreased control of quality of such work to complete the plant.

This matter requires special management attention.

(4) Review of design change control activities at the site revealed deficiencies for which effective corrective actions were not performed. The following is a list of some such deficiencies:

- Incorrect information printed on back of document record cards (DRCs). (Refer to Section VII.B.1.b.(3) for details.)
- Numerous recurring document control problems at site drawing stations. (Refer to Section VII.B.1.b.(7) for details.)
- Increasing number of design documents overdue for updating. (Refer to Section VII.B.2.b.(2) for details.)
- Improved procedure for relating engineering and design change requests (E&DCRs) to originating project change requests (PCRs) was not implemented. (Refer to Section VII.B.2.b.(3) for details.)

c. <u>Conclusions</u>

Weaknesses in the licensee's corrective action program were found in the following areas:

- Failure to promptly document the need for action to avoid recurrence of nonconformances.
- Lack of control of preventive maintenance and corrective action for deficient preventive maintenance after turnover for testing/operation.
- The increasing magnitude of nonconformances at turnover for testing/operation.
- Failure to apply effective corrective actions for design change control and document control deficiencies.

TABLE VIII-1

CORRECTIVE ACTION SAMPLES

ITEM	QUANTITY EXAMINED
(1) Construction Quality Assurance (CQA) Audit (NUSCO)	6
(2) In Process Verification Report (IPV) (NUSCO)	5
(3) Surveillance Report (NUSCO)	24
(4) Significant Deficiencies (SDs) (NUSCO)	4
(5) QA Site Audit Report (SWEC-Corp.)	3
(6) Audit of Contractor (SWEC-PQA)	1
(7) N&D Corrective Action Committee Report (Including N&D Trend Report) (SWEC)	3
(8) QA Department Monthly Project Report (SWEC-FQC)	5
(9) Monthly QA Progress Meeting Report (SWEC)	3
(10) Stop Work Directive (SWEC)	2
(11) Report of a Problem (ROAP) (SWEC)	4
(12) Inspection Report - Type C (SWEC)	53
(13) Inspection Report - Type A UNSAT (SWEC):	
° Mechanical	10
° Piping	15
° HVAC	5
° Electrical	20
° Instrumentation	15
° Structural	5
(14) Nonconformance and Disposition Report (N&D) (SWEC):	
° Mechanical	8
° Piping	10
° Welding	9
° HVAC	6
° Electrical	12
° Instrumentation	5
° Structural	3
° Preventive Maintenance	6
(15) Risk Release (SWEC)	16

TABLE VIII-1 (Continued)

CORRECTIVE ACTION SAMPLES

ITEM	QUANTITY EXAMINED
(16) Installation Completion Report (SWEC)	2
(17) Deficiency and Construction Work Permit (CWP) Report NNECO	2
SUB-TOTAL DOCUMENTS	263
(18) Material/Equipment Samples for Field Verification of Corrective Action	10
(19) Risk Release Samples for Field Verification of Control of Corrective Action	3
TOTAL SAMPLES	276

ATTACHMENT A

A. PERSONS CONTACTED

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

1. Exit meeting

Licensee

H. Albee	R. Lefebvre	G. Pittman
G. Baston	D. Miller	P. Quinlan
R. Busch	E. Mroczha	F. Rothen
J. Crockett	L. Nadeau	W. Rotherforhh
J. Ferland	D. Nordquist	C. Schaffer
M. Hess	S. Orcfice	A. Silva
R. Josh	V. Papadopoli	R. Werner

Stone and Webster Engineering Corporation

R. Ackley	G. Milley	R. Scannell
W. Curtiss	L. Nace	C. Sprouse
W. Emerson	R. Plant	G. Turner
R. Kelly	R. Rudis	

NRC and Consultants

T. Chan	E. McCabe	A. Saunders
R. Compton	J. McCormack	R. Serb
E. Doolittle	J. Partlow	W. Sperko
D. Ford	H. Phillips	R. Starostecki
R. Heishman	T. Rebelowski	E. Wenzinger
O. Mallon	S. Reynolds	R. Wheeler
W. Marini	R. Rohrbacher	H. Wong
E. Martindale		

2. Licensee's Coordinators and Contacts

Area	Name
CAT Coordinator	L. Nadeau W. Curtiss
Electrical and Instrumentation	R. Clark D. Evans P. Hogan R. Dietsel
Mechanical	R. Avery C. Clement R. Hagerman L. Peterson G. Wilson

Welding and NDE	L. Peterson W. Taylor N. Hammer
Civil and Structural	R. Zawacki A. Morales
Material Traceability	A. Little
Design Change Control	R. Rudis
Corrective Action Systems	W. Vos

In addition to the above personnel, numerous other inspectors, engineers, and supervisory personnel 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. References to specific procedures, specifications, and drawings are contained within the body of the report.

1. Final Safety Analysis Report
2. Quality assurance manuals
3. Quality assurance procedures
4. Quality control procedures
5. Administrative procedures
6. General electrical construction procedures and specifications
7. General instrumentation construction 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

GLOSSARY OF ABBREVIATIONS

AISC	American Institute of Steel Construction, Inc.
ANNULUS	Containment Building Annulus
ANSI	American National Standards Institute
ATWS	Anticipated Transient Without Scram
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing & Materials
AUX	Auxiliary Building
AWG	American Wire Gage
AWS	American Welding Society
BLK	Black
BLU	Blue
CAT	Construction Appraisal Team (NRC)
CFR	Code of Federal Regulations
CMP	Construction Methods Procedure
CMTR	Certified Material Test Report
C of C	Certificate of Compliance
CONT	Containment Building
CQA	Construction Quality Assurance
CTI	Construction Team Inspection
CWP	Construction Work Permit
DRC	Document Record Card
EA	Engineering Assurance
EAP	Engineering Assurance Procedure
E&DCR	Engineering and Design Coordination Report
ESF	Engineering Safety Features Building
ESSOW	Engineering Service Scope of Work
FCN	Field Change Notice
FPC	Field Construction Procedures
FQC	Field Quality Control
FSAR	Final Safety Analysis Report
GRN	Green
GTAW	Gas Tungsten Arc Welding
HVAC	Heating, Ventilating and Air Conditioning
ICEA	Insulated Cable Engineers Association
IE	Office of Inspection and Enforcement (NRC)
IEEE	Institute of Electrical and Electronic Engineers
IR	Inspection Report
IS	Information System
LIW	Load Indicating Washers
MCB	Main Control Board
MCC	Motor Control Center
MSVB	Main Steam Valve Building
N&D	Nonconformance and Disposition Report
NDE	Nondestructive Examination
NEAM	Northeast Administrative Manual
NETM	Northeast Technical Manual
NEO	Nuclear Engineering and Operations Procedure
NNECO	Northeast Nuclear Energy Company

GLOSSARY OF ABBREVIATIONS (Continued)

NRC	Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation (NRC)
NSSS	Nuclear Steam Supply System
NUSCO	Northeast Utilities Service Company
NUQAP	Northeast Utilities Quality Assurance Program
NVECO	Northeast Ventilation Company
OIM	Operating, Installation and Maintenance Manual
ORG	Orange
PCR	Project Change Request
PLI	Piping Location Isometric
PTPD	Project Test Program Directive
PWHT	Post Weld Heat Treatment
QA	Quality Assurance
QAAD	Quality Assurance Auditing Division
QAD	Quality Assurance Directives
QC	Quality Control
QCI	Quality Control Instruction
QS	Quality Standards
RG	Regulatory Guide (NRC)
ROAP	Report of a Problem
RPS	Reactor Protection System
SAE	Society of Automotive Engineers
SAR	Safety Analysis Report
SEG	SWEC Site Engineering Group
SIH	High Pressure Safety Injection
SMA	Shielded Metal Arc
SMAW	Shielded Metal Arc Welding
SWEC	Stone and Webster Engineering Corporation
TR	Trouble Report
TVS	Thames Valley Steel Corporation
UNSAT	Unsatisfactory
UT	Ultrasonic Test
VIR	Vendor Information Request
WHT	White
WPS	Weld Procedure Specification

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