UNITED STATES NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

DIVISION OF QUALITY ASSURANCE, SAFEGUARDS, AND INSPECTION PROGRAMS
REACTOR CONSTRUCTION PROGRAMS BRANCH

Report No.: 50-443/84-07

Docket No.: 50-443

Applicant: Public Service Company of New Hampshire
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President and Chief Executive Officer
P.O. Box 330
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Facility Name: Seabrook Station

Inspection At: Seabrook Station, Seabrook, New Hampshire

Inspection Conducted: April 23 - May 4, 1984 and May 14-25, 1984

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I. INSPECTION SCOPE AND OBJECTIVES

The objective of this inspection was to evaluate the adequacy of construction at the Seabrook Station. This objective was accomplished through review of the construction program and selected portions of the quality assurance program, with emphasis on the installed hardware. Because essentially no construction work was in progress during the NRC Construction Appraisal Team (CAT) inspection period, observation of in-process work was not conducted. Additionally, some areas pertaining to quality assurance received only limited review including the determination of QC inspector effectiveness.

Within the areas examined, the inspection consisted primarily of a detailed examination of selected hardware subsequent to quality control inspections and a selective examination of procedures and representative records. Interviews were conducted with designated site managers and some QA/QC personnel.

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

° Is the hardware installed in accordance with the approved design?

° Do individuals with assigned responsibilities in a specific area understand their designated responsibilities?

° Are quality verifications performed during the construction process with applicable hold points?

° Are management controls established and implemented to adequately control activities in the subject area?

The areas in which a selected sampling inspection was conducted include:

° Electrical and Instrumentation Construction
° Mechanical Construction
° Civil and Structural Construction
° Welding and Nondestructive Examination
° Material Traceability and Controls
° Design Change Control and Corrective Action Systems

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 the applicable requirements, 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 reflected the completed work.

B. Discussion

Within the broad categories of electrical and instrumentation construction, attention was given to several specific areas. These areas included installation of electrical raceway, electrical cable, electrical equipment and instrumentation components. Additionally, a review was made of a selected number of documents associated with design change controls and corrective action systems in the electrical and instrumentation areas.

1. Electrical Raceway Installation

a. Inspection Scope

Eighty-eight segments of installed Class 1E cable tray, comprising a total length of about 1,300 feet, were selected from various plant areas and systems for detailed examination by the NRC Construction Appraisal Team (CAT). These segments were inspected for compliance to requirements relative to routing/location, separation, support spacing, identification, protection and physical loading.

Twenty-seven runs of installed conduit, with an aggregate length of about 1000 feet, were selected from various plant areas and systems for detailed examination. These runs were inspected for compliance to specified requirements such as routing/location, separation, minimum bend radii, identification, support spacing and associated fittings. An additional 500 feet of installed conduit and wireways were inspected for separation and general workmanship. The program used to provide detailed conduit routing and installation instructions was reviewed. Sketches are provided by the conduit layout design group when routing problems are encountered in the field.

Fifteen cable tray supports and twenty conduit support from various locations were examined in detail. Inspection attributes such as location, material, anchor spacing, weld quality and bolt torque as well as the installed configuration were reviewed.

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

United Engineers & Constructors, Inc. (UE&C) Specification 9763-006-48-2 "Specification for General Electrical Installation," Rev. 7/14/82

Fischbach-Boulos-Manzi-NH (FBM) Quality Control Procedure (QCP) 503, "Inspection of Cable Tray and Support Installation," Rev. 9/15/83

FBM Construction Procedure (FECP) 503, "Installation of Safety and Non-Safety Related Cable Tray and Supports," Rev. 12/12/83

UE&C Technical Procedure (TP) 8, "Separation Criteria," Rev. 12/29/83

FBM Procedure FECP-502, "Construction Procedure for Installation of Safety and Non-Safety Related Exposed Conduit, Terminal and Pull Boxes and Supports," Rev. 4

FBM Procedure QCP-502, "Quality Control Procedure for Inspection of Exposed Conduit, Terminal and Pull Boxes and Support Installation," Rev. 4

FBM Procedure FECP-206, "Construction Procedure for Separation Criteria and Attachment to Embedded Plates," Rev. 2

UE&C Drawing 9763-M300229, "Cable Tray System Notes and Typical Details"

UE&C Drawing 9763-M-300228, "Conduit System Notes and Typical Details"

[See Table II-1 for a listing of the cable raceway supports inspected.]

b. Inspection Findings

During the examination of raceway components, the NRC CAT inspectors observed that in general, materials used were as specified, and attributes such as location and size were in accordance with the requirements. However, several installation/inspection discrepancies were identified. These are detailed in the following sections:

(1) Cable Tray Supports

Fifteen seismic cable tray supports were examined in detail. The examination was performed using the latest revision of UE&C drawing "Cable Tray System Notes and Typical Details", as these were considered "typical designs." However, a comparison of installed supports to these details revealed that 11 of the 15 supports were not constructed in accordance with the latest design document. Deficiencies observed included items such as changes in the installed configuration and the use of unspecified materials and fittings.

Discussions with Yankee Atomic Electric Company (YAEC) Quality Assurance personnel concerning these deficiencies led to a clarification of the terms "Typical" or "Cookbook." These terms were inappropriately applied by UE&C engineering to the design details used for installation of seismic cable tray suppports. As an example, the "typical" detail for a type T26 support shows a support suspended from the ceiling with diagonal bracing only. The latest design detail for this support indicates weld sizes and material types not shown on earlier revisions of the design. The current revision for this support type is dated 12/7/83 and is preceeded by eight revisions.

To demonstrate construction/design conformance would require a comparison of the support installation to the design detail in effect at the time of installation. Therefore, the NRC CAT inspectors requested previous detail revisions for review, but were informed by UE&C that a complete set of these design drawings were not available on site. UE&C was then requested to provide these drawings from their home office files in Philadelphia. A reinspection of the 15 supports using the design details provided by UE&C was then performed. It was observed that several construction deficiencies still existed.

The NRC CAT inspectors then identified a second concern with regard to the adequacy of Quality Assurance (QA) records which reflected the inspection of seismic cable tray supports. In comparing actual installations to the applicable Quality Control (QC) inspection records, it was observed that a high percentage of "Final QC Inspected" supports had been affected by subsequent design changes. However, in reviewing the inspection records for cable tray supports, the NRC CAT inspectors observed few records which referenced the applicable design change and rework documents.

FBM QCP-203, "Quality Control Procedure for Inspection of Rework" states that "A Quality Control Installation Report from the appropriate QCP shall be completed for each safety-related rework, if required, such as welding, anchor bolts, cable terminations, cable tray, conduit support, etc. The rework number shall be included as a reference document on the installation report." Several of the construction deficiencies identified by NRC CAT inspectors were subsequently resolved when Engineering Change Authorizations (ECAs) or Rework notices were provided which detailed changes from the design drawings. However, these documents were not referenced on the Quality Control inspection records nor had additional Installation Reports been initiated as procedurally required. As a result of these observations, YAEC

Quality Assurance issued a directive requiring construction to initiate a new Installation Report when any form of rework is performed on previously accepted components.

Also of concern is the status of final design for seismic cable tray supports. As previously indicated, the typical details which depict design criteria for seismic supports have been extensively revised. Additionally, as a result of the material qualification and seismic loading problems discussed in Section IV of this report, further design changes have been required. These changes have been incorporated into the UE&C Seismic Cable Tray Bracing drawings which represent the final design for each individual support. To date, a small percentage of the final design drawings have been issued to the installing contractor. In reviewing several of the drawings that have been issued, the NRC CAT inspectors observed that in addition to support bracing, changes to components comprising the actual support have also been specified. These changes will require a subsequent reinspection of original inspection attributes. It is important to note that the drawings requested by the NRC CAT inspectors from UE&C in Philadelphia would necessarily have to be available at the site to verify the adequacy of the original inspection reports.

It was further observed that these bracing drawings did not depict the details for attachment of seismic supports to building steel. Applicant and engineering representatives explained that these details would be as shown on the revision of the "Cable Tray System Notes and Typical Details" drawing used at the time of installation. In other words, the final design details for a given seismic support could only be derived by combining the design information from both the recently issued bracing drawings and the applicable revision on notes and typical details used at the time of installation.

The NRC CAT inspectors reviewed several support installations in this manner. It was noted that in a number of instances, weld details had been modified substanially. Early revisions of typical details specified stitch welds of 1" in length. These were changed to 1½" and subsequently to 2½" lengths in latter revisions of the details. Since U&EC would have no record of which detail was used to install a given support, the NRC CAT inspectors questioned whether the use of shorter weld lengths had been considered in determining seismic loading of the supports. In response, UE&C produced a copy of a Franklin Institute report which demonstrates the adequacy of 1½" stitch welds of strut members for cable tray and conduit supports at the Seabrook Nuclear Station. However, the use of a 1" stitch weld as specified in early revisions of the typical details had not been considered. The NRC CAT inspectors were unable to determine how extensively this weld attachment had been used, but were informed by the applicant and engineer representatives that seismic supports installed in earlier stages of construction may have been constructed using design details which specify the use of 1" stitch welds for attachment of strut members. The NRC CAT inspectors noted that the failure to consider load capacity of 1" stitch weld attachments could adversely affect the acceptability of seismic supports due to changes in seismic loading criteria discussed in Section IV of this report. As a result of the NRC CAT observation, UE&C performed an on-site evaluation of the load capacity of 1" stitch welds.

The NRC CAT inspectors noted a lack of effective communication among the various design, construction and inspection personnel involved with the extensive and continuing design changes associated with cable tray supports. It was also noted that the full significance and quality impact of these changes may not be fully recognized by the applicant or his contractors.

In summary, the current status of seismic cable tray supports is considered indeterminate. The combination of NRC CAT identified hardware deficiencies, the status of design completion, and the status of applicable inspection records indicates that a significant amount of rework and/or reinspection will be required to assure that the 1,300 seismic supports installed and inspected to date are constructed in accordance with the appropriate design documents. The lack of effective communication among those involved with this activity adversely contributed to the above situation.

(2) Cable Tray Installation

In general, cable trays were installed in accordance with requirements. However, the seismic aspects of these cable trays have not been fully resolved. Conflicting information was received from the electrical and civil disciplines and a lack of effective communication between these two disciplines was noted. Questions concerning cable tray seismic qualification are discussed in Section IV.B.4. of this report.

Regarding separation of raceway, isolated instances were observed in which raceway of one electrical division did not maintain the required physical separation from raceway of another electrical division. These have subsequently been documented by YAEC Quality Assurance representatives and are being evaluated for corrective action.

(3) Conduit

No significant discrepancies were noted in the sample of conduit inspected by the NRC CAT inspectors. Of the several instances identified where specified requirements were not met, documentation was available in most cases to indicate that the items had been identified for future corrective action.

It was noted, however, that conduit runs were only identified at the "to" and "from" ends and at most penetrations through walls and ceilings by the use of brass tags near the penetration. Illegible tags or no identification tags were noted at one end or at pull boxes of four conduit runs (1CG/RA, 3WH/LA, 4CD1RB and 1UB/VA).

The lack of electrical division (color) identification along conduit runs and the small size of the existing identification tags does not provide easily recognizable identification of safety-related conduit. [A related matter was previously identified by the NRC Integrated Design Inspection Team (NRC Report 50-443/83-23)].

The work performed by the conduit layout design group was also reviewed and discussed with both the contractor and UE&C representatives. This group provides sketches for conduit routing in cases where the UE&C conduit routing drawings are insufficient regarding details and where problems in routing are encountered in the field. These sketches are used to supplement the UE&C drawings. The sketches are revised and controlled in a formal manner by a document control group. Obsolete revisions of drawings and sketches are not allowed for use during installation or inspection activities. YAEC QA monitors use of these sketches periodically. This program appeared to provide adequate control, but it was not in use during the NRC CAT inspection period.

(4) Conduit Supports

No significant discrepancies were identified in the sample of conduit supports inspected by the NRC CAT inspectors.

c. Conclusions

The NRC CAT inspectors found that, in general, the installation of Class 1E raceways was in accordance with applicable design criteria. However, the quality of seismic cable tray support installations is considered indeterminate. The NRC CAT inspectors noted that the cable tray supports installed and inspected to date may not meet applicable requirements. The combination of NRC CAT identified deficiencies, the inadequacy of applicable inspection records and the extensive and continuing changes in design do not provide assurance that applicable requirements will be met in this area. Ineffective communications among the various design, construction and inspection personnel increased the concern in this area.

2. Electrical Cable Installation

a. Inspection Scope

The NRC CAT inspectors selected for review a sample of installed Class 1E cable runs that had been previously accepted by QC inspectors. The sample included high voltage, power, control and instrument cables. For each of these 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 50 cable terminations for examination. These were inspected relative to the 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.

The following high voltage and power cables totaling approximately 2,000 feet were selected from different systems, electrical trains, and locations and were of various sizes:

Cable	Type	Cable	Type
A56-M09	1-3/C-4/0	AW9-D12	1-3/C-250
A81-M16	1-3/C-4/0	D44-J57	1-3/C-1/0
A80-N14	1-3/C-4/0	GU2-NH1	1-3/C-1/0
BF7-M62	1-3/C-12	D41-VQ9	1-3/C-12
DP2-E2U	1-3/C-2/0		

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

Cable	Type	Cable	Type
D36-FB0	1-2/C-14	FB5-FG1	1-7/C-14
EG1-GN9	1-2/C-14	FB8-FG5	1-7/C-14
EH0-F16	1-2/C-14	D88-HR2	1-2/C-14
E87-E4A	1-2/C-14	EE3-G2J/1	1-4/C-14
E88-F20	1-2/C-14		

The following instrument cables totaling approximately 1,900 feet were selected from different systems and locations:

Cable	Type	Cable	Type
F42-FB6/1	1-4/P-16	F71-FA4	1-1/P-16
F47-FA1/1	1-4/P-16	F80-G10/1	1-1/P-16
F48-FA2	1-2/P-16	GX6-ZV0/1	1-1/P-16
F70-FJ1/1	1-1/P-16	F51-FB6	1-4/P-16
F48-QD0	1-1/P-16		

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

UE&C Specification 9763-006-48-2, "Specification for General Electrical Installation," Rev. 7/14/82

FBM QCP-504, "Installation of Electrical Cable," 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. However, the routing of cable D41-VQ9 was not as indicated on design documents. The actual routing of this cable is through tray 44C2LB instead of 44C1LB as designated on the computer-generated routing slip.

No other deficiencies were identified relative to cable routing. The condition listed above appears to be an isolated case.

(2) Separation

The NRC CAT inspection of cable installations within electrical panels disclosed several separation criteria deficiencies; specifically, cable installations which did not maintain the required separation of six inches between electrical divisions. Appendix 8A of the Seabrook Station Final Safety Analysis Report (FSAR) details the licensee commitments for maintaining physical independence of electric systems. Section 5.6.2 of this document, entitled "Internal Separation" states... "The minimum separation distance between redundant Class 1E equipment and circuits internal to the control board can be established by analysis of the proposed installation. This analysis shall be based on tests performed to determine the flame retardant characteristics of the wiring, (and) wiring materials internal to the control board. Where the control board materials are flame retardant and analysis is not performed, the minimum separation distance shall be six inches. In the event that the above separation distances are not maintained, barriers shall be installed between redundant Class 1E wiring."

The NRC CAT inspectors examined several sections of the installed main control boards, and observed approximately ten instances of separation criteria violations involving some 40 to 50 cables. In addition to field installed cabling, deficiencies in vendor installed wiring were also observed.

Several additional electrical panels also contained cable which exhibited violations of separation criteria. These include the 5KV Switchgear EDE-SWG-E6 and the Remote Safe Shutdown Panel MM-CP-108B. However, in each of these instances, separation criteria violations occurred as a result of inadequate barrier installations and not as an oversight during inspection activities. As an example, division "A" associated cables have been routed to a terminal block located within the division "B" Remote Safe Shutdown Panel. The cables have been separated at the terminal block through use of a metal clad box. However, where the cables exit the panel the flexible conduit used to provide a barrier has been terminated 6" to 8" short of the panel ceiling, thus providing inadequate separation between enclosed cables and division "B" cables in the panel.

As previously stated, the highest concentration of separation criteria violations were observed in the main control boards. In this area, corrective action may be as simple as rerouting field installed cabling; however, several components will require the installation of fire resistant barriers. The NRC CAT inspectors reviewed installation documents for these cables and found no indication of nonconformance or unacceptable installation reports. The NRC CAT inspectors thus concluded that corrective action had not been implemented for these items because they had not been properly identified as deficiencies. It should be noted that most control board components have been turned over to the Startup organization and remain under their jurisdiction.

Prompt identification and adequate corrective actions are required to assure that these deficiencies in cable and wiring within panels conform to FSAR commitments for independence of electric systems.

(3) Cable Spacing

In connection with an issue previously identified by NRC Region I (unresolved item 50-443/83-15-04), the NRC CAT inspectors observed several high voltage cables with installed configurations such that they were in violation of spacing requirements between adjacent cables. Cables A81-M16, A56-M09 and A80-N14 exhibited spacing of less than one-quarter diameter in several places along the run examined.

It is the applicant's position that though conductors may touch here and there, the effect on ampacity of the cables is not significant. Further, the applicant intends to have a third party assessment performed to verify engineering judgement in this matter. This matter is being followed by NRC Region I.

(4) Cable Damage

The NRC CAT inspectors identified one instance in which a Class 1E cable had been damaged. Cable DB1-HR5 exhibits a slice in the insulation about 8" from the terminal point at a motor control center. This damage appears to have occurred during the "dressing" of the cable. Upon notification, YAEC Quality Assurance issued a surveillance report to track the deficiency.

(5) Cable and Cable Reel Identification

A number of cable reels were observed with duplicate prefix and footage markings on cable with the same cable code. Refer to Section VII of this report for details.

(6) Terminations

In general, cable terminations had been performed in accordance with procedural requirements. Cable ends selected by the NRC CAT inspectors were found to be in compliance with design documents relative to terminal point destination, workmanship, and materials used.

During the NRC CAT inspection of 5KV switchgear and 480V motor control centers, several additional cable terminations were observed which were not in accordance with installation procedures. Cables terminated to the current transducers in several cubicles of 5KV switchgear EDE-SWG-E6 have (ground or neutral) conductors which have been terminated by wrapping them around the jacket of the cable. This in in violation of procedures which require that unused conductors be "spared" and taped or cut from the cable. Additionally, in several of these terminations, the functional conductors exhibit excessive bending at the point of termination. The NRC CAT inspectors noted that the cables involved did not have identification tags or the divisional color coding required for field installations. The applicant indicated that the cables in question had been vendor installed. Further applicant attention to this matter will be required.

In motor control center EDE-MCC-612, the NRC CAT inspectors observed several cables in which spare conductors had been used by the Startup organization for sound powered communications. Conductors from cables B45-V60/1, B45-F10, and DA3-F71 have been spliced in different sections of the MCC wireways. The NRC CAT inspectors observed that the Startup organization has no procedural provision for use of Class 1E spared conductors in this manner. As a result of this observation, YAEC Quality Assurance has issued a Surveillance Report and Deficiency Report 649 to document this condition.

In summary, the condition of field installed Class 1E terminations was found to be in accordance with requirements. However, Startup organization modifications should be procedurally controlled to assure that previously accepted installations are not adversely affected.

(7) Cable Tray Fill

The NRC CAT inspectors identified several cable tray segments where the installed cable extends above the top of the tray side rails. The NRC CAT is concerned that the TP-8 program may not adequately consider this tray overfill condition when performing an analysis of TP-8 violations. The TP-8 Program was established to determine whether minimum clearances between the various installed components were met. These clearances are defined in UE&C Technical Procedure (TP) 8, "Separation Criteria for Public Service Company of New Hampshire Seabrook Station." A similar matter has been previously identified by NRC Region I and is designated as unresolved item 443/83-03-01.

c. Conclusion

Class 1E cable installations are generally acceptable. However, numerous separation criteria deficiencies were observed; most were in the main control boards. Deficiencies with regard to high voltage cable spacing and cable tray fill will require further applicant response to the unresolved items issued by NRC Region I.

3. Electrical Cable Qualification Records

a. Inspection Scope

Six UE&C cable specifications and 16 qualification reports from the cable manufacturers were examined to determine whether Class 1E cable delivered and installed at the site met specified requirements. Qualification reports were reviewed to evaluate the qualification methods used by the manufacturers (Anaconda, Okonite, Brand-Rex and ITT Surprenant) for about three-fourths of the Class 1E cable to be installed at the site. The data used and the qualication test results obtained were compared with the values specified.

b. Inspection Findings

For the qualification reports reviewed, the values obtained for thermal aging, water absorption, irradiation and flame tests met the specified requirements.

UE&C issued two NCRs (1468 and 1555) concerning 15 reels of cable supplied by the Rockbestos Company that did not have satisfactory proof that the cable passed the required qualification tests. This cable was subsequently returned to the manufacturer.

c. Conclusion

The cable specifications and qualification records examined indicated that the cable meets specified requirements.

4. Electrical Equipment Installation

a. Inspection Scope

Approximately 30 pieces of installed electrical equipment and associated hardware were inspected. Samples were selected based on system function and safety classification.

The following electrical components were inspected:

(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	SI-P-6A
Safety Injection Pump Motor	SI-P-6B
Containment Spray Pump Motor	CBS-P-9A
Residual Heat Removal Pump Motor	RH-P-8B
Charging Pump Motor	CS-P-2B

(2) Electrical Penetration Assemblies

The following penetration assemblies were inspected:

EDE-MM-104
EDE-MM-131
EDE-MM-95
EDE-MM-90

The location, type, mounting and identification were compared with the installation drawings.

(3) Switchgear and Motor Control Centers

The following switchgear and motor control centers were inspected:

Motor Control Center	EDE-MCC-E512
Motor Control Center	EDE-MCC-E612
Motor Control Center	EDE-MCC-E621
Motor Control Center	EDE-MCC-E513
4160V Switchgear	EDE-SWG-5
4160V Switchgear	EDE-SWG-6

(4) Station Batteries and Racks

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

(5) 125V DC System Equipment

The following equipment comprising portions of the 125V DC systems were inspected for compliance to design and installation documents for such items as location, mounting, and proper configuration.

Battery Charger	EDE-BC-1A
Battery Charger	EDE-BC-1B
DC Distribution Panel	EDE-PP-111A
DC Distribution Panel	EDE-PP-111B
DC Power Panel	EDE-PP-111C
DC Power Panel	EDE-PP-111D
DC Control Panel	EDE-CP-24B

(6) Control Panels

Several Class IE control panels were examined in detail relative to design criteria for location, mounting and configuration. The following panels were selected:

Safe Shutdown Panel	MM-CP-108A
Safe Shutdown Panel	MM-CP-108B
Diesel Generator Control Panel	DG-CP-76A
Main Control Boards	(Several Locations)

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

UE&C Specification 973-006-48-2, "Specification for General Electrical Installation," Rev. 7/14/82

FBM QCP-319, "Inspection of 15KV and 5KV Indoor, Metalclad Switchgear Installation," Rev. 12/8/83

FBM QCP-511, "Inspection of Batteries and Racks," Rev. 9/26/83

UE&C Drawing 9763-F-300209, "Typical Floor Mounting of Electrical Equipment," Rev. 8/31/82

b. Inspection Findings

(1) Motors

Motors examined were installed in accordance with the applicable design and installation documents. The review of Quality Control records indicates that installation/inspection activities had been performed in accordance with procedural requirements. Maintenance requirements such as shaft rotation, oil level checks and energized space heaters were found to have been performed as required.

(2) Electrical Penetrations

Penetrations examined were found to be in accordance with design and installation documents. The NRC CAT inspectors reviewed installation records and Fischbach Quality Control inspection documentation and concluded that procedural requirements for installation had been met. Pullman Power Products weld process sheets were also reviewed to assure that appropriate procedural controls had been implemented during welding activities, and no deviations were noted. Performance of maintenance items, such as verifying specified nitrogen pressure, was reviewed also. They were performed in accordance with procedural requirements.

(3) Switchgear and Motor Control Centers

During the NRC CAT inspection of installed motor control centers, it was observed that the mounting weld configuration was not in accordance with the weld configuration specified by the vendor's seismic qualification report. The field installation does match the UE&C design details which specify a fillet weld of 3/16" by 2" long; however, the vendor requires a 1/4" by 3" long weld. [This item was previously identified during the NRC Integrated Design Inspection (NRC Report 50-443/83-23)]. Information provided to the NRC CAT inspectors regarding vendor acceptance of the field installed weld configuration will be incorporated into the applicants response to the Integrated Design Inspection Report.

The NRC CAT inspectors also observed that indeterminate fastening materials had been used for intercabinet connections in motor control centers. This item is further discussed in Section VI of this report.

The NRC CAT inspectors also identified a concern with regard to the installed configuration of several vendor wiring installations. The inspectors observed several motor control center cubicles in which number 2 AWG size vendor wiring was installed in a manner that does not meet industry standards for minimum bend radius. In several installations, number 2 AWG conductors exhibited sharp bends. The NRC CAT inspectors were not able to determine whether these installations were as shipped from the vendor or whether field modifications to cubicle components had affected a rerouting of the conductors. Because of the proximity of other load carrying devices, the as-installed configuration will require engineering review to determine technical acceptability.

Several field wiring deficiencies were also observed in motor control centers and 5KV switchgear. These deficiencies were discussed in the electrical cable installation section of this report.

(4) 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. However, signs prohibiting smoking or open flames had not been posted.

The 125V batteries EDE-B-1A and EDE-V-1B were examined and found to be in good condition. Maintenance activities had been performed in accordance with requirements. However, the inspection of the 125V battery racks disclosed that indeterminate bolting material had been used in the assembly process. This matter is detailed in Section VI of this report.

(5) 125V DC System

Inspection of components comprising the 125V DC system revealed no deficiencies relative to the installed configuration of the equipment. Seismic qualification reports were also reviewed for several panels. No deficiencies were noted.

(6) Control Panels

The mounting and installed configuration of the panels inspected were found to be in accordance with design and installation documents.

Deficiencies identified relative to the acceptablity of cable installations within these panels are detailed in the Electrical Cable Installation section of this report.

c. Conclusions

In general, electrical equipment installations were found to be in accordance with design and installation documents.

The acceptability of fastening materials in several seismically mounted equipment installations is indeterminate.

Several vendor wiring installations in 5KV switchgear and 480V motor control centers were not in accordance with industry and site standards.

5. Instrumentation

a. Inspection Scope

The NRC CAT inspectors selected for inspection a sample of instrumentation components which monitor process variables in the Component Cooling System (CC), Diesel Generator System (DG), Residual Heat Removal System (RH), Containment Spray System (CS), Reactor Makeup Water System (RMW), and the Service Water System (SW).

Instrument components and associated instrument racks were inspected to determine whether installations were accomplished in accordance with design drawings, installation procedures, applicable codes and specifications. Items such as location, mounting, identification, separation and protection were compared with installation drawings and inspection reports for the following components:

Level Transmitters

1-CC-LT-2172-1, -2 and-3	1-CC-LT-2192-1, -2 and -3
1-CC-LT-2272-1, -2 and-3	1-CC-LT-2292-1, -2 and -3

Pressure Transmitters

1-SW-PT-8272	1-SW-PT-8282
1-SW-PT-8273	1-SW-PT-8283
1-SW-PT-8274	1-SW-PT-8284

Pressure Indicators

1-DG-PI-9550, -9552, -9557 and 1-CS-PI-187

Flow Indicating Switches

1-RH-FIS-610 and-611

Solenoid Valves

1-RH-HY-606-1 and -607-1

In addition, the NRC CAT inspectors inspected approximately 500 feet of installed instrument tubing, including supports and associated hardware. Tubing was examined to verify proper material, slope, mounting, support spacing, protection and separation. The inspectors also examined installation packages and inspection records associated with the installation of tubing and tubing supports.

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

UE&C Specification 9763-006-46-1 "Specification for Instrumentation Installations for Public Service Company of New Hampshire (PSCNH) Seabrook Station," Rev. 8

UE&C Field Instrumentation Procedures

Johnson Controls, Inc. (JCI) Procedure FIPC-403, "Interim Procedure Change," Rev. 1

JCI Procedure FIPC-404, "Preparation of ECA, RFD and SAC," Rev. 0

JCI Procedure FICP-603, "Design Control: Procedures and I/F Packages," Rev. 0

UE&C Drawing 9763-M-504601, "Instrumentation Notes and Details"

b. Inspection Findings

During the NRC CAT inspection, a number of discrepancies were found. These included four cases of failure to meet tubing slope criteria, two loose wire terminations, six instrument rack mounting welds not painted in accordance with specification requirements, one support spacing discrepancy adjacent to fittings and two tubing separation criteria violations.

In regard to tubing slope, the NRC CAT inspectors identified two concerns with ECA 1206A. This ECA gave the Construction Manager the authority to approve tubing slope deviations different from the specified criteria. The first concern pertained to slope design changes that did not receive review commensurate with the original design. The second concern was the use of Speed Letters, written by the Construction Manager to construction engineering, to initiate slope deviations. Speed Letters are not controlled documents.

The NRC CAT inspectors requested seismic and environmental qualification records for a selected sample of instrument components but were unable to make any conclusions due to insufficient information available on site.

c. Conclusion

As a result of the inspection in this area, a number of discrepancies were identified. Most were considered to be minor. However, in regard to instrument tubing slope, an ECA gave the Construction Manager the authority to approve tubing slope different from the specified criteria, but the slope changes involved did not require review commensurate with the original design.

TABLE II-1

CABLE TRAY INSPECTED

Tray	Drawing	Area
92B-1HB	F-310621	Containment
92N-1RB	F-310614	"
90Q-1RB	F-310621	"
90R-1RB	F-310621	"
90U-1RB	F-310614	"
91G-1RB	F-310615	"
91F-1RB	F-310622	"
91E-1LB	F-310622	"
91X-1LB	F-310621	"
90W-1RB	F-310621	"
90V-1LB	F-310621	"
10C-1LA	F-310476	Control Building
10E-2JA	F-310476	"
10G-2JA	F-310476	"
10H-2JA	F-310476	"
10J-2JA	F-310476	"
10K-2JA	F-310476	"
10L-2JA	F-310476	"
11V-2JA	F-310476	"
13F-2JA	F-310476	"
13E-2JA	F-310476	"
13D-2JA	F-310476	"
13C-2JA	F-310476	"
13B-2JA	F-310476	"
17L-2JA	F-310476	"
17M-2JA	F-310476	"
17N-2JA	F-310476	"
17P-2JA	F-310451	"
22J-2RB	F-310452	"
22H-2RB	F-310463	"
22G-2RB	F-310463	"
22F-2RB	F-310463	"
22E-1VB	F-310463	"
22D-2RB	F-310463	"
26B-2RB	F-310463	"
26C-1VB	F-310463	"
86T-1LA	F-310688	Main Steam Tunnel
86S-1LA	F-310688	"
86R-1LA	F-310688	"
86Q-1VA	F-310688	"
86P-1LA	F-310688	"
86N-1LA	F-310688	"
86M-1LA	F-310688	"
86L-1LA	F-310688	"
86K-1LA	F-310688	"
86J-1LA	F-310688	"
86H-1LA	F-310688	"
86G-1LA	F-310688	"

TABLE II-1 - Continued

CABLE TRAY INSPECTED

Tray	Drawing	Area
44P-1JA	F-310790	Primary Aux. Bldg.
44R-1JA	F-310790	"
44Q-1JA	F-310790	"
44S-1JA	F-310790	"
44H-1JA	F-310790	"
44H-1LA	F-310805	"
44W-1LA	F-310805	"
44Y-1LA	F-310805	"
47M-1VA	F-310788	"
47L-1VA	F-310788	"
47K-1VA	F-310788	"
47J-1VA	F-310788	"
47H-1VA	F-310788	"
47G-1VA	F-310788	"
47F-1VA	F-310788	"
47E-1VA	F-310788	"
47D-1VA	F-310788	"
47C-1VA	F-310788	"
37Q-1LB	F-310535	Diesel Generator Bldg.
37O-1LB	F-310535	"
36G-1LB	F-310538	"
36F-1LB	F-310538	"
36E-1LB	F-310538	"
36D-1LB	F-310538	"
36C-1LB	F-310538	"
36B-1LB	F-310538	"
36A-1LB	F-310538	"

CONDUIT INSPECTED

Conduit	Location	Conduit	Location
GVC/RA	Control Bldg.	1AJ1VA	Control Bldg.
3HB/RA	"	3WH/LA	"
3JK/LA	"	2FF1VB	"
GYW/LA	"	2FD1VA	"
GYW/RA	"	2AC/VA	"
GYM/RB	"	4DK/RA	Pri. Aux. Bldg.
3YD/LA	"	4CD1RB	"
1AQ1VA	"	4JL/RA	"
1UH1VA	"	JYK/VA	"
1UL1VA	"	JFM/VA	"
1UJ1VA	"	JDZ/RB	"
AAL/LA	"	JAG/JB	Eqpt. Vault
AAK/LA	"	3TH/RA	D.G. Bldg.
1CG/RA	"		

TABLE II-1 - Continued

SEISMIC CABLE TRAY SUPPORTS INSPECTED

Support	Drawing	Type
1-12M1	F-310451	T27
1-13F1	F-310451	T1
1-13L3	F-310451	T4
1-24Z2	F-310452	T2
1-33V4	F-310452	T12
1-26C2	F-310452	T5
1-44G1	F-310785	T7
1-46Z1	F-310788	T4
1-92B26	F-310606	T28
1-92B14	F-310607	T30
1-96P1	F-310608	T14
1-20C1	F-310452	T6
1-12Z-2	F-310451	T26
1-92B11	F-310607	T30
1-92B10	F-310607	T30

CONDUIT SUPPORTS INSPECTED

Support	Location
20683	Control Building
20843	"
17027	"
13107	"
26133	"
5120	Diesel Generator Building
5876	"
26434	"
5576	"
26314	"
2966	"
7280	Primary Auxiliary Building
23921	"
22240	"
3541	Containment Building
32057	"
31707	"
24442	"
32170	"
2398	Equipment Vault

III. MECHANICAL CONSTRUCTION

A. Objective

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

B. Discussion

The specific areas of mechanical construction evaluated were: piping, pipe supports/restraints, mechanical equipment, 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, the NRC CAT inspectors examined a sample of piping, pipe supports/restraints and mechanical equipment that had not been QC accepted. This approach was required because only a small percentage of installed hardware in the field had been through final QC inspection. Applicable procedures and documentation were also reviewed as required to support or clarify hardware inspection findings.

1. Piping

a. Inspection Scope

Four design piping isometric drawings which represented approximately 720 feet of large bore and 50 feet of small bore ASME Class 1 and 2 piping were selected. The installed piping associated with these drawings was inspected for conformance to design and installation requirements. Approximately 530 feet of this piping had been "as-built certified" by United Engineers & Constructors, Inc. (UE&C). The installed piping was examined for proper configuration, valve identification, clearances between piping and other structures, and support/restraint type and location. Also, nine valves and fifteen valve operators were compared to their orientations as specified on field drawings. Documentation that supported as-built activities was also reviewed. See Tables III-1 and III-2 for listings of the piping and valve inspection samples.

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

UE&C Specification 9763-006-248-51, "Package 19 Piping & Mechanical Equipment Erection"

UE&C Technical Procedure (TP) 8, "Separation Criteria," Rev. 6

UE&C Administrative Procedure (AP) 39, "As-Built Documents," Rev. 4

UE&C Field Administrative Construction Procedure (FACP)-13, "Site Engineering Procedure for As-Building Piping Systems and Pipe Supports Installed by Pullman-Higgins," Rev. 2

Pullman Higgins (P-H) Procedure IX-3/R9-2, "Fabrication and Field Installation Specifications for Nuclear Power Plants Components, Piping Systems and Appurtenances ASME Section III"

P-H Procedure XV-7/R4-1, "Minimum Separation Criteria and Reporting of Deviations"

P-H Procedure X-4/R9, "Final Inspection"

P-H Procedure X-9/R13-1, "In-Process Inspection Operations"

Applicable UE&C design and P-H field erection piping isometric drawings

Engineering Change Authorization (ECA) 193538B

b. Inspection Findings

UE&C was responsible for the piping design and for providing design isometric drawings from which field drawings (or erection isometrics) were prepared. These field drawings generally detailed smaller sections of the line and provided erection details such as special process requirements and field weld designations. Field Drawings were originally developed by P-H, but have been provided by UE&C since January 1983. Piping was installed by P-H, "as-built" by UE&C and final QC inspected by P-H. Yankee Atomic Electric Company (YAEC) QA provided quality surveillance.

At the time of this inspection, large bore pipe was approximately 90% installed and small bore pipe approximately 75% installed. Of the approximately 4000 field drawings for ASME piping, approximately 417 had been as-built and 364 (or about 9 percent) final QC inspected. This represents a long lag time between installation completion and final QC acceptance. Approximately one-third of these as-builts had been "Certified Incomplete" which meant that portions of these lines or supports/restraints were not yet installed, or that the isometrics contained test boundaries and only a portion of the line had been as-built or QC final inspected. A problem in this regard was that the procedures did not require the listing of outstanding items or explanations as to what specific item(s) rendered a "Certified As-Built" drawing incomplete. Therefore, a complete review of the redlined working drawing was necessary to ascertain missing or incomplete items.

In-process QC inspections were performed for each welded and bolted connection in the piping system. When the installation of the piping on a field drawing was completed, the P-H Field Engineer performed an installation verification, and signed off a nine point checklist which documented that the installation was complete, correct and ready for as-built drawing development. With the exception of a few technically insignificant dimensional discrepancies, the piping runs and valves inspected were found to conform to the requirements for the attributes checked. However, two areas of concern were identified by the NRC CAT inspectors; the first involved undocumented violations of the piping to structure clearance requirements as specified by the separation criteria of TP-8 and P-H Procedure XV-7, and the second involved the inspection and as-building programs for piping and pipe supports/restraints.

Regarding the first concern, as a result of a NRC Region I Notice of Violation in 1983, a program to specify clearance requirements between adjacent hardware installations to allow for seismic and thermal movements was established. This program, delineated by TP-8, called for an area walkdown by UE&C engineers to document existing conditions and for contractors to establish programs to identify, document and approve installations that exceeded the criteria. Although covered by procedure, the P-H program was not considered a QA/QC activity and verification of conformance was not required to be performed by QC or any other personnel during final inspections or system/area walkdowns.

Field installation personnel were to identify separation problems prior to or during installation and report them to UE&C engineering on a Request For Information [RFI] (See Section VII with regard to further discussions on the use of the RFI). Installation work could continue. However, several instances of undocumented separation violations were found by the NRC CAT inspectors during the piping walkdown both on the selected inspection sample and on adjacent piping, as well as during the pipe support/restraint inspection (see Tables III-1 and III-4 for the specific examples).

These violations existed on work that was performed after the initiation of the TP-8 program and/or was in areas that had been walked down by UE&C. Final inspections and/or walkdowns should verify that violations have been completely addressed. The NRC CAT inspectors found the incidences of interference problems to be numerous at the Seabrook Station.

The second area of concern involves the inspection and as-built programs. This concern centers on two basic points. The first point is that site procedures lack clarity regarding acceptance criteria, handling of nonconforming conditions and task responsibility. It should be noted that the basic programs and implementing procedures for the support/restraints have undergone numerous and significant changes over the last 18 months and, in fact, were being completely revised during the current curtailment of work activities on-site.

During the review of records and procedures, and discussions with responsible personnel, it became apparent that the lines of responsibility for inspection and identification/resolution of noted discrepancies were not clearly defined, and inspection criteria were not always specified. The timing and sequencing of installation verification, as-building, final inspection and document/design change reviews were not specifically detailed and had been performed in various sequences.

The acceptance criteria and verification of proper orientation of valves and valve operators were not clearly defined in construction or inspection procedures (i.e., how globe valve or other valves without flow arrows or inlet markings were to be installed). P-H Procedure FACP-13 included valve flow direction as an as-built checklist item. However, in two cases (valves CC-V-370 and CS-V-168), markings which would have permitted "as-built" verification of correct installation relative to flow were not found. Flow direction was mentioned in the text of Procedure X-9 as an item for the Field Engineer to check during installation verification, but it was not included as a sign-off point, nor was it an attribute to be verified/documented during the QC final inspection. For the two valves noted, weld process sheets were amended by the QC inspector to include verification of valve flow direction. However, valve orientation verification was not included on the issued weld process sheet form, and was not consistently added to the form by the in-process inspector.

Also, P-H Procedure X-4 for the final acceptance inspection of piping by P-H QC required verification of proper configuration per the as-built drawings and the location of supports/restraints in relation to tne piping, but specifically stated that measuring devices were not required to be used. Further, no acceptance tolerances were specified. This method is not considered by the NRC CAT inspectors to be an adequate acceptance inspection of installed piping systems. "Certified As-Built" field isometrics, RH-158-03, RH-158-06, RH-158-02, RH-160-1, RH-160-2 and RH-160-3, did not show penetration to pipe clearance dimensions as required by paragraph 6.2.11(c) of FACP-13.

With regard to the lack of clarity for handling of nonconforming conditions, Procedure X-4, paragraph 5.4.1 indicated that when inconsistencies and/or discrepancies between the existing condition in the system and the as-built field drawing existed the inspector was to simply note this on the inspection form. These conditions were noted in the remarks column of the form and in some instances referenced corrective action documents such as Nonconformance Reports (NCRs). However, Procedure X-4 did not detail or reference the proper procedure for documenting and resolving nonconforming conditions, nor did it specify how or by whom the inspector's noted "inconsistencies/discrepancies" should have been resolved. This procedural inadequacy contributed to the second basic point.

The second point is that nonconforming conditions are often improperly documented and resolved. A review of UE&C as-building procedure FACP-13 and several "as-built" packages indicated that when UE&C "as-builders", who were ANSI certified inspectors, identified a condition in the field which was outside of the design requirements and/or construction tolerances, they notified P-H rather than write an NCR. This notification originally was via unnumbered memoranda and telephone calls, and later on numbered speed memos, which are uncontrolled QA records. This notification was then sent to P-H field engineering for resolution.

Discrepant conditions included dimensional discrepancies and numerous instances where the field drawings did not agree with the design drawing. Discussions with P-H and YAEC QA/QC personnel indicated that they were not aware of the method used to handle potential NCR conditions. In addition, no evaluation had been made of the types and severity of the problems being identified to determine if generic corrective action was required. The NRC CAT inspectors concluded that nonconforming and potential nonconforming conditions were not processed in accordance with the QA program requirements.

The NRC CAT inspectors also performed a limited review of draft procedures which were prepared to implement the latest program changes. This review indicates that many of the ambiguities and concerns discussed above have not been eliminated.

In conjunction with the piping sample, several Schedule 160 reducing tees (3"x3"x2", 4"x4"x2, 2"x2"x1") did not appear to meet ASME Section III Code requirements with respect to interior configuration. Since the NRC CAT inspection, UE&C has reviewed the contractor's manufacturing and testing documentation which qualified the fittings to the Code requirements. The NRC CAT inspectors have reviewed the UE&C memorandum which evaluated the contractor's documentation, and conclude that the use of these fittings is acceptable.

c. Conclusions

No major hardware discrepancies were noted in the QC accepted piping and valves inspected by NRC CAT inspectors. The as-built activities that have been completed appeared to be thorough and accurate. However, our sample was only a very small portion of the ASME piping that had been as-built (15 of 417).

Considering the number of isometrics with discrepancies noted during as-builting activities, the NRC CAT inspectors cannot conclude that the quality of initial installations are acceptable. The NRC CAT inspectors found that procedures did not clearly and completely define acceptance criteria, inspection and as-built responsibilities, and the proper mechanisms to document and to resolve nonconforming conditions. Nonconforming conditions have often been improperly identified, trended and resolved.

2. Pipe Supports/Restraints

a. Inspection Scope

Twenty-one ASME Class 1, 2 and 3 safety-related pipe supports/restraints which represented a variety of types, sizes, systems and locations were selected for inspection. Eight of these supports/restraints had been as-built certified and none had received a final QC inspection. Less than 15 supports/restraints had been final QC inspected at the time of the NRC CAT inspection. Those inspected by the NRC CAT inspectors were in at least some stage of as-building. These supports/restraints were inspected for configuration, clearances, member size, identification and damage. In addition, approximately 75 other supports 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. Documentation such as weld process sheets, as-built records, design changes and nonconformance reports was also examined (see Table III-3 for a listing of the inspection sample).

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

UE&C Drawing 9763-M-804945S/R6, "Pipe Support Standard Notes and Details"

UE&C Field Administration Construction Procedure (FACP) 13, "Site Engineering Procedure for As-Building Piping Systems and Pipe Supports Installed by Pullman-Higgins," Rev. 2

UE&C Technical Procedure (TP) 10, "Location of Attachments to Embedded Plates," Rev. 3

Pullman-Higgins (P-H) Procedure JS-IX-6/R11-2, "Installation and Inspection of ASME Pipe Supports"

P-H Procedure X-9/R13-1, "In-Process Inspection Operations"

P-H Procedure XV-7/R4-1, "Minimum Separation Criteria and Reporting of Deviations"

P-H Procedure IX-1/R16, "Hilti Installation and Inspection"

P-H Field Instruction 307/R3, "Clearances for Support Guides/Restraints"

P-H Field Instruction 347/R1, "Installation of Figure 211 Sway Struts"

P-H Field Instruction 366/R1, "Final Inspection of ASME and NNS-I Supports"

b. Inspection Findings

With the exception of missing locknuts on one support and loose locknuts on two others, no hardware problems were noted on the supports/restraints in the NRC CAT inspectors' primary sample. The support/restraints in the primary sample were either "certified as-built" or in some stage of as-building. From the examination of this sample, from the review of the as-built documentation packages and from the itemizations of discrepancies by the as-built crews, the NRC CAT inspectors conclude that the as-built supports/restraints that have gone through the as-built program generally comply with requirements. However, the inspection of adjacent supports/restraints, for the which the as-building process had not been yet started, revealed a number of hardware problems. These problems included dead weight supports not taking the loads (779-SG-12, 38-SG-13, 160-SG-18), box guide clearances exceeding allowables (1304-SG-28), U-bolts cinched down tight with no gap as required (328-SG-19, 495-SG-01, 304-SG-02, 251-RG-30, 177-SG-9, 160-RG-23), no spacers or wrong size spacers on strut rod ends (14-SG-7, 14-SG-13, 256-SG-4, 256-SG-3), loose pipe clamp (256-SG-8), mislabeled support (256-SG-8 tagged 256-SH-8) and high strength bolts installed without required washers (158-SV-2).

Although the hardware in the NRC CAT primary sample was in conformance with drawings, several factors indicated that some corrective actions and continuing close attention were needed relative to the pipe supports/restraints program. These factors or areas of concern include: (1) the very small percentage of "installed" hardware that has been "final inspected" by QC; (2) the lack of clarity and consistency in site procedures; (3) the numerous program and procedure changes; and (4) the use of improper mechanisms to identify, track and resolve nonconforming conditions.

Regarding the very small percentage of "installed" hardware that had been "final inspected" by QC, of approximately 4570 ASME Unit 1 and Common pipe supports/restraints, approximately 2084 (46%) were installed complete, but only 103 (2.2%) had been "certified as-built" and only 30-40 (less than 1%) had been final inspected by QC. The NRC CAT inspectors consider that this significant lag of QC acceptance behind installation does not allow for timely identification of construction and quality problems. In addition, the QC organization may come under increasing pressures to accept hardware to meet turnover/startup schedules as the project approaches completion.

In general, site procedures for supports/restraints were quite detailed and extensive. However, a lack of clarity and consistency was noted with some site procedures. As discussed in the piping section, a review of procedures and discussions with responsible personnel revealed that site procedures in some areas were not clear and consistent with regard to inspection criteria, responsibilities and engineering/contractor interfaces, and the proper methods by which nonconforming conditions were to have been handled. The numerous program/procedure revisions have contributed to this ambiguity. The various cut-off dates for changes in inspection, drawing preparation and as-building criteria and responsiblilities also contributed to confusion in both documentation and procedural requirements.

For example, the NRC CAT inspectors noted in numerous instances that the spacers installed on the load pins of sway struts were of varying diameters (which indicated the use of non-standard parts), and that for smaller struts used on larger diameter pipes with the "mini stiff pipe clamp", the spacers were too thin (1/16") to serve any purpose of alignment or retention of the spherical bearing. Site quality and engineering personnel were unable to provide any details on the required size of these spacers for specific applications. Field Instruction (FI) 347, which detailed the installation of sway struts and provided an inspection checklist, did not provide any requirements for spacer size and, in fact, only addressed the use of special double bolt pipe clamps, not the "mini stiff pipe clamp" often installed.

Fairly detailed inspection checklists existed in Field Instructions for sway struts and snubbers, but the Final Inspection Checklist in P-H Procedure JS-IX-6 was too generic for other types of supports/restraints such as spring supports, guides which use insulation protection clamps, and U-bolts. For both the Field Engineers Installation Verification checklist Form 10A and the QC Final Inspection Checklist Form 10B, the instructions specifically stated that no measuring tools or devices were required to verify conformance to design criteria and as-built drawings. The NRC CAT inspectors, however, consider that QC acceptance of installation configurations require detailed and accurate verifications, and thus require tools or devices to verify gaps, angularity, pin-to-pin dimensions, member sizes and lengths, and other physical attributes.

Another problem with P-H Procedure JS-IX-6 was that it did not reference Field Instructions that specified final acceptance inspections; e.g., FI-347, FI-366 and FI-307. The Pipe Support Inspection Matrix, Appendix S to P-H Procedure JS-IX-6 did not reference Procedure IX-75 for inspection of snubbers. In addition, this matrix did not indicate that the sway strut installation inspection was performed by QC, rather than engineering.

As-built procedure FACP-13 did not require as-builders to verify shop welds for placement or length. An apparent drafting error that increased a weld from one side of a member to both sides on support 1209-RG-1/1209-SV-2 was not detected by the as-builders. Although only one side was welded in the field, the as-built red line retained the double-sided weld symbol.

With regard to clear instructions for proper reporting and correction of nonconforming conditions, P-H Procedure JS-IX-6 did not detail what actions were to be taken by QC if discrepancies were noted between the actual installation and the as-built drawing.

In addition, FACP-13 required only that UE&C as-builders "bring to the attention of the Erection Contractor" any deviations which exceeded installation tolerances for correction or required issuance of an NCR. A review of as-built documentation showed that deviations from design/criteria and construction tolerances noted during as-building were being reported from about August 1983 until March 21,1984 on informal memoranda, and since that time, on three-part speed memos.

In addition to the fact that ANSI certified inspectors (UE&C as-builders) were noting nonconformance conditions and not properly reporting them, a review of these memoranda and their responses produced several additional concerns for the NRC CAT inspectors. The "potential NCR" memos were often sent directly to P-H Field Engineering, and in some cases, the responses were improper. One example was support 710-SG-1 for which a pipe was installed at its design location, at the expense of having created a support attachment to embedded plate connection that exceeded the allowable deviation specified by Procedure TP-10. Speed memo ABD-64 which described this situation, dispositioned this configuration as acceptable. Another example was speed memo ABD-92 where the Field Engineer indicated that a zero gap on a box guide was acceptable because only 25% of the bearing area had no gap which assured that no cold spring had occurred. This technical disposition is unacceptable in that a zero gap at any point would require a physical or case specific evalution per FI-307 to verify cold spring.

Another example of the improper handling of nonconforming conditions was the use of Support Rework Orders (SROs) to correct hardware problems identified by the as-builders, without the generation of an NCR. ABD-69 reported gusset plates welded on a support that were not located on the clamp centerline as required. SRO-7650 was written and the plates were cut out and reinstalled in the correct location. The main attachment member of restraint 222-RG-3 was installed 30 degrees from the position shown on the drawing. SRO-7527 was issued and this assembly was removed and reworked to design requirements. SROs are not quality documents and are not reviewed or trended by QA. However, since these supports had been accepted by QC during the in-process inspection as having been in the proper design configuration, deviations to the contrary would have required the generation of an NCR.

Another problem with proper documentation and correction of nonconforming conditions was noted where ECAs were written after QC acceptance of installation which identified and authorized conditions out of specification limits. On 59-SG-15, ECA 2559224B was issued on 2/7/84 that identified Hilti-bolt spacing violations for installations that had been signed off as acceptable by QC on 12/16/83 and 1/17/84. For 59-RG-10, "On The Spot" ECA 2510616A was issued on 3/14/84 that showed an attachment location on an embedment that had originally been outside the envelope allowed by TP-10. The attachment weld had been accepted for fitup and tack on 3/13/84.

Furthermore, welding detail inspection/verification was eliminated from the as-builders purview as of February 20,1984. This program change was brought about because of the high number of problems identified by as-built inspectors in welds previously accepted during in-process inspections. The retraining of P-H QC in-process inspectors and the relaxation of restrictive welding acceptance criteria were determined by YAEC QA as having made sufficient program improvements which justified deletion of this additional weld inspection. During subsequent as-built inspections, over 75% of supports/restraints were found to have had potential nonconforming conditions pertaining to non-welding problems. These recently reported problems included improper attachment locations and box guide gaps, and Hilti-bolt spacing violations. Discussions with responsible P-H and YAEC QA/QC personnel indicated that they were not aware of the way these potential nonconforming conditions were being handled, and that no evaluation had been made of the types and severity of the problems being identified.

Another problem that was noted in the NRC CAT field inspections was a number of cases where the physical separation criteria of TP-8 and P-H Procedure XV-7 had not been identified by construction at installation. Examples are listed in Table III-4. As previously detailed in the piping section of this report, the NRC CAT inspectors consider that this program needs attention. The inspectors consider the identification and resolution of separation criteria deviations to be prudent and more effective during the erection phase of construction, rather than during the as-building process.

The program and procedures for inspection and as-building of supports/restraints are being completely revised during the current curtailment of site activities. In addition, an "Accelerated Hanger Program" has been developed and has been partially implemented. A limited review of draft procedures for these new programs indicates that many of the ambiguities and concerns discussed above have not been eliminated.

c. Conclusions

No major hardware discrepancies were noted in the NRC CAT primary sample of supports/restraints. However, discrepancies were identified by the NRC CAT inspectors in hardware not yet as-built. The improper documentation and resolution of nonconforming conditions, the weaknesses identified in site procedures, the number of program changes, and the time lag of QC inspection behind pipe supports/restraints installation activities are causes for concern.

Applicant management should review the programs and procedures currently being revised and developed, and assure they will correct existing deficiencies/weaknesses.

3. Heating, Ventilating and Air Conditioning (HVAC)

a. Inspection Scope

Fourteen seismic restraints, six HVAC components, and approximately 125 feet of ducting were inspected. Restraints were examined in the Service Water Pump House, Fuel Handling Building, Primary Auxiliary Building (PAB), PAB Equipment Vaults and the Containment Building. Features verified were location, configuration, member size, and duct joint makeup. Eight fire dampers were inspected for proper installation, operability, and condition. Types of fire dampers included gravity curtain dampers and spring assisted curtain dampers (see Table III-5 for a listing of inspected items).

Installation packages for four HVAC components which represented two systems were reviewed for completeness, accuracy and clarity. This equipment also received field checks by the NRC CAT inspectors for condition, location and configuration. Also reviewed were the documentation for reporting of physical separation violations per TP-8 and for the recently instituted Construction Procedure (CP) 12, "Rework and Repair Procedure." Field Installation and Inspection Summaries were reviewed for several restraints.

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

UE&C Specification 9763-006-225-7, "Specification for Field Installed Heavy Gauge Ductwork," Rev. 7

Hirsch, Arkin, Hershman Fabricators, Inc. (HAH) Construction Procedure (CP) 2, "Installation Erection Procedure," Rev. 2

HAH CP-6, "Installation of Concrete Expansion Anchors", Rev. 0

HAH Quality Procedure (QP) 2, "Inspection Procedure," Rev. 2

UE&C HVAC Design Drawings

ECA 520592A, "Support Fabrication and Installation Tolerances"

Duct Construction Details

Applicable detail drawings

b. Inspection Findings

HVAC systems were designed by UE&C and detailed on UE&C "concept" (typical) drawings. Hardware for fabrication and installation were detailed by HAH on "take off" and "pick off" drawings, which were developed from the concept drawings. One other contractor, Bluen, had performed some fabrication, installation, inspection and as-building of HVAC hardware prior to replacement by HAH. Several of the restraints in our sample had been installed and inspected by Bluen.

Of the approxomately 1510 total Unit 1 and Common Seismic Category I restraints, about 835 had been QC accepted.

HVAC duct pieces (which were shop fabricated), restraints and fire dampers were found to be installed in accordance with design drawings and requirements. Workmanship appeared to be good.

Documentation that was reviewed was acceptable with the exception of Procedure CP-12. CP-12 allowed rework/repair of hardware prior to QC final acceptance, and permitted changes to be documented only on "As Installed Reports (AIR)." Although a review of existing AIRs indicated that the majority were for minor changes that were required due to as-built locations of existing concrete and steel structures, the NRC CAT inspectors noted that CP-12 did not adequately restrict the limits of allowed changes, nor define completed/accepted work for which NCRs should be used to document deviations from design. One instance was noted (on FN-8A-14) where a gusset plate had been notched to clear another restraint member. This action should have been handled through the formal design change program as an ECA. An NCR has now been written for this item.

During our inspection of fire dampers, damper assemblies functioned as designed. No installation deficiencies were identified.

Installation packages for four ANS Safety Class 3 HVAC components exhibited proper QC verification and acceptance of the installation processes. The four components were the Diesel Generator Building Suction fans (DAH-FN-25A and DAH-FN-25B) and the Control Room Air Handling Units (CBA-AH-3A and CBA-AH-3B). The installation packages contained equipment installation checklists, ducting leak test inspection checklists (which included a subsystem boundary listing) and anchor bolt torquing checklists. A field check of the equipment revealed that the condition, configuration and location were acceptable. Two ANS Non-Nuclear Safety Class fans (CBA-FN-27A and CBA-FN-27B) associated with the Control Room Complex Emergency Cleanup System were also field checked. No significant installation deficiencies were identified.

The ducting for the supply air and exhaust air for Battery Rooms "A" and "C" located in the 4KV Switchgear Room "A" exhibited acceptable dimensions, support spacings, joint configurations, and location.

c. Conclusions

The inspected HVAC hardware conforms to design and drawing requirements.

Procedure CP-12 should be evaluated to assure that design change and QA program requirements are satisfied.

4. Mechanical Equipment

a. Inspection Scope

Installation records of 35 pieces of equipment for eight systems (Chemical and Volume Control, Primary Component Cooling Water, Service Water, Containment Building Spray, Spent Fuel Cooling, Residual Heat Removal, Safety Injection and Diesel Generator Fuel Oil Storage) were reviewed for content, clarity, consistency and thoroughness. Twenty eight components received field checks for proper configuration, location, condition and bolt size.

Equipment examined included the Primary Component Cooling Water (PCCW) pumps, Thermal Barrier Circulating Water pumps and heat exchangers, Safety Injection accumulators and the Residual Heat Removal pumps. Table III-6 provides a listing of inspected items.

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

Seabrook Station Final Safety Analysis Report, up to and including Amendment 52

UE&C Specification 9763-006-263-2, "Specification for Mechanical Equipment Erection," Rev. 4

Pullman-Higgins (P-H) Procedure IX-39, "Handling, Installation, Testing and Inspection of Safety Related Equipment," Rev. 1

Applicable equipment foundation detail drawings

b. Inspection Findings

Installation travelers exhibited proper chronological QC verification and acceptance of handling and installation processes, and sequences. Due to the construction phase of the facility, some components had not been completely installed and QC accepted. The NRC CAT inspectors examined documentation for components which were considered to be completely installed and those which were still in-process. The NRC CAT inspectors considered those equipment which had been "final" aligned and/or whose foundation anchor bolts had been either tensioned or torqued to have been completely installed. Since the transfer of components from Construction to Start-Up and Test jurisdiction could occur prior to the complete installation of the component, the transfer of components by itself could not be relied upon as an accurate indicator of installation completion.

Of the 35 components whose installation documentation was reviewed, approximately 15 components had been tensioned and/or "final" aligned QC inspected and accepted. Of these 15 components, discrepancies between installation requirements and as-installed conditions were noted for two Primary Component Cooling Water (PCCW) Pumps 1CC-P-11A and 1CC-P-11B that had washers missing on many of the foundation anchor bolt attachments.

No deficiencies were noted between hardware and documentation for components that were still in-process.

Also regarding the installed PCCW pumps, the NRC CAT inspectors noted that although the as-installed anchor bolt material (A-36) was correct per foundation steel detail drawings, it was in conflict with the anchor bolt material assumed by the seismic analysis of the pumps. The seismic analysis took credit for the use of A193 Grade B7 high strength material rather than the mild steel material designated by design and construction drawings. The validity of the seismic qualification of the component is therefore questionable.

An additional concern regarding anchor bolts is that the seismic shear loads on the foundation anchor bolts for the PCCW pumps and heat exchangers appear to be high (average shear load per anchor bolt approximately 7 kips) for a one-inch diameter anchor bolt when considering the allowable bearing stresses of the concrete. The applicant should review these analyses and foundation designs to assure that the resistive components will not be overstressed, or that excessive deflection will not exist in the system. The assumptions considered in the seismic analyses of components should also be reviewed to assure that they are consistent with design assumptions and construction specifications (The evaluation of seismic analyses of other mechanical equipment is further discussed in Section IV of this report).

For those components which were not completely installed prior to transfer to the Start-Up and Test organization, activities which remained to be performed were documented and tracked on the Incomplete Items List (IIL). Required work was to be initiated and tracked via a work authorization, whose document number would be entered on the IIL. The incomplete item would be closed out upon satisfactory completion of the work authorization. Each IIL was contained in their respective Start-Up and Test system packages known as Boundary Identifications Packages (BIPs). Information and status of incomplete items were also documented and tracked via a periodically updated computer printout. The printout listed entries in numerical sequence; as incomplete items were closed out, the change in status was recorded, but the entry was not deleted. The NRC CAT inspectors found the overall tracking system to be comprehensive and effective.

During the NRC CAT inspectors review of installation documentation, seven components identified in the FSAR as possessing ASME Section III classification did not possess any documentation regarding their handling and installation. These components were:

° Thermal Barrier Circulating Water Pumps (1CC-P-322A, 1CC-P-322B)

° Thermal Barrier Heat Exchangers (1CC-E-153A, 1CC-E-153B)

° Boron Injection Tank Recirculating Pumps (1SI-P-4A, 1SI-P-4B)

° Boron Injection Tank (1SI-TK-6)

These deficiencies appeared to be attributable to discrepancies between FSAR commitments and the UE&C Specification 9763-006-263-2, and a lack of understanding of the scope of installation procedure P-H IX-39. Subsequent to the identification of this concern by the NRC CAT inspectors, an applicant's review of FSAR commitments and the UE&C Specification revealed additional discrepancies.

Three ASME Section III classified components that were identified as not having QA handling and installation documentation have since been identified by the applicant as being considered as a nonessential portion of the system. These components were the two Boron Injection Tank Recirculating Pumps, and the Boron Injection Tank. However, because this licensing consideration comes after the fact, it does not provide justification for the lack of documentation.

In addition, during the review of documentation for the Safety Injection accumulator tanks, it was determined that the handling and installation traveler for SI-TK-9D was lost. This deficiency is being tracked via a nonconformance report.

Two Intermediate Head Safety Injection pumps (SI-P-6A, SI-P-6B) were initially set in place prior to the issuance of P-H Procedure IX-39; thus QA documentation for those activities were unavailable. The notes of the field engineer, however, were available, and the applicant has stated that any further activities regarding their installation will be governed by P-H Procedure IX-39.

It was noted that the ASME Code classification for the Reactor Coolant Pump Thermal Barrier Heat Exchanger "tube side" (Class 1) differed from the classification stated in Westinghouse Equipment Specification G 677188, and the nameplate Code Classification of the Thermal Barrier Heat Exchangers [CC-E-153A, CC-E-153B] (Class 2). The NRC CAT inspectors were not able to determine which classification was applicable.

Where equipment was handled and installed in accordance with P-H Procedure IX-39, the documentation packages generally contained the basic records associated with equipment installations (foundation bolt tensioning records and pump alignment records), even though guidance was not provided as to what records were required. The procedure adequately outlined administrative considerations and handling activities. However, a comparison of P-H Procedure IX-39 to P-H Procedure IX-54 "Installation of Non-Safety Related Mechanical Equipment" revealed that Procedure IX-54 was more comprehensive than Procedure IX-39 (safety-related equipment) with respect to defining the methods and guidelines for implementing the requirements and criteria applicable to the installation, establishing documentation requirements, defining responsibilities, and specifying special tools or equipment. Guidance was provided for the following areas in P-H Procedure IX-54, but not in Procedure IX-39:

- Tensioning and/or Bending of Anchor Bolts
- Use of Calibrated and Controlled Tools
- Use of Solvents or Cleaning Agents
- Lubricants and Lubricating Instructions
- Installation Tolerances (e.g., level, concentricity, alignment)
- Use of temporary supports
- Detailed Checklists, Data Sheets and Report for levelness, alignment, elevation.

As such, several ASME classified equipment installation packages utilized checklists from the non-safety related procedure. Because Procedure IX-39 did not specify the use of calibrated instruments, the final alignment of a Spent Fuel Cooling pump (SF-P-10A) is suspect. Also, due to the use of unspecified record forms, it was difficult to distinguish between records for "preliminary" and "final" installation. Because of the ambiguities between "preliminary" and "final" records in existing installation packages, the NRC CAT inspectors can only assume that the records represent final installation unless other documents indicate differently. As exhibited by the undesignated alignment records, this approach lends itself to confusion.

The Boric Acid Storage Tanks, which are classified ASME Section III, were fabricated on-site, and are currently grouted and set in place. Documentation regarding their installation (tensioning of foundation bolts) was not available, despite the foundation nuts being tight and double-nutted (the normal configuration following tensioning). The applicant has stated that final tensioning of the foundation bolts have yet to be performed since the assignment of the work had not been decided. On-site fabricated "safety-related" components whose installation is to be performed by "others" should possess appropriate guidelines and documentation.

c. <u>Conclusions</u>

No major hardware discrepancies were noted in the mechanical equipment inspected by the NRC CAT inspectors. However, concerns were identified regarding: the disparity between the material specified for installed anchor bolts for the PCCW pumps, and the anchor bolt material assumed to be used in the seismic analysis of the pump; and the seismic shear loads of the PCCW pumps and heat exchanger which, for the anchor bolts used, appears to encroach the allowable bearing stresses of the concrete. Foundation attachment designs may not be consistent with their design bases requirements. The NRC CAT inspectors also have concerns regarding the lack of quality documentation for seven ASME Section III components and the numerous content deficiencies contained in P-H Procedure IX-39. Equipment may not be receiving adequate attention to assure proper installation.

TABLE III-1

PIPING INSPECTION SAMPLES AND OBSERVATIONS

System	Design Isometric	Field* Isometric	Diameter [Inches]	Class	Observations
SI	9763-F-800256	SI-256-04	2, 4	1, 2	TP-8 violation; line 256-1-1501-4 touching decking at El-27'9" in RHR vault #1
RH	9763-F800160 (for as-built field 150 portion only)	RH-160-01 RH-160-02 RH-160-03 RH-160-04	8	2	
RH	9763-D-800163	RH-163-01 RH-163-03	6	1, 2	TP-8 violation, orifice flange on line 163-6-2501-6 1¼ inches from 163-SG-1
RH	9763-F-800158	RH-158-01 RH-158-02 RH-158-03 RH-158-04 RH-158-05 RH-158-06 RH-158-07	6, 8	1, 2	TP-8 violation, 3/8 inch clearance to penetration 1583
Miscellaneous TP-8 violations noted in adjacent piping:					Line CBS-121602 was 1-1/8 inches from penetration sleeve; Line CBS-1201-1-151-14 was 1-1/8 inches from penetration sleeve and ¼ inch from second penetration.

RH - Residual Heat Removal
SI - Safety Injection

* Partial or complete "certified as-built drawing"

TABLE III-2

VALVE ORIENTATION INSPECTION SAMPLE

Valve orientation relative to flow checked in the field:

SI-2-V130
SI-3/4-V267
RH-3/4-V110
RH-6-V29
RH-6-V30
RH-3/4-V112
CC-V-370
CC-V-168
CS-HCV-182

Valve operator orientation verified in the field:

SI-3/4-V267
RH-3/4-V110
RH-6-V63
RH-3/4-V112
RH-6-V65
CS-V-168
CC-V-438
CS-HCV-182
CS-FCV-121A
CC-V-439
SI-V-3
SI-V-17
CBS-V-2
CC-V-395
CC-V-420

TABLE III-3

PIPE SUPPORT/RESTRAINT INSPECTION SAMPLE

*Dwg. No.	System	Type	ASME Class	Size (inch)
13-SH-10	RC	Rod	2	12
202-SV-13	SI	Spring	1	10
15-SG-2	RC	Strut	1	2
*158-SV-14	RH	Spring	2	8
59-RG-10	RC	Box	1	3
59-SG-13	RC	Box	1	3
*332-SG-10	CS	U-bolt	2	2
*332-RG-31	CS	U-bolt	2	2
*778-RG-2	CC	Strut	3	6
*M/S 4407-RG-7	DG/DM	U-bolt	3	3/4 & 1
232-RG-3	SI	Strut	2	2
454-RG-2	CS	Box	3	2
778-SH-11	CC	Strut	3	6
1209-RG-1/1209-SV-2	CS	Box/Spring	2	12
*203-RG-1	SI	Box	2	10
891-SG-1	CC	Box	[illegible]	1
868-SG-9	CC	Box	3	4
*351-SG-4	CS	Box	2	1
97-SG-17*	RC	Box	1	3
1656-RG-16	NG	U-bolt	2	1
59-SG-12	RC	Strut	1	3

* - "Certified As-Built" issued, the remainder were in some stage of the as-built process.

CC - Component Cooling Water
CS - Chemical & Volume Control
DG - Diesel Generator
DM - Demineralized Water
NG - Nitrogen Gas
RC - Reactor Coolant
RH - Residual Heat Removal
SI - Safety Injection

TABLE III-4

PIPE SUPPORT/RESTRAINT INSPECTION OBSERVATIONS

Support/Restraint	Observation
1209-RG-1/1209-SV-2	Shop welds shown on latest drawing do not match actual installation.
778-RG-2	Loose strut locknut.
15-SH-10	Clamp bolts not double nutted.
868-SG-09	TP-8 violation.
351-SG-4/351-SG-6	TP-8 violation.
234-RG-8	TP-8 violation.
756-RG-2	TP-8 violation.

See paragraph III.B.2.b of text for listing of other observations on adjacent supports/restraints that had not been as-built.

TABLE III-5

HVAC INSPECTION SAMPLE

Items Inspected

Supports/Restraints

FN-11B-4	FN-8A-12
FN-6A-205	FN-5B-39
FN-40B	FN-34-80
FN-1-129	FN-6A-203
FN-1-237	FN-5B-38
FN-1-33	FN-8A-37
SA-152	FN-38B

Fire Dampers		Type
CBA-DP-160	(2 assy's)	Curtain, Spring (Vertical)
CBA-DP-149	(1 assy)	Curtain, Spring (Vertical)
CBA-DP-150	"	Curtain, Spring (Horizontal)
CBA-DP-155	"	Curtain, Spring (Horizontal)
DAH-DP-856	"	Curtain, Gravity
DAH-DP-857	"	Curtain, Gravity
TAH-DP-481	"	Curtain, Spring (Horizontal)

Equipment

CBA-AC-3A
CBA-AC-3B
CBA-FN-27A
CBA-FN-27B
DAH-FN-25A
DAH-FN-25B

TABLE III-6

MECHANICAL EQUIPMENT SAMPLE

Equipment (Unit 1)

CC-P-11A	CC-E-17A	CC-P-322A
CC-P-11B	CC-E-17B	CC-P-322B
CC-P-11C	CC-TK-19A	CC-E-153A
CC-P-11D	CC-TK-19B	CC-E-153B
CS-TK-4A	SF-P-10A	RH-E-9A
CS-TK-4B	SF-P-10B	RH-P-8A
CS-P-128	SF-E-15A	*CBS-P-9B
*CS-P-002A	SF-E-15B	CBS-E-16B
SI-TK-6	SI-P-4A	*SW-P-41A
SI-TK-9A	SI-P-4B	*SW-P-41C
SI-TK-9B	SI-P-6A	
*SI-TK-9C	*SI-P-6B	
*SI-TK-9D		

CC - Component Cooling Water
CS - Chemical and Volume Control
CBS - Containment Building Spray
CBA - Control Building Air Handling
DAH - Diesel Generator (Building) Air Handling
RH - Residual Heat Removal
SF - Spent Fuel Pool Cooling
SI - Safety Injection
SW - Service Water

Components received both hardware and documentation reviews unless otherwise noted.

Note: * - Document Review Only

IV. 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 and procedures.

B. Discussion

The specific areas of civil and structural construction evaluated were: concreting activities, structural steel installations, bolting applications, concrete expansion anchor bolt installations, and the design impacts on installed hardware.

1. Concreting Activities

a. Inspection Scope

The concreting activities reviewed by the NRC CAT inspectors included seven concrete placement areas of Units 1 and 2. These areas were reviewed for conformance of rebar placement to the United Engineers and Constructors, Inc. (UE&C) design drawings and Bethlehem Steel Corporation fabrication and installation drawings. General concrete quality was examined from surrounding areas for conformance to site specification requirements. Six of the areas were selected in Unit 2 because of the ready access to directly review rebar placement. These areas were ones in which the rebar were partially embedded in concrete and had been Quality Control (QC) accepted. The specific areas reviewed are given in Table IV-1.

Selected cadweld inspection records and cadwelder qualification records were reviewed by the NRC CAT inspectors for five cadwelders (Nos. 34,56,150,177,224). Using the computerized summary of cadwelding for the five cadwelders selected, the records were reviewed for proper qualification and requalification (if necessary), QC inspection evidence and meeting tensile test frequencies and acceptance criteria.

Records associated with concrete material certification and surveillance testing were reviewed for conformance to construction specifications and regulatory commitments. The records reviewed included records for cement, aggregate, admixture (including user testing), rebar, and mixer uniformity testing. The certification and testing records were reviewed for conformance to the specified testing frequency and acceptance criteria.

In addition, documentation supporting the chipping out of a small area of a Unit 1 Primary Auxiliary Building wall to expose rebar for through-bolting was reviewed. Background information and the technical justification for the "maturity method" (used to determine the approximate concrete compressive strength for curing considerations) were also reviewed, as well as Windsor Probe testing.

The requirements and acceptance criteria for concrete activities and rebar placement are included in the following specifications and procedures:

UE&C Specification 13-2, "Containment Concrete Work," Rev. 11

UE&C Specification 13-3, "Concrete Work for Category I Structures Other than Containment," Rev. 13

UE&C Specification 14-2, "Installation of Reinforcing Bar in Containment Structure," Rev. 8

UE&C Specification 14-3, "Installation of Rebars in Category I Structure," Rev. 7

UE&C Specification 14-6, "Acceptance of Damaged Rebar," Rev. 5

UE&C Specification 69-1, "Concrete Batch Plant," Rev. 11

UE&C Specification WS-4C, "Requirements for Mechanical Splicing and Nondestructive Examination of the Reinforcing Bars Spliced by the Cadweld Method," Rev. 8

NRC Regulatory Guide 1.10, "Mechanical (Cadweld) Splices in Reinforcing Bars of Category I Concrete Structures," Rev. 1

Perini Power Constructors (PPC) Field Civil Construction Procedure (FCCP) 2, "Concrete Placing," Rev. 8

PPC FCCP-7, "Cadwelding," Rev. 9

PPC Quality Control Procedure (QCP) 10.2, "Testing of Concrete Materials and Concrete," Rev. B

PPC QCP 10.4, "Concrete Preplacement Inspection," Rev. B

PPC QCP 10.5, "Concrete Placement Inspection," Rev. A

PPC QCP 10.12, "Reinforcing Steel Inspection," Rev. A

b. Inspection Findings

In the seven concrete placement areas reviewed, the size and grade of rebar and the general concrete quality placed in the areas were acceptable. Five areas were found to have the rebar placed in accordance with the UE&C design drawings and the Bethlehem Steel Corporation fabrication and installation drawings. The rebar installed in two areas were found not to be placed in accordance with the design drawings, as described in the following paragraphs.

In the Unit 2 Emergency Feedwater Pumphouse wall at Elevation (+) 8'-2", it was identified by the NRC CAT inspectors that vertical rebar (replacing interrupted rebar) located at the sides of a doorway opening was not placed in accordance with the comments on the latest Bethlehem Steel Corporation drawing [Foreign Print (FP) 17887, Issue 1] and the UE&C design drawing. The original Bethlehem Steel Corporation drawing detailed only six additional bars to be placed on each side of the doorway; however, UE&C comments on the latest drawing indicate that standard doorway opening details should be used. The standard doorway opening details (UE&C Drawing 101565, Rev. 17) specifies that the equivalent bar area (equal to the area of the interrupted bars) be placed around the opening. For this wall, since 16-#8 vertical rebar were interrupted by the doorway, eight #8 rebar on each side of the doorway should have been installed. Only six #8 rebar on each side was actually installed. This is an example of rebar placed not in accordance with the latest installation drawings.

In the review of the design and installation drawings (FP 13881, Issue 8) for the identical location in the Unit 1 Emergency Feedwater Pumphouse, it was identified that only six #8 rebar were placed on each side of the doorway whereas eight #8 should have been specified. This is an example of a rebar detailing error made by Bethlehem Steel Corporation that was not identified by UE&C in the review of the Bethlehem Steel Corporation drawing. This error has led to the installation of less rebar than called for in the typical design details.

The review of the Unit 2 Containment Enclosure Building around the personnel air lock at Elevation (+) 20' revealed that vertical rebar were not placed in accordance with the UE&C design drawing. This rebar was placed in accordance with the Bethlehem Steel Corporation drawings (FP 14884, Issue 4 and FP 14017, Issue 6) which showed the inner layer of the outer face of #11 vertical rebar to extend to Elevation (+) 30'-5". However, UE&C Drawing 101460, Rev. 7 specifies the inner layer only to extend to Elevation (+) 11'. This is another example of a rebar detailing error by Bethlehem Steel Corporation that was not idenfified by UE&C.

Two similar instances occurred in which Bethlehem Steel Corporation drawings contained detailing errors. One is described in a Final 50.55(e) Report, dated 8/16/82, regarding the Containment Enclosure Building horizontal missle shield and the other in NRC Region I inspection reports 50-443/83-09 and 50-443/83-15.

The five cadwelders selected were found to be properly qualified by testing and requalified when required. The inspection records and tensile test reports for a sample of 13 cadwelds were reviewed and were found acceptable. Tensile testing met the required testing frequency. Cadwelder 224 was qualified for cadwelding, however, this cadwelder never made a production cadweld.

It was noted that in one instance for Cadwelder 34 for #18 horizontal splices, consecutive splice numbers 51 through 56 are listed twice in the computerized summary and for #18 vertical splices, numbers 51 through 56 are missing. It was subsequently identified that a computer input error had occurred in the designation of the cadwelds.

The concrete material certification and testing records reviewed were for: two shipments of bagged cement, 21 shipments of admixtures (air entraining, water reducer, and super-plasticizer) including user tests; 22 aggregate certifications (#7, #8, #57 and sand); five cement certifications (Marquette and Atlantic); six shipments of various size rebar; and 17 mixer uniformity test reports. The documents were found to be acceptable. In one case, a minor discrepancy was found in that an erroneous, corrected test report for air entraining admixture received on 3/22/79 was transmitted to the Seabrook site. The erroneous test report had transposed two test results; however, other corrected copies existed which demonstrated the acceptability of the admixture.

During a routine plant tour, the NRC CAT inspectors also noticed a small chipped out area of a Primary Auxiliary Building wall at Elevation (+) 14'-0". The chipped out concrete had exposed the first horizontal and vertical layer of rebar. The documentation to support the chipping out of the concrete was requested. Engineering Change Authorization (ECA) 25/8481A was provided and showed that difficulties in installing a concrete expansion anchor bolt had caused engineering to use through-bolting as a fix. The concrete chipping was necessary in order not to damage vertical rebar during core drilling as specified in the ECA. Adequate measures were in place to control the chipping of concrete and the cutting of rebar.

The concrete "maturity method" described in UE&C Specification 13-3, Rev. 13 (Section 3.14.5.2) was discussed with UE&C engineering personnel. The "maturity method" uses internal concrete temperature and time to obtain a measure of concrete strength in order to cease manual monitoring of curing conditions. Correlation tests were performed to establish the relationship between "maturity number" and concrete compressive strength of four concrete mix designs. The correlation test results were reviewed with the established criteria to discontinue cure monitoring as defined in ECA 01/3385E. The test results showed that the criteria established in ECA 01/3385E did provide a concrete compressive strength of 70% of the design strength. In addition, from discussions with engineering personnel, it was identified that: it would usually take five days to reach the criteria in the ECA; the "maturity method" was not used in the Containment Building shell concrete; and due to the late utilization of the method at the Seabrook Site, the "maturity method" had limited usage in

Unit 1 structures. The methodology developed for the "maturity method" was acceptable.

Regarding Windsor Probe testing, PPC QCP 10.8, Rev. B, Section 5.1.3 allows the use of the Windsor Probe method in the evaluation of distressed concrete areas. When UE&C personnel were questioned by the NRC CAT inspectors regarding the correlation curves used with the Windsor Probe testing to determine concrete compressive strength, four Nonconformance Reports (NCRs) (2705AI; 2704; 2309, Rev. 1 AI; and 141) were provided which documented the technical justification and use of the Windsor Probe test data. It was noted that control tests were used to correlate the Windsor Probe testing and that the Windsor Probe test results were not used solely to justify acceptability (concrete cylinder break tests were also used).

c. Conclusions

The two areas in which vendor rebar detailing errors were identified (Unit 1 Emergency Feedwater Pumphouse wall and Unit 2 Containment Enclosure Building personnel air lock area) and the additional instances identified by the applicant and Region I personnel demonstrate the need for a review of vendor rebar details, especially in areas around the more significant openings in Unit 1 structures.

For the most part, concrete quality was found to be acceptable and rebar was placed in accordance with the Bethlehem Steel Corporation drawings. Cadwelding activities were found to be performed in an acceptable manner. The concrete material certification and testing records reviewed showed conformance to the construction specifications and regulatory commitments. Concrete chipping and rebar cutting appeared to be performed in a controlled manner. Although the "maturity method" was not used to a large extent in Unit 1 structures, the methodology and the discontinuation of curing criteria defined in ECA 01/3385E were found to be acceptable. The use of Windsor Probe test data was found to be acceptable.

2. Structural Steel Installations and Bolting Applications

a. Inspection Scope

Structural steel installation activities were reviewed by the NRC CAT inspectors. Installed and QC accepted structural steel was inspected for member size, configuration, conformance of bolted connections to design drawings, proper use of washers, and minimum radius cuts on re-entrant corners. Structural steel bolts were tested using a calibrated torque wrench to determine whether the bolts were properly tightened. Unit 1 building structures inspected were: the Containment Building, the Service Water Pumphouse and the Emergency Feedwater Pumphouse.

Structural steel installations reviewed included: 20 members for proper size and dimensions, 14 bolted connections, and 263 bolts tested for minimum installation torque (see Tables IV-2 and IV-2a).

The majority of bolted connections used "Tension Set" type bolts which did not use a torque or turn-of-the-nut criteria for installation. The "Tension Set" bolts utilize a spline on the end of the bolt which shears off when the proper installation torque is reached. No calibrated torque wrenches or nut markings are necessary in the "Tension Set" bolt method. Qualification tests were done on each heat of "Tension Set" bolts received at the site to ensure that the torque to shear off the spline did develop the minimum required tension in the bolt. A sample of qualification tests was reviewed by the NRC CAT inspectors.

The acceptance criteria used in the review of structural steel installations are specified in the following:

UE&C Specification 12-2, "Structural Steel Erection," Rev. 9

PPC FCCP-155, "Installing and Tightening of High Strength Bolts using the Tension Set Fastening System," Rev. 4

PPC QC Procedure QCP 10.21, "Structural Steel Inspection," Rev. B

b. <u>Inspection Findings</u>

Twenty structural steel members and 14 bolted connections were found by the NRC CAT inspectors to be in conformance with design drawings for configuration and location.

In the bolted connections which were checked for minimum torque, a significant number of insufficiently torqued bolts were found in the Unit 1 Containment Building annulus steel. For the "Tension Set" type bolts, ten of 95 were found to be below the minimum inspection torque specified by PPC QCP 10.21 (425 ft-lbs for 7/8" diameter A325 bolts). These ten bolts were found on knife plate type connections from annulus steel beams to embedded plates on the secondary shield wall and were described in ECAs 01/3793H and 01/3888C. The ECAs were issued to resolve a lamellar tearing problem in these connections.

In standard heavy hex bolted connections in the Containment annulus steel, five of 28 bolts were found below 425 ft-lbs. These deficient bolts were found scattered in the various connections in the Containment Building annulus steel. In a few cases, the observed bolt torques were as low as 200-250 ft-lbs in both the Tension Set type bolts and the standard heavy hex type bolts. The low torque values found are significant in that the design of the Containment annulus steel used friction type connections.

Only two of 98 bolts tested in the Service Water Pumphouse were found below minimum torque values. None of 42 bolts examined in the Emergency Feedwater Pumphouse were found below minimum torque values.

In accordance with UE&C Specification 12-2, the "Tension Set" type bolts were subject to qualification testing when received on-site. A sample of bolts were Skidmore tested to determine the tension developed in the bolt under normal installation conditions. A sample of the qualification test reports were reviewed by the NRC CAT inspectors. It was noted that NCR 827, Rev.1 described nine of the first 30 lots of bolts which had failed the prequalification testing. The disposition was to reject the bolts and return them to the vendor. A review of the next 30 qualification reports showed no additional rejected lots of bolts.

During the NRC CAT review of structural steel installations, the NRC CAT inspectors identified several large pipe whip restraints (steam generator hot leg restraints) which were attached to the Containment floor mat by four relatively small (1" diameter) anchor bolts. The anchor bolts were small in comparison to the size of the structural members making up the pipe whip restraint. The design calculations were reviewed and it was found that these pipe whip restraints were also used as the attachment point for the Safety Injection line (10") seismic supports. In the review of the design loading combinations it was identified by the NRC CAT inspectors that the seismic loads from the Safety Injection line had been combined with the pipe break loads from the steam generator hot leg. Since the pipe break loads give a considerable downward load (3400 kips) on the restraint, any horizontal load would be taken up by the shear resistance of the downward load and friction between the base plate and the concrete floor. However, it is not conservative in the design of the anchor bolts to consider the pipe break loads from the hot leg in conjunction with the seismic loads from the Safety Injection line. The horizontal (seismic) loads of the Safety Injection line, when acting alone would have to be taken completely by the anchor bolts. This load case was not considered by UE&C engineers in the design of the pipe whip restraint structure.

Discussions with UE&C engineering personnel indicated that four hot leg restraints and one cross-over leg restraint are similarly affected. As a result of the NRC CAT inspectors' review, one hot leg restraint was reanalyzed and the anchor bolts were found to be acceptable. This case is similar in nature to an unresolved issue discussed in an NRC Region I Inspection Report 50-443/83-09-04, wherein the NRC Senior Resident Inspector questioned the design of anchor bolts shared by a Feedwater pipe support and pipe whip restraint.

c. Conclusions

In general, structural steel installation activities (member size and configuration, connections, and bolt qualification testing), with the exception of bolt torque, were found to be in conformance with the specifications and design drawings. The number of bolts found below minimum torque values for the Containment annulus steel connections indicate that these bolts have not developed the proper tension specified by AISC. Based on the NRC CAT sample of bolted connections, the insufficiently torqued bolts are the "Tension Set" type bolts in knife plate connections to the secondary shield wall and standard heavy hex type bolts in various connections of Containment annulus steel.

The design loading combination for the four steam generator hot leg restraints and one cross-over leg restraint were not properly considered in the UE&C design calculations. UE&C personnel informed the NRC CAT inspectors that a reanalysis has been performed on one hot leg restraint (identified by the NRC CAT inspectors) and the anchorage has been found to be acceptable.

3. Concrete Expansion Anchor Bolts

a. Inspection Scope

The qualification test reports for the concrete expansion anchor bolts (Hilti Kwik and Super Kwik) used at the Seabrook Station were reviewed for technical adequacy, conformance to the project specifications and demonstration of satisfactory anchor performance. The test reports reviewed included results from the latest tests performed in March and June 1981 and are FP 44132, Issue 2 and FP 47369, Issue 1. The site standard installation and inspection procedure, UE&C Field General Construction Procedure (FGCP) 35, and the procedures for three major contractors [Pullman-Higgins (P-H), Fischbach-Boulos-Manzi (FBM) and Johnson Controls, Inc. (JCI)] were reviewed for conformance to the specifications and qualification test reports.

A sample of expansion anchor bolts were selected to check for proper torque. These included 82 mechanical pipe support anchor bolts (17 supports), 71 electrical anchor bolts (23 supports), and 40 instrumentation and control (I&C) anchor bolts (17 supports).

The supports contained anchor bolts ranging in size from 1/2" to 1-1/4" diameter and included ASME Class I supports. Additional examinations performed by the NRC CAT inspectors included verification of installation of washers and proper thread engagement of the nut.

The basic acceptance criteria are provided on the following documents:

UE&C Specification 18-17, "Installation of Concrete Expansion Anchors," Rev. 4

UE&C Field General Construction Procedure (FGCP) 35, "Hilti Kwik Bolt Installation and Inspection," Rev. 1

P-H Procedure IX-1, "Hilti Installation and Inspection," Rev. 16

FBM Procedure FECP-507, "Installation of Concrete Anchors," dated 6/28/83

FBM QC Procedure, "Inspection of Concrete Anchor Installations," dated 5/19/83

JCI QC Procedure QAS-1035, "Hilti Inspection Procedure," Rev. 0

b. Inspection Findings

The concrete expansion anchor bolt (Hilti Kwik and Super Kwik Bolts) qualification test reports were reviewed and found to be consistent with the specifications, the site standard installation and inspection procedure, and three major contractor's procedures. It was noted that the installation and inspection procedures specified installation and torque values in some instances lower than called for in the qualification test reports. In discussions with UE&C engineering personnel, the cause for the lower torque values was that the Seabrook Station uses a retorque program in which the installation torque is reapplied after a minimum of five days. A slightly lower torque value could be justified as the Hilti testing was based on the assumption of only a single torque application.

A sample of anchor bolts for piping, electrical, and instrumentation supports were torque checked in accordance with the Quality Assurance (QA) check torque values in UE&C Specification 18-17, Rev. 9, Table 3.2.2 (See Table IV-3 of this report). For pipe support anchor bolts installed by P-H, 30 1-1/4" diameter anchor bolts were tested and six found below QA check torque value of 475 or 325 ft-lbs, respectively, for Hilti Super Kwik or Kwik-Bolts. One Super Kwik anchor bolt had a torque value of 300 ft-lbs. In addition, two of 13 5/8" diameter anchor bolts were found below the specified QA check torque value of 55 ft-lbs.

For electrical supports, 71 anchor bolts were tested and seven found to be below QA check torque values. The deficiencies occurred on 1/2" diameter bolts and were found to have torque values of 30-40 ft-lbs (QA check torque value is 40 ft-lbs). It was noted that Yankee Atomic Electric Company (YAEC) QA Audit Report SA438CS126, conducted in December 1980, identified a similar problem in which 32.4% of the sample of electrical supports failed to maintain the required torque. A corrective actions program was initiated by the applicant which included increasing the initial installation torque values and requiring retorquing of anchors five days after initial installation.

In the instrumentation area, 40 anchor bolts were torque tested and none were found to be deficient.

c. Conclusions

Concrete expansion anchor bolt qualification test reports, site specifications, and installation and inspection procedures were found to be acceptable. However, for some sizes (1 1/4" and 5/8" diameter) anchor bolts for pipe supports and 1/2" diameter anchor bolts for electrical supports were found below the specified QA check torque values. It appears that the corrective actions used in resolution of the YAEC QA audit were not successful in maintaining the proper amount of bolt torque.

4. Design Impacts on Installed Hardware

a. Inspection Scope

During the course of the NRC CAT inspection it became evident to the NRC CAT inspectors that changes in the design of components and structures had caused design efforts to continue while hardware was being installed and inspected, sometimes after seismic qualification had been performed. This has significantly affected and will continue to affect the installation and inspection work that has been thus far expended. The NRC CAT inspectors were told that some design changes were caused by refinements in the seismic loads [amplified response spectra (ARS)]. However, in some cases, the ARS had increased rather than decrease the seismic loads as would be expected in a refinement.

b. Inspection Findings

The following cases illustrate the difficulties the continuing design efforts has caused in construction and inspection.

(1) Electrical cable tray supports, as discussed in Section II, will require a considerable amount of rework caused by the "iterative" design process for these supports. In addition, the hardware deficiencies and inadequate inspection records identified by the NRC CAT inspectors resulted in the conclusion that status of the cable tray supports is indeterminate.

Also, the NRC CAT inspectors had numerous discussions and meetings with the applicant and UE&C engineering personnel on the seismic classification of the cable trays themselves. In several of these discussions conflicting information was provided by the applicant, UE&C, and contractor personnel concerning their procurment classification, the design philosophy of the cable trays, and the seismic qualification of the trays. Throughout the entire inspection period, no consistent philosophy was presented as to how the cable trays were procured, designed, and qualified. Information provided to the NRC CAT inspectors usually conflicted with previous information provided. This topic had been previously discussed at length with the NRC Region I and Nuclear Reactor Regulation (NRR) offices.

(2) Two recent ECAs, 05/1294A and 05/1169A, issued on 5/27/83 and 3/9/83 respectively, indicate that installed instrumentation and control hardware will have to be reanalyzed due to higher ARS.

(3) The NRC CAT inspectors selected eight pieces of electrical and mechanical equipment for review of seismic design and qualification. The selected equipment is listed in Table IV-4. The review included: comparison of the seismic qualification input to the UE&C specification and the latest ARS; comparison of the field installation with the analysis; qualification methodology; and specification input consistency with the structural seismic model.

Three of eight pieces of equipment selected were found to be acceptable (Gould motor control centers, Brown-Boveri switchgear, and the battery rack support structures). Five pieces of equipment were found not be be in conformance with the seismic specification (the Primary Component Cooling Water head tank, pump and motor, and heat exchanger; the Containment Building polar crane; and the Boric Acid Storage Tank). In general, the reasons for the nonconformances were the seismic values used in the analysis were less than those specified, and in two cases, the shear transfer mechanism from the equipment to the concrete foundation appears to be inadequate.

Of the five pieces of equipment originally found to be nonconforming, three were identified to be currently under UE&C review (head tank, polar crane, and Boric Acid Storage Tank). One (pump and motor) required later revisions of the analysis (revisions 10, 11 and 12) to demonstrate acceptability of the pump. The motor analysis had been reviewed by UE&C and found to be acceptable even with the seismic analysis input values less than those specified. For the heat exchanger, later revisions to the seismic analysis than provided to the NRC CAT inspectors were stated to demonstrate seismic adequacy.

A review of the forms used to document the seismic design review performed by UE&C personnel for Technical Procedure (TP) 17 showed that the foreign print numbers used in the analysis and provided to the NRC CAT inspectors did not in all cases agree with the foreign print numbers referenced on the TP-17 forms.

Additional discussions on the welding of switchgear cabinets to their foundations and the incorrect installation and design considerations for equipment anchor bolts are provided in Sections II and III of this report.

(4) Several instances of design changes to components causing reanalyses or rework are described in the recent NRC Independent Design Inspection Report 50-443/83-23 (this inspection was conducted in November-December 1983). These instances included: nozzle loads on containment spray pumps which were revised twice to ensure qualification of the pumps; pipe break analysis which have not yet been performed; pipe supports which had to be reanalyzed after fabrication and installation to account for support stiffness and ARS data incorporation; and equipment qualification in the area of instrumentation and control which has not been fully effective in demonstrating proper qualifications, even at this stage of construction.

(5) The design adequacy of structural steel beams will not be determined until the exact location of loads are known. However, since loads are not reviewed by UE&C structural engineering, this will not occur until late in the construction stage and an as-built walkdown review is performed.

c. <u>Conclusions</u>

The five cases described above indicate a trend of allowing procurement, installation and inspection to proceed while design is being finalized. While it cannot be accurately predicted how significant the changes in design may be, there exists in the NRC CAT inspectors' opinion a significant potential for a large amount of reanalysis and possibly rework. In addition, these efforts will be performed late in the construction stage. While a certain amount of design changes can be expected at any nuclear power station under construction, it appears that the full impact of changes and revisions to designs at the Seabrook Station have not been properly assessed for their potential impact on procured and installed hardware. The prime example is in the case of cable tray supports in which installed and inspected supports can only be considered at this time to be of an indeterminate status as design changes are currently in progress. More importantly, there are communication problems between the design and construction groups (utility, UE&C engineering, contractor, and QA/QC personnel) which will impact significantly on construction, if not corrected in a timely manner.

TABLE IV-1

CONCRETE PLACEMENT REVIEW

Location	Drawings	Comments
Unit 1 - Secondary Shield Wall El.(-)26'-0"	UE&C - 101420, Rev.8 Bethlehem Steel Corp. (BSC) FP 13135, Issue 9 13016, Issue 7 PPC- FP 44041, Issue 2 44084, Issue 2	Concrete chip out area per ECA 05/1661A; ECA 01/0816A allowed placement of horizontal rebar from outside to inside of the vertical rebar (as-built drawing was verified); RFI 59/4957A clarified tolerances on cadweld locations shown on Perini cadweld maps; no discrepancies were identified.
Unit 2 - Emergency Feedwater Pumphouse Wall El.(+) 8'-2"	UE&C - 101610, Rev. 10 101611, Rev. 12 101664, Rev. 5 101665, Rev. 5 BSC - FP 17887, Issue 1	Installed rebar were not placed in accordance with comments on the latest BSC drawing around doorway opening (6 vertical rebar on each side installed whereas 8 required due to 8 rebar being interrupted).
Unit 2 - Cont. Enclosure Bldg. Personnel Air Lock Area El.(+) 20'	UE&C - 101460, Rev.7 BSC - FP 14884, Issue 4 14017, Issue 6	Installed vertical rebar per BSC drawing, but not in accordance with UE&C drawing; inner layer of outer face rebar detailed in BSC drawing to extend up to El.(+) 30'-5" whereas design drawing specified rebar only to El.(+) 11'.
Unit 2 - Cont. Exclosure Bldg. Equipment Hatch Area El.(+) 6'6" and 30'	UE&C - 101453, Rev.11 101457, Rev.12 BSC - FP 14885, Issue 4 14886, Issue 4 10475, Issue 10	Temporary access opening per ECA 59/4783A; no discrepancies were identified.
Unit 2 - Cont. Enclosure Bldg. Electrical Penetration Room Area El.(+) 22'-0"	UE&C - 101458, Rev.14 101459, Rev.9 BSC - FP 14015, Issue 2 14017, Issue 6 14295, Issue 5	No discrepancies were identified.
Unit 2 - Containment Bldg. Wall El.(+) 84'	UE&C - 101435, Rev.6 BSC - FP 16572 through 16578, Issue 1	No discrepancies were identified.
Unit 2 - Fuel Storage Bldg. Wall El.(+) 20'-6"	UE&C - 101570, Rev.18 101576, Rev.4 BSC - FP 16965, Issue 3 Perini - FP 4588A, Issue 4	Rebar interferences with column baseplate previously identified in NCR 3241; no discrepancies were identified.

TABLE IV-2

STRUCTURAL STEEL INSTALLATION

Review	Structure	Number of Connections	Number of Members or Bolts	Comments
			(members)	
Configuration	Containment Building	12	17	No deficiencies were identified.
	Emergency Feedwater Pumphouse	2	3	No deficiencies were identified.
	Total	14	20	
			(bolts)	
Bolt Torque	Containment Building	35	123	- 10 of 95 Tension Set bolts found below 425 ft-lbs (lowest torque found 200-250 ft-lbs) - 5 of 28 standard bolts found below 425 ft-lbs (lowest torque found 200-250 ft-lbs)
	Service Water Pumphouse	18	98	- 2 bolts found below 425 ft-lbs (one 350-425 ft-lbs; one 200-250 ft-lbs)
	Emergency Feedwater Pumphouse	12	42	- Bolts found acceptable
	Total	65	263	

TABLE IV-2a

STRUCTURAL STEEL INSTALLATION

Location	UE&C Drawing	Cives Drawing
Containment Building:		
El. 0; AZ-170°	102317	E102
El. (-) 10; AZ-170°	112329 102318	E110
El. (-) 16'-9"; AZ-120°	102322	E113
El. (-) 16'-9"; AZ-140° -130° -120°	102322 102327 102320	E113 E115
El. (-) 13'; AZ- 40°	102320 102320T	E112
El. (-) 10'6"	101469 101926	
El. (-)5'; AZ-240°	102323 102315	E101
El. (-) 8'; AZ-160°	102317 102323	E102
Emergency Feedwater Pumphouse: El. (+) 47'	101663	E1

TABLE IV-3

CONCRETE EXPANSION ANCHOR BOLTS

Contractor	Structure	No. Supports Tested	No. Bolts Tested	Comments
P-H (pipe supports)	Containment	17	82	6 - 1 1/4" and 2 - 5/8" diameter bolts found below QA check torque
FBM (electrical supports)	PAB El. (-) 53'+ (-) 25'	23	71	7 - 1/2" diameter bolts found below 40 ft-lbs
JCI and UE&C (instrumentation supports)	PAB El. (-) 53'+ (-) 25'	17	40	No deficiencies found
	TOTAL	57	193	

Contractor	Support No.	Bolt Size	No. of Bolts Tested	Comments
P-H (pipe (supports)	155 A 12	1-1/4	4	1 bolt 300 ft-lbs
	155 SG 13	1	4	Acceptable
	155 SG 12	1-1/4	4	1 bolt below QA check torque;
	202 SG 8	1-1/4	4	1 bolt below QA check torque ASME Class 1
	MS 104 SG-7	5/8	2	ASME Class 1
	203 SV 13	5/8	7	2 bolts below QA check torque; one bolt could not be torqued NCR 4692

TABLE IV-3 - Continued

CONCRETE EXPANSION ANCHOR BOLTS

Contractor	Support No.	Bolt Size	No. of Bolts Tested	Comments
	352 SG 5	1/2	4	Acceptable
	334 SG 15	1/2	4	Acceptable
	343 RG 23	3/4	4	Acceptable
	204 RG 6	1-1/4	7	Acceptable
	859 A 7	1	10	Acceptable
	343 SG 22	1/2	4	Acceptable; ASME Class 1
	366 A 5	1-1/4	4	1 bolt below QA check torque
	852 RG 11	5/8	4	Acceptable
	852 SG 14	1	4	Acceptable
	708 RG 11	1, 3/4	4	Acceptable
	203 SG 3	1-1/4	8	1 Hilti Super Kwik Bolt and 1 Kwik-Bolt below QA check torque; ASME Class 1
FBM (electrical supports)	16788	1/2	3	Acceptable
	23691	1/2	4	1 bolt between 30 - 40 ft-lbs
	28957	1/2	2	Acceptable
	29619	1/2	2	Acceptable
	28935	1/2	2	Acceptable
	9630	1/2	4	Acceptable
	16794	1/2	3	1 bolt between 30-40 ft-lbs
	22449	1/2	4	2 bolts between 30-40 ft-lbs
	22457	1/2	3	Acceptable
	25642	1/2, 3/4	8	Acceptable
	9402	1/2	3	Acceptable
	9400	1/2	2	Acceptable
	9480	1/2	3	1 bolt between 30-40 ft-lbs

TABLE IV-3 - Continued

CONCRETE EXPANSION ANCHOR BOLTS

Contractor	Support No.	Bolt Size	No. of Bolts Tested	Comments
	9463	1/2	2	Acceptable
	26046	1/2	2	Acceptable
	23665	1/2	3	Acceptable
	23662	1/2	3	Acceptable
	23664	1/2	3	1 bolt between 30-40 ft-lbs
	26042	1/2	4	1 bolt between 30-40 ft-lbs
	22248	3/4	4	Acceptable
	22258	3/4	4	Acceptable
	22257	3/4	3	Acceptable
JCI (instrumentation supports)	1-PABL-H-PLI-135	1/2	2	Acceptable
	1-PABH-H-PLI-38	1/2	1	Acceptable
	1-PABH-H-PLI-37	1/2	2	Acceptable
	1-PABH-H-PLI-36	1/2	2	Acceptable
	1-PABH-H-PLI-35	1/2	2	Acceptable
	1-PABH-H-B2-2	5/8	2	Acceptable
	PB-1-175-498	1/2	2	Acceptable
	PB-175-452	5/8	2	Acceptable
	1-PABH-H-PLI-62	1/2	2	Acceptable
	1-PABH-H-PLI-64	1/2	2	Acceptable
	PB-175-916	3/4	4	Acceptable
	PB-175-917	3/4	4	Acceptable
	1-SK-PB-84-Q2	1/2	4	Acceptable
	1-PABL-H-R-252	3/4	2	Acceptable
	SK-TH-529-Q1	3/4	3	Acceptable
	SK-TH-525-Q7	1/2	2	Acceptable
	SK-TH-525-Q8	1/2	2	Acceptable

TABLE IV-4

SEISMIC REPORT REVIEW

Equipment	Specification No. & Seismic Analysis Foreign Print (FP) No.	Comments
1. Gould Motor Control Centers (Control Bldg., Service Water Pumphouse, Service Water Cooling Tower) El. (+) 21'-6"	Specification 143-1 FP 31120, Issue 2	Analysis acceptable. See Note 1.
2. Brown-Boveri 5KV Switchgear (Control Bldg. El. (+) 21'-6")	Specification 145-2 FP 33975, Issue 2	Analysis acceptable. See Note 1.
3. Battery Rack Support Structure	Specification 137-1	Analysis acceptable.
4. Primary Component Cooling Water Head Tank (PAB El. (+) 65'-9")	Specification 246-2 FP 51058, Issue 4	Static values used in analysis are less than specification values (See Note 2)
5. Primary Component Cooling Water Pump and Motor	Specification 238-5 FP 51053, Issue 12 53011, Issue 2	Seismic input used in motor analysis is less than specification values shear transfer to foundation may be adequate. (See Notes 1 and 3)
6. Primary Component Cooling Water Heat Exchanger	Specification 258-1 FP 52016, Issue 5 and 7	Seismic input used in analysis less than specification values; shear transfer to foundation may be inadequate (See Notes 1, 3, and 4).
7. Containment Bldg. Polar Crane (Whiting)	Specification 257-2 FP 52014, Issue 3	Seismic input used in analysis is less than specification values.

TABLE IV-4 - Continued

SEISMIC REPORT REVIEW

Equipment	Specification No. & Seismic Analysis Foreign Print (FP) No.	Comments
8. Boric Acid Storage Tank (PDM)	Specification 246-1 Vendor Report - PDM Analysis 6/83	Seismic input used in analysis is less than specification values.

NOTES

1. Discrepancy in the seismic analysis provided to the NRC CAT inspectors and the analysis referenced on the TP-17 sheet for the particular piece of equipment.

2. Currently under UE&C review.

3. UE&C performed additional calculations to qualify motor. Based on discussions with UE&C personnel, sufficient margin exists to qualify the motor.

4. Based on discussions with UE&C personnel, a revised analysis had been submitted and accepted by UE&C. This could not be verified by the NRC CAT inspectors.

V. WELDING AND NONDESTRUCTIVE EXAMINATION

A. Objective

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

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

B. Discussion

To accomplish the above objectives, welds and welding details for pipe, piping supports/restraints, pipe whip restraints, structural steel installations, heating, ventilation and air conditioning (HVAC) installations, electrical supports and instrument tubing were inspected. The inspected welds were selected to provide a representative sample of the applicant's contractor welding activities in terms of welding processes used, materials welded and existing weld-joint configurations. Considerations such as the physical location, the difficulties for welding and limited accessibilities were also included in the sample selection.

NDE activities were appraised through the review of radiographs for both field and vendor-fabricated welds, the review of NDE procedures and personnel qualifications, the inspection of the calibration status of NDE equipment and the witnessing of in-process NDE activities.

During the inspection of NDE activities, the NRC Construction Appraisal Team (CAT) inspectors reviewed samples of radiographic film in final storage in the vault. The NRC CAT inspectors reviewed a sample of film which was reviewed by the applicant's NDE organization as well as film which had not been reviewed prior to vault storage. No significant problems were identified involving film that was reviewed by the applicant's NDE organization. However, several irregularities were identified involving film that had not been reviewed by the applicant. Detailed discussion concerning these irregularities are included later in this section.

The welding and NDE activities were examined in order to ascertain compliance with the governing construction codes and involved the following contractors:

Field Fabrication

1. Pullman Higgins (P-H): Piping installation, and piping supports/restraints
2. United Engineers and Constructors (UE&C): Architect engineer; installation of instrumentation and controls
3. Pittsburgh-Des Moines (PDM) Steel: Containment liner, field fabricated tanks
4. Johnson Controls, Inc. (JCI): Instrumentation and controls installation
5. Fischbach-Boulos-Manzi (FBM): Electrical installations and electrical supports.
6. Hirsch-Arkin-Hershman (HAH): Heating, ventilation and air conditioning (HVAC)
7. Perini Power Constructors (PPC): Structural steel installation
8. Grinnell Fire Protection (Grinell): Fire protection piping and related supports
9. General Electric (GE): Turbine/Generator installation
10. Nooter Corporation: Reactor vessel, refueling pool and spent fuel pool liner
11. Nuclear Installation Services Company (NISCO): Reactor internals installation

Shop Fabrication

1. Dravo Corporation: Piping supplier
2. Sterns-Roger: Pipe whip restraints
3. Westinghouse: Nuclear Steam Supply System (NSSS)
4. Cives Steel Corporation: Structural steel supplier
5. Borg Warner: Valve manufacturer
6. Walworth: Valve manufacturer
7. Lunkenheimer: Valve manufacturer
8. Bingham Willamette: Pump manufacturer
9. Pacific Pumps: Pump manufacturer
10. Posi Seal International: Valve manufacturer
11. Southwest Fabricating & Welding Company: Shop fabricated tank supplier
12. Ceramic Cooling Tower: Mechanical draft cooling towers supplier
13. Process Engineering: Piping expansion joint manufacturer
14. Woolly Corporation: Containment vessel hatches fabricator and supplier
15. Corner & Lada: Shop fabricated pipe support supplier
16. Ishikawjima-Harima-Heavy Industries (I.H.I.): Containment vessel plate supplier and fabricator
17. Struthers Wells Corporation: Cooling Water Heat Exchangers
18. P-X Engineering: Tanks and deminerlizer supplier and fabricator

The results of the inspection activities involving each of these contractors are documented in this section of the report.

1. Pullman-Higgins (P-H)

a. Inspection Scope

The NRC CAT inspectors reviewed activities relating to the P-H contracts in the areas of piping system welds, support/restraint welds, welding procedures, welder's qualifications, NDE procedures, NDE personnel qualifications, and the review of radiographic film for shop and field fabricated welds. Welding by Corner and Lada on preassembled pipe supports, restraints fabricated by Sterns-Roger and welding by Dravo Corporation on shop fabricated piping spools were also inspected as a part of the P-H inspection.

(1) Welding Activities

The NRC CAT inspectors performed a detailed inspection on 55 pipe supports/restraints involving approximately 700 welds in order to verify conformance of welding to drawing requirements and to confirm the visual acceptability of the welds (See Table V-1 for listing of supports inspected). Additionally, another 60 supports/restraints involving 900 welds were also visually inspected in order to verify the quality of the completed welds. Both shop and field fabricated welds were inspected.

The NRC CAT inspection of piping welds consisted of visual inspection during walkdown of piping systems and inspection of pipe welds located near the supports/restraints inspected during this inspection. Approximately 56 piping spools involving 1200 ASME Class 1, 2 and 3 welds were inspected (See Table V-2 for a listing of welds inspected). Both field and shop welds were inspected in order to assure compliance with the requirements of the ASME Code. Some of the surfaces of the inspected welds were blended for inservice inspection.

Welder qualification records for 40 welders and ten welding procedures were reviewed for compliance with applicable specifications, procedures and the ASME Code requirements.

(2) Nondestructive Examination Activities

The NRC CAT inspection of NDE activities for P-H included the review of radiographic film for 61 shop and 180 field fabricated pipe welds which involved 1990 film. The shop welds were fabricated by Dravo Corporation. The review of six NDE procedures and seven NDE personnel qualifications was also included in this inspection. Four NDE technicians were observed while performing liquid penetrant and magnetic particle examinations in order to verify their abilities to follow the applicable procedures.

b. Inspection Findings

(1) Welding Activities

The inspected pipe supports/restraints were found to meet the acceptance criteria of the ASME Code. In the area of pipe welding, the inspected ASME pipe welds were also found to comply with the requirements of the Code. However, two welds which were fabricated under the rules of ANSI B31.1 Power Piping Code were found to be deficient with respect to the ANSI Code acceptance criteria. Field Weld F0101 on line SF1750-A7-01 had unacceptable undercut and field weld F0303 on line SF1748-03-R had improper weld profile. As a result of this finding, the applicant issued Construction Followup Report (CFR) 049 and the welds will be evaluated and repaired as needed.

(2) Nondestructive Examination Activities

No problems were identified in the area of NDE procedures, NDE personnel qualifications and field fabricated pipe welds. However, during the review of Dravo radiographs, one weld (weld #141 8L-1MS-4001-41908) was found to display linear indications which did not meet the specified acceptance criteria. This weld was rejected at the site and documented by Yankee Atomic Electric Company (YAEC) Deficiency Report (DR) 660.

c. Conclusions

Some problems were identified in the areas of inspected welding and NDE activities. With the exception of the findings previously discussed, welds were found to generally comply with the applicable construction codes and specifications.

2. United Engineers & Constructors (UE&C)

a. Inspection Scope

The NRC CAT inspectors reviewed 11 UE&C specifications related to fabrication and welding in order to verify adequacy with respect to the ASME Code and SAR requirements. In addition, approximately ten welds involving instrumentation supports were visually inspected. (UE&C has recently taken over the instrumentation contract from Johnson Controls, Inc.).

b. Inspection Findings and Conclusions

Inspected welding and NDE activities were found to comply with the applicable construction codes and SAR committments.

3. Pittsburgh-Des Moines (PDM)

a. Inspection Scope

The NRC CAT inspection activities related to the PDM contracts were in the area of field fabricated tanks and containment vessel liner. Both shop and field fabricated welds were inspected in order to assure compliance with the applicable code and specification requirements. Woolly Corporation fabricated the containment vessel hatches while I.H.I. supplied the containment vessel plate for the plant. The review of NDE procedures and radiographic film was also included in this inspection.

(1) Welding Activities

Approximately 150 feet of containment liner seam and 1500 feet of welded seam on fabricated tanks was visually inspected to determine if attributes such as mismatch, weld contour and appearance were in accordance with the ASME Code. Twelve welding procedures and the qualification test records for 15 welders were also reviewed for adequacy.

(2) Nondestructive Examination Activities

The NRC CAT inspection of NDE activities included the review of NDE procedures and NDE personnel qualification records. The inspectors also reviewed 92 feet of containment liner seam involving 207 film and 220 feet of welded seam on field fabricated tanks which involved 222 radiographs. In addition, 60 feet of weld fabricated by Wooley Corporation involving 48 film and 140 feet of weld fabricated by I.H.I. involving 126 film was reviewed for compliance with the governing codes and specifications.

b. Inspection Findings

(1) Welding Activities

Inspected welding activities were found to comply with the applicable code and specification requirements.

(2) Nondestructive Examination Activities

No problems were identified in the area of NDE procedures, personnel qualifications and the containment liner welds.

However, during the review of radiographic film for the Condensate Storage Tank (1-CS-TK-4B), the NRC CAT inspectors found that the repair radiographs for one weld (4H1) were missing. Since the condensate tank is completely encased in concrete, a re-radiograph of the area was not possible at the time of this inspection.

In addition, during the review of the Wooley's radiographs [identified as job #23550N (LS4) (GS1) (GS2) (LS1) (LS2) (LS3) (RS1) (RS2) and (RS3)], the film displayed evidence of poor processing such as the presence of water, chemical stains and yellowing. This problem was documented by YAEC Deficiency Report (DR)-662.

c. Conclusions

With the exception of the missing repair radiographs for one weld and the evidence of poor processing of the Wooley radiographs, no problems were identified in the area of inspected welding and NDE activities. Welds, in general, met the quality standards of the ASME code.

4. Johnson Controls, Inc. (JCI)

a. Inspection Scope

Approximately 350 shop and field fabricated welds were inspected for compliance with the applicable code and specification requirements. Ten welding procedures and 35 welder qualification test records were also included in this inspection. In addition, NDE procedures and NDE personnel qualifications were reviewed for adequacy.

b. Inspection Findings and Conclusions

No problems were identified in the area of inspected welding and NDE activities. Inspected tubing and structural welds were found to meet the requirements of the governing construction codes and specifications.

5. Fischbach-Boulos-Manzi (FBM)

a. Inspection Scope

Approximately 150 welds consisting of 60 shop and 90 field fabricated welds were visually inspected in order to ascertain compliance with the specified acceptance criteria. Six welding procedures and the qualification test records for 16 welders were reviewed.

b. Inspection Findings and Conclusions

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

6. Hirsch-Arkin-Hershman (H-A-H)

a. Inspection Scope

Approximately 340 welds (80 shop and 260 field) were visually inspected. In addition, eight welding procedures and the qualification test records for 20 welders were reviewed for adequacy.

b. Inspection Findings

During the visual inspection of field welds fabricated by HAH, the NRC CAT inspectors identified two welds which did not meet the HAH acceptance criteria. Weld #FN1-199 had undercut and weld #FN35-199 had overlap. As a result of this finding, the applicant issued Nonconformance Report (NCR) 474 and the welds will be repaired as needed.

c. Conclusions

No problems were identified in the area of inspected welding and NDE activities. With the exception of the minor findings regarding Weld #FN1-199 and #FN35-199, welds met the quality standards of the applicable code and specifications.

7. Perini Power Constructors (PPC)

a. Inspection Scope

Approximately 350 welds (60 field and 290 shop) were inspected for compliance with the specified acceptance criteria. The shop welds were fabricated by Cives Steel Corporation. Eighteen welder qualification test records and twenty welding procedures were reviewed for compliance with the applicable codes and specifications. In addition, 29 welds involving 84 radiographs were reviewed. Two NDE procedures were also reviewed for adequacy.

b. Inspection Findings

(1) Welding Activities

No concerns were identified in the area of inspected field welding. However, during the inspection of shop welds fabricated by Cives Steel Corporation, the NRC CAT inspectors found welds which did not meet the specified acceptance criteria. The deficient welds were identified to be in the clip to web connection of the inspected structural beams. As a result of this finding by the NRC CAT inspectors, the applicant issued NCR 74/2723. Thirty-three additional clip to web connections were then reinspected. Twenty of those 33 connections were found to be deficient with respect to the specified acceptance criteria. The NRC CAT inspectors selected the "worst" two connections and requested that an engineering evaluation be performed in order to assess the safety significance of this finding. The selected welds were undersized and approximately 50% of the weld was seal welded instead of having the required 5/16 inch fillet weld. The two welds were evaluated by UE&C engineering representatives, and were determined to be adequate for the intended application.

(2) Nondestructive Examination Activities

During the review of radiographs, the NRC CAT inspectors found that two welds identified as 1F1130D to 1F1130B weld 1 and 2 were radiographed using improper technique which resulted in improper coverage of the weld area. In addition, six welds (#1F1100A to #1F1100B weld 2 and 3; #HF11038 to #4F1103A weld 1 and 2; #1F1127A to #1F1126A weld 2 and 3) did not identify the proper repair sequence; therefore, the NRC CAT inspector could not determine whether the right weld had been re-radiographed.

c. Conclusions

The NRC CAT inspectors identified two welds that were radiographed using improper technique and six welds where the proper repair sequence was not identified. In general, welds met the quality standards of the applicable code and specifications. However, a problem was identified by the NRC CAT inspectors where shop welds did not meet the specified acceptance criteria.

8. Grinnell Fire Protection (Grinnell)

a. Inspection Scope

Approximately 80 welds (30 piping and 50 structural support) were inspected for compliance with the applicable code and specifications. In addition, six welder qualification test records and seven welding procedures were reviewed for adequacy.

b. Inspection Findings and Conclusions

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

9. General Electric (GE)

a. Inspection Scope

Approximately 30 welds were visually inspected for compliance with the specified acceptance criteria. Twenty-nine welder qualification test records and twelve welding procedures were reviewed for compliance with the applicable code and specifications. In addition, the NRC CAT inspectors reviewed the radiographs for 13 welds which involved 69 film.

b. Inspection Findings

No problems were identified in the area of visual inspection, welder qualifications and welding procedure reviews. However, during the review of GE radiographs, the inspectors found that three reader sheets did not have the accept/reject disposition checked. The welds are identified as 1-SSF-11-8260-11, 1-MSV-2-8260-FW2, and 1-SSF-5-8260-5. In addition, weld 1-CA-3A-8260-FW2 was found to have incomplete radiographic coverage, and this was documented by YAEC DR-662.

c. Conclusions

No problems were identified in the area of inspected welding and NDE activities. With the exception of the minor findings regarding the three reader sheets and one weld with incomplete radiographic coverage, welds met the applicable codes and specifications.

10. Nooter Corporation

a. Inspection Scope

Approximately 200 feet of welded seam on the spent fuel liner and refueling pool cavity was visually inspected for compliance with the specified acceptance criteria. Five welding procedures and the qualification test records for ten welders were reviewed. In addition, six liquid penetrant and four vacuum test records were also reviewed for adequacy.

b. Inspection Findings and Conclusions

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

11. Nuclear Installation Services Company (NISCO)

a. Inspection Scope

The NRC CAT inspectors reviewed the qualification test records for seven welders and six welding procedures in order to ascertain compliance with the ASME Code and SAR committments. In addition, the documentation packages related to the control rod drive mechanism weld end area and the installed thermal sleeve of the reactor pressure vessel head adapter were reviewed for adequacy.

b. Inspection Findings and Conclusions

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

12. Vendors and Shop Fabricators Other than Those Previously Addressed

a. Inspection Scope

In addition to the welds previously discussed, the NRC CAT inspectors reviewed radiographs related to work performed by 12 vendors which have supplied various equipment and hardware to the Seabrook project. A total of 1,447 radiographs were reviewed which involved 16 welds, 20 valve bodies, 12 castings and 350 feet of welded seam (See Table V-4 for detailed listing of vendors reviewed).

b. Inspection Findings and Conclusions

No problems were identified in the area of inspected welding and NDE activities. The reviewed vendor radiographs meet the quality standards of the applicable codes and specifications.

TABLE V-1

P-H SUPPORTS WHICH WERE SUBJECTED TO DETAILED WELD INSPECTION

165-RG-01	4609-SG-10
165-RG-06	4609-SG-11
183-RG-07	4614-SG-07
203-SG-02	4614-SG-11
203-SG-05	4617-SG-09
204-SG-01	4617-SG-10
218-SG-01	367-RG-01
221-SG-04	372-SG-19
822-SG-12	828-SG-04
4614-SG-11	828-SH-04
4617-SG-10	829-RG-05
4614-SG-07	1701-SG-05
4617-SG-09	1702-RG-02
4606-SU-12	1702-SG-03
4609-SG-11	360-SG-03
4609-SG-10	351-SG-04
4606-SG-10	97-SG-17
712-RG-12	351-SG-02
703-RG-03	777-SG-11
797-SG-02	472-SG-02
838-SG-08	470-SG-02
15-SG-04	788-RG-06
15-RG-08	4606-RG-06
703-RG-03	703-RG-03
712-RG-12	155-SG-15
797-SG-02	4606-SG-10
838-SG-08	4606-SU-12
840-RG-01	

TABLE V-2

P-H PIPE SYSTEMS WHICH WERE SUBJECTED TO VISUAL WELD INSPECTION

Identification	Pipe Size (inches)
SI-203-03	10
MS-4003-02	30
MS-4000-07	30
MS-4003-01	30
MSD-4508-01	1
MS-4000-23	6
MS-4000-13	30
RH-155-12	3/4
NG-1656-01	1
FW-4614-02	4
FW-4614-03	4
FW-4614-04	4

TABLE V-2 (Continued)

P-H PIPE SYSTEMS WHICH WERE SUBJECTED TO VISUAL WELD INSPECTION

Identification	Pipe Size (inches)
CC-410701	6
RH-158-07	6
RH-158-08	6
RH-162-02	6
1-COP-9311-06	3/4
1-MS-4000-09-906	6
1-FW-4614-01-1506	4
1-FW-4632-01-D2	4
1-FW-4631-01-D2	4
1-MS-4000-32-906	30
1-MS-4003-02-907	30
1-MSD-4508-02-2503	1
1-FW-4627-01-D2	3
1-NG-1656-2-906	1
1-RH-155-14-2501	3/4
DG-4403-01	10
CC-751-06	3/4
CC-751-01	3/4
CS-368-03	3
CS-360-13	2
CC-739-01	1/2
RMW-1114-01	2
CC-752-02	24"
CC-410713	3
1RH-180-61	8
RC-58-06	12
RC-45-02	2
CBS-1204-01	6
CBS-1210-01	12
CC-828-01	18
CC-829-01	16
CC-835-01	16
CS-357-01-01	4
RC-44-04	3
SI-251-01	4
SI-255-01	3
SF-1701-03	8
RH-164-02	3
RH-190-01	3/4
FW-4606-02	16
RC-11-01	31
SI-201-03	10
SI-201-02	10

TABLE V-3

SAFETY-RELATED TANKS WHICH WERE SUBJECTED TO VISUAL WELD INSPECTION

Identification	Component Description
1-CC-TK-19.A	Component Cooling Tanks
1-CC-TK-19.B	
NAH-CS-ATVC-01	Charging Volume Control Tank
(1)1-CBS-TK-8	Refueling Water Storage Tank
1-CBS-TK-13	Spray Additive Tank
(1)1-CS-TK-4A	Boric Acid Tanks
1-CS-TK-4B	
MAH-SIA-TV-01	Boron Injection Tank
1-DG-TK-78A	Fuel Day Tanks
1-DG-TK-26A	Main Fuel Tanks
1-DG-TK-26B	
2-DG-TK-46A	Expansion Tanks (Water Cooling)
2-DG-TK-46B	
(1)1-TK-1-CO-25	Condensate Storage Tank

NOTE (1): The radiographs for these tanks were also reviewed.

TABLE V-4

VENDOR RADIOGRAPHS REVIEWED

Contractors	Number of Castings	Number of Valves	Number of Welds	Feet of Weld	Number of Film	Comments
Westinghouse	5		2	200	545	Acceptable
Borg Warner		6			56	"
Walworth		12			207	"
Lunkenheimer		1			90	"
Bingham Willamette	6				154	"
Pacific Pumps	1				24	"
Posi Seal International		1			25	"
Southwest Fabricating			1		8	"
Ceramic Cooling Tower				10	18	"
Process Engineering			7		58	"
Struthers Wells Corp.				140	130	"
P-X Engineering			6		132	"

VI. MATERIAL TRACEABILITY AND CONTROLS

A. Objective

The objective of this portion of the inspection was to examine material traceability and controls to determine the adequacy of the applicant's program relative to these activities.

B. Discussion

The approach used to perform this part of the inspection was to identify and select samples of installed material and equipment for examination. Some samples of delivered (but not installed) material and equipment were also included that were observed in warehouses, lay-down areas or shops. A total of 330 inspection samples were reviewed for compliance with applicable codes or specifications.

Applicable organizations, facilities and procedures for the various activities were reviewed. Table VI-1, "Summary of Samples" indicates the contractors of the Seabrook Station and the types of samples examined. Table VI-2, "Sample Breakdown by Contractors" indicates the number and type of samples applicable to each selected contractor.

1. Material Traceability

a. Inspection Scope

A total of 330 samples were examined for traceability to drawings, specifications, procurement records, Certified Material Test Reports (CMTRs), Certificates of Compliance (C of Cs), heat numbers or other required documentation as applicable to the samples selected.

b. Inspection Findings

In general, it was noted that the applicant and contractors performing work had appropriate procedures in place for material traceability and for control of material at the site. Procedures reviewed were adequate for procurement, receipt, storage and issue of material and equipment.

Material and equipment listed in Table VI-2 were examined for material traceability and control. Some deficiencies were found regarding the traceability and control of fastener materials and the control of weld filler materials.

Deficiencies involving material traceability and control of fastener materials and the control of weld filler materials were noted by the NRC CAT inspectors as follows:

(1) Deficiencies in fasteners were noted for such fastener items as anchor bolts/nuts and equipment mounting bolts, studs and nuts. These deficiencies included the lack of the required markings on some installed and uninstalled fasteners, the

lack of the required documentation, or documentation which did not match the required markings on the materials.

Of 53 samples of equipment fastener installations inspected, 15 were found to have discrepancies. The following is a list of the fastener installations found to have discrepancies to the Seabrook Station material control program requirements:

- The Safety Injection Accumulator Tanks #1, #2, #3 & #4 (four samples) did not have the required traceability data for anchor bolt installations. One anchor bolt on Tank #1 was identifiable via a traceable heat number. Other anchor bolts either had non-traceable heat numbers or were not marked.

- The Reactor Coolant Pump 1B (one sample) did not have the required traceability data for anchor bolts. Each anchor bolt inspected had portions of the correct heat number stamped on the bolt end; however, the required grade markings were not present.

- The 1¼" Anchor Bolt Assemblies (one sample) were not stamped with the required permanent markings; however, traceability data was available through attached tags.

- The Diesel Generator 1-SKD-7B (one sample) did not have the required traceability data for the installed anchor bolts/nuts. The nuts had no visible markings while the anchor bolts had portions of the correct heat number stamped on the bolt end. The required grade markings for the bolts were not present.

- The Pressurizer (one sample) did not have the required traceability data for the installed anchor bolts. The required grade markings were not present. There appeared to be heat numbers stamped on the stud end; however, these markings were different from one another and inconsistent with other anchor bolt installations.

- The fasteners for the battery racks in Battery Rooms A, B, C and D, for both Trains A and B (four samples) could not be confirmed since the material specified and installed is indeterminate. Three different grades of bolts were used to assemble these racks.

- The material control for the packing gland fasteners for Valve 1-CC-V0114 (one sample) was not maintained. One fastener was missing, the other had no visible markings.

- Material controls for the 6" Bolted Flange adjacent to Valves 1-RH-V134 and 1-RH-V133 (one sample) were not adequate since nuts of different grades were installed.

° Material controls regarding the cabinet to cabinet connection fasteners for the Motor Control Centers (one sample) were not adequate since the material specified and installed was indeterminate.

(2) It was also noted that large anchor bolts/nuts for pumps, motors, supports and tanks, which were required to be high strength steel, were found to be not marked or improperly marked, thus making it difficult to determine whether the anchor bolts/nuts were the correct material. Anchor bolts inspected could be identified, or at least partially identified, as the correct material by comparing thread specifications in the event that no markings existed or by comparing thread specifications and heat numbers. The high strength steel specification requires type "UN" threads, whereas the mild steel specification requires type "UNC."

Prior to June, 1982, site specifications and procedures required only that the Quality Control (QC) inspector verify that the anchor bolt threads were protected and that the anchor bolt assemblies were properly located prior to concrete placement. No requirements for checking material grade or traceability markings existed. The current preplacement inspection procedure provides for verification of anchor bolt traceability (size, grade, type and traceability markings). A limited inspection of recently installed high strength anchor bolts in Seabrook Unit 2 indicates that the bolts have been properly marked.

(3) The NRC CAT inspectors found several examples of a problem with weld rod control. At least three sitings of uncontrolled weld rod (bent used stubs, bent unused rod or unbent unused weld rod) were noticed by the NRC CAT inspectors in the reactor containment building. This appears to be a continuing problem at the Seabrook Station (See Section VII for further discussion of weld rod control).

c. Conclusions

Review of the material traceability and material control programs revealed some traceability program deficiencies and material control deficiencies involving fastener materials, including large anchor bolts/nuts. Several examples were identified in the plant regarding uncontrolled weld filler materials.

2. Storage

a. Inspection Scope

While accomplishing inspections of various components/systems, limited inspections of enclosed storage areas and lay-down areas were also accomplished.

b. Inspection Findings

Warehouses and outside storage facilities were generally found to meet requirements.

c. Conclusions

Storage areas were generally acceptable and in order.

3. Maintenance

a. Inspection Scope

The site organization and procedures for preventive maintenance of equipment were reviewed. A total of 13 inspection samples involving various equipment were reviewed for adequacy.

b. Inspection Findings

Procedures for preventive maintenance were found to be satisfactory.

The results of the inspection of 13 samples of equipment requiring maintenance revealed that in general, maintenance requirements had been satisfied.

c. Conclusions

The preventive maintenance program was found to be satisfactory.

TABLE VI-1

SUMMARY OF SAMPLES

Contractors	Activities & Samples	No. of Samples
Pullman-Higgins (P-H)	Mechanical Construction	174
Fischbach-Boulos-Manzi (FBM)	Electrical Construction	28
Johnson Controls, Inc. (JCI)	Instrumentation Construction	33
Perini Power Constructors (PPC)	Civil/Structural Construction	32
Hirsch-Arkin-Herschman (HAH)	Heating, Ventilation and Air Conditioning (HVAC)	34
Pittsburg-Des Moines Steel (PDM)	Containment Liner	3
Dravo (DRA)	Piping (Shop)	17
Westinghouse (W)	NSSS Equipment	3
Northeast Surfco Leonard (NSL)	Coatings	6
	TOTAL	330

TABLE VI-2

SAMPLE BREAKDOWN OF BY CONTRACTORS*

	PDM	HAH	DRA	PPC	P-H	W	FBM	JCI	NSL	TOTAL
Equipment	1	2	-	-	18	3	11	8	-	43
Piping	-	-	8	-	8	-	-	-	-	16(L)
Tubing	-	-	-	-	-	-	-	6	-	6(L)
Structural Steel	-	-	-	5	1	-	-	-	-	6(L)
Rebar	-	-	-	3	-	-	-	-	-	3(L)
Hangers/ Supports	-	6	-	-	16	-	1	-	-	23
Embedments	-	-	-	-	1	-	-	-	-	1
Coatings	-	-	-	-	-	-	-	-	6	6(L)
Filler Material	-	-	-	-	58	-	-	-	-	58(L)
Weld Joints	2	24	9	-	48	-	4	17	-	104
Unistruts	-	-	-	-	-	-	3	-	-	3
Elec. Cables (Reels)	-	-	-	-	-	-	3	-	-	3(L)
Fasteners	-	2	-	21	22	-	6	2	-	53(L)
Shims	-	-	-	-	2	-	-	-	-	2(L)
Cadweld Sleeves	-	-	-	3	-	-	-	-	-	3(L)
TOTAL	3	34	17	32	174	3	28	33	6	330

* See Table VI-1 for abbreviations used in this Table.
** (L) - Lots

VII. DESIGN CHANGE CONTROLS AND CORRECTIVE ACTION SYSTEMS

A. Objective

The objective of this portion of the NRC CAT inspection was to examine the Seabrook Station site design change control system to determine whether conditions requiring changes in design resulted in design changes that were adequately described, resolved, approved and implemented in the installation of hardware. Corrective action systems and related activities were examined to determine whether nonconformances and other conditions adverse to quality were promptly identified and corrected.

B. Discussion

1. Design Change Controls

a. Inspection Scope

Details of the design change control program in the areas of pipe and pipe support installation were examined. These details included the types of problems requiring design changes and the proposed solutions to these design changes. This examination also included the review of the design changes prior to issuance for actual work and the review of their subsequent engineering concurrence. The incorporation of the design change into the appropriate revision of the applicable drawing and the programs in force to track the status of the design change process were also reviewed.

Three-hundred sixty-five Engineering Change Authorizations (ECAs)/ Requests for Information (RFIs) were reviewed in the areas of pipe and pipe support installations. Thirty-four related field drawings were also examined in this portion of the inspection.

In addition, the design change program and related procedures pertaining to electrical and instrumentation construction were reviewed. This review included an additional 100 ECAs that were reviewed for completeness, appropriate approvals, and the adequacy of the technical justifications for the proposed changes. Ten piping and instrumentation diagrams were also examined. Samples of design change documents from other disciplines such as mechanical, civil, Quality Assurance and those coded for specific site groups were also reviewed.

The following United Engineers and Constructors (UE&C) procedures and specifications were reviewed in whole or in part as applicable to the design change control process.

Administrative Procedure (AP) -4, "Control of UE&C Issued Drawings", Rev. 10.

AP-15, "Changes to Project Documents, Engineering Change Authorization (ECA) and Request for Information (RFI)", Rev. 20.

AP-39, "Administrative Procedure, As Built Documents", Rev. 4.

Technical Procedure (TP) -8, "Technical Procedure for Separation Criteria", Rev. 6

TP-23, "Supplemental Information for Design Change and Nonconformance Disposition Programs", Rev. 2.

Field Administrative Construction Procedure (FACP) -1, "Project Instruction for Handling UE&C/Contractor Nonconformance and/or Deficiency Reports", Rev. 4.

FACP-7, "Preparation and Control of Field Drawings, Piping Erection Isometrics", Rev. 3.

FACP-8, "Preparation and Control of Field Drawings, Pipe Support Installation Drawings", Rev. 3.

FACP-13, "Site Engineering Procedure for As Built Piping System and Pipe Support Installation by Pullman Higgins", Rev. 2.

Field Administrative General Procedure (FAGP) -2, "Drawing, Specification and Document Control", Rev. 9

Quality Assurance Procedure (QA) -3, "Quality Assurance Procedure for Design Control", Rev. 11.

UE&C Specification 9763-006-248-1, "Shop Fabricated Piping".

UE&C Specification 9763-006-248-43, "Design Specification for Nuclear Power Plant Piping Systems for Seabrook", Rev. 10.

UE&C Specification 9763-006-248-51, "Field Assembly/Installation - Piping and Mechanical Equipment".

UE&C Specification 9763-006-249-3, "HVAC Duct and Equipment Insulation", Rev. 8.

Letter of 3/2/84, Seabrook Station, "DSCC/SCL Implementation".

The NRC CAT inspector reviewed the following program elements in the applicant's design change control program:

(1) Quality Assurance Audits

The UE&C QAP QA-3 provides for periodic audits, review and evaluation of the design control program, including design changes.

The NRC CAT inspector reviewed schedules for both UE&C and Yankee Atomic Electric Company (YAEC) audits of design control and design change control. The UE&C schedule provides for once per quarter Quality Assurance (QA) surveillance of design change areas. The areas of the project change system and the revision of the affected documents are scheduled for surveillance on a monthly basis. The UE&C QA Surveillance Report 253 was examined as a sample of QA audit coverage of the site design change activities.

The YAEC audit schedule for design and design change areas was reviewed. QA Reports SA805UE026 covering the UE&C home office engineering and SA794CS328 covering the site construction design group were reviewed with the YAEC responsible QA engineer.

(2) Processing of Engineering Change Authorizations

The purpose of the ECA is to provide a record of design document changes. The ECA provides for the statement of the situation requiring a change, the affected drawings and the record of work completion to the ECA requirement. The ECA format provides for a separate category, the RFI. The RFI is a formal method of asking engineering questions such that the question and answer are documented. When an RFI answer requires a design document change, the RFI by definition becomes an ECA.

As of this inspection the numbers and status of ECAs/RFIs, is as follows:

- 30,000 - Processed to the point of determining the scope of work
- 14,000 - Eligible for closeout
- 9,000 - Closed out by reply from the contractor
- 11,000 - Applicable to pipe supports only

ECAs are grouped as either major generic, major specific or minor. The minor ECAs are defined in TP-23, a companion document to AP-15, as those ECA situations which are minor and have been reviewed by the UE&C home office engineering.

Numerous changes have been made to the ECA program. For example, the ECA/RFI administrative procedure, AP-15, was recently revised on 3/2/84 to Rev. 20. The direction of change has been toward central site control of the ECA function by UE&C with establishment of the Site Change Coordinator (SCC) and the Project Change Notice (PCN-II) system, the system for statusing design changes on project documents. Processing of both ECAs and RFIs were reviewed by the NRC CAT inspectors.

(3) Tracking of Engineering Change Authorizations

The NRC CAT inspector examined ECA tracking systems in both the site piping and pipe support design engineering groups. These two groups are responsible for having ECAs applicable to piping or pipe supports incorporated on drawings. Both groups use the PCN II system for tracking ECAs but have separate and independent methods of ECA tracking within their departments.

The PCN II system was established in August 1983 and requires more input and corrections prior to being sufficient as the sole source of ECA data and status. From observations of the independent ECA tracking programs and a sampling of the files of the piping and pipe support design groups, the NRC CAT inspector concluded that sufficient control exists over ECA processing to provide for incorporation of ECA data onto the appropriate affected drawings. Both groups showed evidence of feedback to the PCN II system of data to upgrade the PCN II accuracy and completeness.

(5) ECA and/or RFI Sample Review

Refer to Table VII-1 for a sample of typical ECA and/or RFI problems and solutions from typical documents.

b. Inspection Findings

From the review of the applicant's audit program, the NRC CAT inspector concluded that QA activities were providing a measure of control over the design and design change activities. In general, the ECAs and RFIs were processed and statused in accordance with the Seabrook Station site specification and procedural requirements, even though the PCN II system is not yet sufficient as the sole source of ECA/RFI status. However, from the sample of ECAs reviewed, several problems with specific ECAs were identified as discussed below:

(1) ECA 19/0781 B was rejected by UE&C home office engineering on 9/21/83. No ECA revision C was issued although the PCN II indicated closeout of 19/0781 B. This is not consistent with the AP-15 requirement that an ECA rejected on design concurrence be followed by a subsquent revision. The NRC CAT inspector then requested a listing of design concurrence rejected ECAs to establish the extent of ECA rejections where a subsequent ECA revision was not issued. Although the complete rejected ECA listing was not available during the inspection, the NRC CAT inspector did review those rejected ECAs from 8/19/83 to 12/29/83 on file with the SCC. In the pipe support ECA category, nine of the rejected ECAs had subsquent ECA revisions issued. The engineering followup of rejected ECAs to consolidate work completed to an acceptable

design condition and to determine the status of rejected ECAs needs further attention to assure adequate control.

(2) The solution to field installation problems on 1-RC-80-5-B13 included a pipe length of 9 1/8" between field welds F0306 and F0307. This design change was shown on ECA 19/3181C. It was incorporated onto drawing 1-RC-80-05 on 4/1/84; however the actual pipe length measured in the field was 4". The piping contractor issued a Field Trouble Report (FTR) on 5/24/84 describing this condition and the cause.

(3) One major Generic ECA, 05/2454A provides for revision of the applicable code for instrument piping from safety class equipment to non-nuclear safety instrumentation (from ASME Code Section III to ANSI B31.1), thus implementing NRC Regulatory Guide 1.151, "Instrument Sensing Lines". This change requires a Final Safety Analysis Report (FSAR) change which is in the progress of preparation even though the ECA has been issued. However, as of 5/3/84, no equipment had been installed to the conditions reflected by the design change.

(4) RFI 73/5633A questions if additional work is required due to 1/32" maximum width cracks in the cement lining of certain service water pipe sections. The RFI solution states that cement lining damage shall be evaluated to site Specifications 248-2 and 248-51. The NRC CAT inspector further investigated this question and determined the topic to be covered in a technical report forwarded to the YAEC Project Manager on 3/14/84 by UE&C. This report indicated that extensive evaluation of the significance of minor cement lining cracks had been completed. Several nonconformance reports (NCRs) were then reviewed for cases where cement lining defects exceeded the permissible limits and were dispositioned for correction.

c. <u>Conclusions</u>

The NRC CAT inspector concluded that design changes are made, approved and documented under a program that provides for design change control and provides for approval similar to that required for the original design. Quality assurance auditing by both UE&C and YAEC of the design change control function were noted to cover essential aspects of the program as evidenced by UE&C QA surveillance reports and YAEC QA audit reports.

Individual ECAs and RFIs tracked by the PCN II system, as well as supplemental tracking systems and hard copy files, were noted to be present in both the piping and pipe support engineering groups. These supplemental tracking systems and files provide for ECA flow and control during ECA review, incorporation on drawings and closeout by work completion.
Those problems identified by the NRC CAT inspector during review of the ECA/RFI program were verified by the NRC CAT inspector as not being indications of a general program problem. In summary, the

observations of the NRC CAT inspector support the conclusion that the implementation of the design change control program satisfies the applicant's commitments and site procedural requirements.

2. Corrective Action Systems

a. Inspection Scope

The corrective action programs of the following 11 organizations were examined:

° Yankee Atomic Electric Company	(YAEC)
° United Engineers & Constructors	(UE&C)
° Pullman - Higgins	(P-H)
° Fischbach-Boulos-Manzi	(FBM)
° Johnson Controls, Inc.	(JCI)
° Perini Power Constructors	(PPC)
° Hirsch-Arkin-Hershman	(HAH)
° Pittsburgh-Des Moines Steel	(PDM)
° Williams Crane & Rigging	-
° Ceramic Cooling Tower	-

Corrective action programs, including procedures, trending reports, audit reports and related documents were examined as appropriate for the contractors listed above.

The programs and procedures of the contractors were found to be generally acceptable. However, it was noted that each contractor utilized procedures, nomenclature and practices peculiar to each organization, and this resulted in different programs hindering communications among interfacing project participants.

Samples of corrective action documents, such as Surveillance Reports (SRs), Inspection Reports (IRs), Nonconformance Reports (NCRs), Deficiency Reports (DRs), Corrective Action Requests (CARs) and related documents were also reviewed. A total of 189 SRs, ten IRs, 207 NCRs, 32 DRs and 25 CARs were reviewed. Field inspections in the plant and in storage areas were conducted to verify information and closed NCRs requiring rework.

In addition, a special review of documentation associated with corrective action in the electrical and instrumentation areas was conducted for completeness, prompt and proper identification of problems, and control of related documents. NCRs, RFIs, IRs, SRs, Inspection Surveillance Reports (ISRs) and Contractor Incident Interface Reports (CIIRs) were used to identify, document, and in some cases, to provide disposition of the deficiencies involved. This review incorporated a sample of 240 NCRs, 40 IRs and 50 CIIRs in the electrical area, and 25 NCRs and ten ISRs relative to instrumentation.

b. Inspection Findings

The following deficiencies were identified regarding the applicant's corrective action programs:

(1) The NRC CAT inspectors discovered a failure to identify deficiencies and take timely and adequate corrective action to provide for control of cable identification and markings as required by the Final Safety Analysis Report (FSAR) and cable specifications during this review. This included a failure to identify improperly marked installed cables and to determine the required actions, including the impact on the project Information Management System (IMS). The problems involve duplicate cable prefix and foot markings on reels of cable of the same code, which is specifically contrary to the FSAR and site specification requirements for the cable.

Of 213 reels of cable in storage examined by a Quality Control inspector, 24 revealed duplications with one to four other reels. Approximately 1500 reels of cable are estimated to be presently installed. Based on the ratio of 24 of 213 reels in storage having this problem, approximately 170 reels are estimated to already be installed with duplicate markings, and these have not yet been identified.

A review of FBM NCRs revealed that cable marking problems were reported in 1981, 1982, 1983 and 1984. Corrective action by UE&C to one cable supplier was noted in February, 1984, but did not address the problem of corrective action regarding the cable already installed.

It was noted that, during the week of May 21, 1984, Yankee initiated an overall review of this problem which, the NRC CAT inspector was advised, may result in a management action request (MAR) or other action to require UE&C to respond with recommended corrective action for the applicant's review to cover activities of UE&C, cable vendors and FBM, as well as action to be taken regarding already installed cable and the IMS.

The NRC CAT inspectors determined that the cable markings and identification deficiencies do not indicate that the cables do not otherwise meet specification requirements.

(2) The NRC CAT inspectors found that repeated in-process weld material control deficiencies were identified. A review of YAEC Surveillance Reports (SRs) relative to P-H activities revealed that 85 weld material control deficiencies had been recorded since January 7, 1982, including 45 such deficiencies reported from January 1983 through March 1984.

Most of these deficiencies involved failure of welders to return unused weld rod and/or stubs as required, and such material was left in the plant work areas. The NRC CAT inspectors also found similar deficiencies as described in Section VI of this report.

The large number of repeated deficiencies requires more positive corrective action. It is noted that this matter has been identified by NRC Region I (unresolved item 83-22-01) and is still under review.

(3) The NRC inspectors noted untimely corrective actions and repetitive nonconformances in several areas. These problems involved the failure to detect deficiencies at check points prior to final inspection, inadequate steps to prevent recurrence of nonconformances, and numerous open nonconformances.

Prior NRC inspections by NRC Region I (Reference NRC Inspection Reports 83-09, 83-12 and SALP report December 1983) noted such deficiencies. The NRC CAT noted similar project-wide examples. This matter requires continuous attention by the applicant and contractors to reduce untimely corrective actions and repetitive nonconformances.

c. Conclusions

The applicant's corrective action program is generally acceptable. However, from the above noted inspection findings, it is evident that the program has been deficient with regard to corrective action in several areas. They are as follows:

(1) Failure to identify nonconformances and take corrective action to provide for control of cable identification and markings in accordance with FSAR commitments and specification requirements.

(2) Failure to provide adequate corrective action to avoid continued repeated in-process weld material control deficiencies.

(3) Several repetitive nonconformances were identified where adequate corrective actions were not taken to preclude recurrence of the nonconforming conditions.

TABLE VII-1

TYPICAL ECA AND/OR RFI PROBLEMS AND SOLUTIONS

Problem	Solution
Butterfly Valve Backwards	Flow arrow - preferred but not the required direction
High Point Vents	Where possible code problem - RFI/ECA used for resolution
Interference in pipe installation	Reroute pipe/remove interference
Hilti Questions (Imbed Bolts)	RFI to answer
ISO - Incorrect Dimensions	Solution provided (ISO Revision)
Previous ECA Revision Problem	Correction issued as ECA Revision
Bolt Torque Inadequate (leaks)	Increase torque by specific amount
Clearance Problem Identification	TP-8 evaluation/result stated
RWST - Teflon Tape	Revise to standard (bolt) lubrication - no RCS tape
Instrument Tube/Piping ASME to ANSI Change	Clarification per RG 1.151
Define Support of Tubing and Capillary Lines Off Equipment	Show Design Revision
RC leg movements due to temperature change	Values provided
Radiation monitor location question	Location OK - Access via crane
Electrical grounding question	Solution provided
Pipe supports - AWS to ANSI Welding	Revise Spec 248-51-(B31.1)

TABLE VII-1 (Continued)

TYPICAL ECA AND/OR RFI PROBLEMS AND SOLUTIONS

Problem	Solution
Code date plate removal and relocation	OK per ECA, details provided
Support weld discrepancies	Fix or accept as is as stated
SS Mesh (for insulation)	ASTM Spec. requirements defined
Not clear drawing	Revise drawing to clarify
Hold on drawing	Hold removed (reason provided)
ECA not correct in disposition	Replace spool pipe section
Valve not at elevation (weld shrink)	Cut & weld new field weld
Cement lining cracks	Define lining damage evaluation criteria (justification via report)
Is GTAW required over GTAW root welding	Weld question - continue with GTAW on GTAW roots per procedure

A. PERSONS CONTACTED

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

1. Exit Meeting

Applicant

F. Bean
B. Beckley
P. Bohane
D. Coville
J. DeVincento
J. Gramsammer
R. Guillette
D. Hoisington
W. Johnson
E. Kann
D. Lambert
G. McDonald
D. Moody
D. Nordquist
P. Oikle
A. Shepard
J. Singleton
C. Wiley
H. Wingate

NRC and Consultants

A. Beach
A. Cerne
T. Chan
R. Compton
D. Ford
R. Gallo
G. Georgiev
J. Grace
E. Gray
R. Heishman
H. Jimenez
H. Kister
R. Lloyd
O. Mallon
E. Martindale
G. Myers
V. Nerses
E. Nightingale
H. Phillips
R. Rohrbacher
R. Serb
R. Starostecki
J. Taylor
H. Wescott
H. Wong

2. Applicant's Coordinators

a. Overall NRC CAT Coordinator

G. McDonald

b. Electrical and Instrumentation

F. Bean

c. Mechanical

J. Azzopardi
B. Mizzau
K. Stidham

d. Welding and NDE

R. Boyle
R. Julian
P. Oikle

e. Civil and Structural

C. Moynihan
A. Spooner

f. Material Traceability

W. Temple

g. Design Change Controls and Corrective Action Systems

W. Temple
H. Wingate

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

B. DOCUMENTS REVIEWED

The types of documents listed below were reviewed by the inspection team 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 inspection procedures
5. Administrative procedures
6. General electrical construction installation procedures
7. General electrical installation specifications
8. General instrumentation construction installation procedures
9. General instrumentation installation specifications
10. General piping installation procedures
11. General piping specifications
12. General mechanical installation specifications
13. General concrete specifications
14. As-built drawings
15. NDE procedures
16. Personnel qualification records
17. Material traceability and control procedures
18. Procedures for processing design changes
19. Procedures for processing field change requests
20. Procedures for controlling as-built drawings
21. Procedures for processing nonconformances

ATTACHMENT B

GLOSSARY OF ABBREVIATIONS

AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
AWG	American Wire Gage
BSC	Bethlehem Steel Corporation
CAR	Corrective Action Request
CAT	Construction Appraisal Team
CBA	Control Building Air (Handling)
CBS	Containment Building Spray
C of C	Certificate of Conformance
CC	Component Cooling System
CFR	Construction Followup Report
CMTR	Certified Material Test Report
DC	Direct Current
DG	Diesel Generator
DGB	Diesel Generator Building
DR	Deficiency Report
DAH	Diesel (Generator Building) Air Handling
DW	Demineralized Water
ECA	Engineering Change Authorization
FACP	Field Administrative Construction Procedure
FBM	Fischbach-Boulos-Manzi
FI	Field Instruction
FP	Foreign Print
FSAR	Final Safety Analysis Report
GE	General Electric Compqany
Grinnell	Grinnell Fire Protection
HAH	Hirsch-Arkin-Hershman
HVAC	Heating, Ventilating & Air Conditioning
IMS	Information Management System
IR	Inspection Report
ISR	Inspection Surveillance Report
I&C	Instrumentation and Controls
JCI	Johnson Controls, Inc.
KV	Kilovolt
MAR	Management Action Report
NCR	Nonconformance Report
NDE	Nondestructive Examination
NG	Nitrogen Gas
NISCO	Nuclear Installation Services Company
NRC	Nuclear Regulatory Commission (U.S.)
NSL	Northeast Surfco Leonard
PAB	Primary Auxiliary Building
PCCW	Primary Component Cooling Water
PCN	Project Change Notice
PCN II	Project Change Notice System II

PDM	Pittsburgh-Des Moines Steel
P-H	Pullman-Higgins
P&ID	Piping and Instrumentation Drawing
PPC	Perini Power Constructors
PSNH	Public Service Company of New Hampshire
QA	Quality Assurance
QAP	Quality Assurance Procedure
QC	Quality Control
RC	Reactor Coolant
RFI	Request for Information
RH	Residual Heat Removal System
RMW	Reactor Makeup Water System
SAR	Safety Analysis Report
SCC	Site Change Coordinator
SF	Spent Fuel Pool Cooling
SI	Safety Injection
SR	Surveillance Report
SRO	Support Rework Order
SW	Service Water System
TP	Technical Procedure
UE&C	United Engineers & Constructors
V	Volt
YAEC	Yankee Atomic Electric Company

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