U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

DIVISION OF REACTOR PROGRAMS
REACTOR CONSTRUCTION PROGRAMS BRANCH

Report No. 50-438/82-32, 50-439/82-32

Docket Nos. 50-438, 50-439

Licensee: Tennessee Valley Authority
500 A Chestnut Street, Tower II
Chattanooga, Tennessee 37401

Facility Name: Bellefonte Nuclear Plant

Inspection At: Bellefonte Nuclear Plant, Scottsboro, Alabama and Tennessee Valley Authority, Knoxville, Tennessee

Inspection Conducted: September 20 - October 1, 1982 and October 12 - October 22, 1982

Inspectors:

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## TABLE OF CONTENTS

## I. INSPECTION SCOPE AND OBJECTIVES

The objective of this inspection was to evaluate the adequacy of construction, the quality assurance program, material traceability, and procurement at the Bellefonte Station. Within the areas examined, the inspection consisted of detailed examination of selected hardware subsequent to final TVA Quality Control inspections, a selective examination of procedures and representative records, observation of in-process work, and interviews with management, inspectors, and craft personnel. For each of the areas inspected, the following was determined:

a. Is the hardware/product fabricated/installed as designed?

b. Do individuals who have been assigned responsibilities in a specific area understand their responsibilities?

c. Are quality verifications performed during the process with applicable hold points and are quality verifications conducted to adequate inspection/acceptance criteria at final Quality Control inspections?

d. Do personnel involved with Quality Assurance/Quality Control have the organizational freedom to perform their tasks without harassment or intimidation?

e. Are management controls established and implemented to control activities in the subject area?

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

1. Quality Assurance
2. Project Management
3. Design Control Changes and Corrective Action Systems
4. Electrical and Instrumentation Construction
5. Welding - NDE
6. Mechanical Construction
7. Civil and Structural Construction
8. QC Inspector Effectiveness
9. Material Traceability
10. Procurement, Receipt and Storage

## II. QUALITY ASSURANCE

### A. Objective

The objective of this review was to determine the adequacy of the licensee's QA organization and to assess whether the quality assurance program has been established in the facility Quality Assurance manuals and is in conformance with the TVA QA Topical Report and/or 10 CFR 50, Appendix B. In addition, a review of the specific areas of licensee assessment of the QA Program, oversight of contractors, control of measuring and test equipment, drawing control, control of QA records, and audits was made to determine if there was proper implementation of the specific program.

### B. Discussion

#### 1. Quality Assurance Program

The site quality assurance program is implemented by a hierarchy of procedures that control the various safety related site activities. To determine the adequacy and completeness of the program, the following documents and procedures were reviewed:

a. QA Topical Report
b. Quality Assurance Procedures
c. Quality Control Procedures
d. Purchasing Procedures
e. Inspection and Test Procedures
f. Standard Operating Procedures
g. Field Construction Procedures
h. General Specifications

(1) QA Topical Report

A review of the Topical Report indicated that the site quality assurance program in place was essentially as indicated in the Topical Report and that the duties of the site management were in agreement with the Topical.

(2) Construction Procedures

Site quality activities are principally controlled by Quality Control Procedures (QCPs), Construction Test Procedures (CTPs), Field Construction Procedures (FCPs) and Standard Operating Procedures (SOPs). A review of a number of these documents in each area indicated the following problems:

(a) There is no procedure covering the generation of Field Construction Procedures.

(b) Field Construction Procedures are not reviewed by the Quality Assurance Unit.

(c) There are no cross references in the QCP to identify SOPs or FCPs that amplify the QCP.

(d) While QCPs and CTPs are controlled, both the SOPs and FCPs are uncontrolled.

(e) There is no provision for annual review of SOPs and FCPs as in the case with QCPs.

(f) Both the QCPs and CTPs have included a series of addenda as part of the procedures. The failure to periodically incorporate these addenda into the body of the procedures leads to a confusing and difficult effort to understand procedures. By letter of October 8, 1982 addressed to the Project Manager, the site Construction Engineer has developed a program to incorporate those portions of the SOPs and FCPs that control quality activities into the QCPs and CTPs. However there is at this time no target date for the completion of this task and the size of the task and the manpower available raises questions whether the task can be completed within an adequate period of time.

(3) Quality Assurance Manual

Five locations were selected to determine if controlled copies of Quality Control Procedures and Construction Test Procedures were of latest revision. The manuals were found to be of latest revision with the exception of Construction Test Procedure 6.1 Rev .1 of 6/8/82 which was missing from manual No. 26.

2. Licensees Quality Assurance Organization

The licensee's Quality Assurance Organization was reviewed along with the latest Bellefonte organization charts and position descriptions. The current organization and reporting chain was compared to the "O" chart in QC Procedure 10.32 Rev. 2 and was found not to be in agreement. The organization chart in QCP-10.32 did not include the position of the Quality Manager in the Construction Engineer's organization, nor did it indicate the current reporting chain for the Hanger Engineering Unit Supervisor. Further, it was determined that QCP-10.32 Rev. 2 does not include the position of the Quality Manager nor a description of his duties. Interviews were conducted with management in the QA and QC organization to evaluate their qualifications and experience in order to determine if they were capable of implementing their responsibilities. They were found to be qualified and experienced in order to carry out their assignments.

The Quality Assurance Unit Supervisor who has audit and other quality assurance responsibilities reports off-site to the Chief Construction Quality Assurance Staff (QAS). The chief (QAS) reports directly to the Director of Construction who has direct responsibility for the Bellefonte cost and schedule. The line organization does not provide for QA independence and is contrary to 10 CFR 50 Appendix B, Criterion I requiring such freedom. By letter of September 15, 1982 to the NRC, the TVA Manager of Nuclear Licensing has indicated to NRR that a new Office of QA has been established and that there will be changes in organization and transfer of QA activities. Until such time as these changes are implemented, the QA organization does not appear to have sufficient freedom and independence from cost and schedule. While the proposed reorganization of the QA Branch will correct the lack of independence of the QA group, there is concern for the lack of independence of the QC group in the Construction Engineer's Organization. The Construction Engineer has primary responsibility for quality control for all work performed on site by TVA work forces and contractors. However, his other activities include responsibility for activities of TVA engineers in their respective areas of responsibility, providing technical guidance to craft and service management, requisitioning permanent material and for partial scheduling of construction activities.

The concern that there is not sufficient organizational freedom of the Quality Control Organization from cost and schedule is further indicated by:

(a) The reporting chain that has the Construction Engineer reporting directly to the Project Manager.

(b) A review of management appraisal forms of one group of supervisory QC personnel in which the supervisor is graded on his ability to "make appropriate and effective decisions that do not adversely impact meeting the construction schedule."

(c) Sections V, VI, VII of this report which indicate a number of problems encountered on hardware after QC inspections.

The NRC CAT inspectors found that the onsite QA organization was essentially the same as that approved by the NRC.

A review of the Construction Engineer's organization indicates that there are adequate managers to accomplish objectives. A review of the quality assurance audit unit indicates that it is not up to complement and the lack of personnel is evident in the delay in accomplishing scheduled annual audits as well as the overtime worked in the unit.

3. <u>Licensee's Management Assessment of the Quality Assurance Program</u>

The TVA upper level management has a program in place to periodically assess the scope, implementation and effectiveness of the QA Program to ensure its compliance with Appendix B. The Office of Engineering Design and Construction at least annually conducts independent reviews of selected parts of the QA Program. Such an audit was conducted of the Bellefonte Plant's QA Program on May 17 - 20, 1982. The audit, No. M82-03, was conducted to determine the compliance with regulatory and OEDC QA program requirements in the areas of organization, QA Program and Audits. This audit identified two deficiences in this area. In addition to this review, audits were conducted in May 1981, audit No. M81-05. However, review of the audit areas for this time frame of 30 months indicates that for this period the areas of document control, control of purchased material, equipment and services, inspection; test control, control of measuring and test equipment, and inspection, test and operating status were not audited by an offsite audit team.

4. <u>Control of Measuring and Test Equipment</u>

   a. The instrument calibration laboratory was inspected to determine how records were maintained, how calibration was performed and how measuring and test equipment was controlled. A computerized system is utilized to track the calibration of the tools and instruments that are included under the programs. A computer printout form is issued monthly that indicates the identification number of each item, the organization to whom issued, the date of calibration and the calibration renewal date. Each item that falls under this program has secured to it a sticker that indicates its identification number, its calibration date, its calibration due date and the initials of the tester.

The following list of test equipment was inspected in the laboratory to determine if they had been calibrated and were found to be in compliance with test requirements:

| Test Equipment | I.D.NO. | Calibration Date | Due Date |
|---|---|---|---|
| Torque Wrench Tester 0-2000 Ft. lbs. | 406564 | 4-27-82 | 4-27-83 |
| Torque Wrench Tester 0-2000 Inch lbs. | 406563 | 8-31-82 | 8-31-83 |

| | | | |
|---|---|---|---|
| Dead Weight Pressure Gage Tester 0-10,000 PSI | 900044 | 4-28-82 | 10-28-82 |
| Ashcroft Vacuum Gage Tester | 400030 | 5-11-82 | 11-12-82 |

An electrical conductor hand crimping tool, ID No. 4-T269 was also tested for acceptability with three go-no-go gages, EEU-198, 199 & 200 and was found acceptable.

In the instrument test laboratory, there were a large number of pressure gages on shelves D and E that were damaged or out of calibration. These defective gages were neither segregated nor identified by tags to prevent their misuse.

An inspection was made of the Hanger Engineering Unit storage locker, and two damaged torque wrenches were located, Nos. HEU-153 and HEU-160, which were damaged and in need of repair and which were not segregated from workable tools. In this same storage locker was found a Wild Nak I Surveyor's transit that was out of calibration and was not suitably tagged to indicate this condition. The ID No. of this item was 360673, the calibration date was 11/18/81 and the calibration due date was 12/17/81.

5. Quality Assurance Records Control System

The Quality Control Records Supervisor was interviewed to determine the Supervisor's responsibility and knowledge of the records control system and was found fully cognizant of the procedures and controls for the records control system. The position description was reviewed and found to be current and was found to fully describe his responsibilities and authority.

The records index in the form of a computer printout was reviewed and found to contain information by index number, the record title, records retention time requirement and record location. Five specific records were arbitrarily selected from the index and the inspector requested that they be retrieved. All five records were located in their designated filing cabinets and were immediately retrieved. These records were:

| | | |
|---|---|---|
| 16.16.00.00 | Stop Work | Cabinet O |
| 16.11.00.00 | Allegation Report | Cabinet O |
| 16.17.00.00 | Employee Concerns/ Differing Opinions | Cabinet O |
| 17.01.79 | Material Identification and Marking | Cabinet WWW |
| .07.03.00 | Storage Maintenance Inspection | Cabinet A-1 |

The method for records receipt control was reviewed to determine that it provided for a records checklist indicating the required QA records, a record of all QA records received, a review of incoming records and a means of tracking records during the receiving process.

The storage vault area was inspected and found to be a controlled access area, provisions existed to detect and alarm fires and that there was provision for automatic fire extinguisher actuation using Halon 1301. The storage area was determined to be clean and orderly and the records stored in the vault cabinets were found to be organized, secured in binders or folders, the cabinets properly identified and the records readily retrievable. A records check out log is maintained that controls the removal and return of records from the vault area.

In the storage vault area, a daily record is maintained of the temperature and relative humidity. The log utilized to record the temperature and humidity indicated that on a number of occasions the entry was not made because an employee was sick. In addition, QCP 10.7 Rev. 5 Paragraph 6.5.5 requires that the relative humidity be maintained at 30% to 50% for the preservation of radiographs that are stored in the vault. The log indicated that there were numerous instances of the humidity exceeding this limit with no corrective action indicated as being implemented.

6. Drawing Control

TVA design drawings are received in the Quality Control and Records Unit (QCRU) print room where one regular size drawing is identified as the "Master" print and filed in the print room master files. Drawings are then distributed according to a predetermined list. The filing of new and revised drawings in designated construction files is done by members of the QCRU print room. After Field Change requests are approved by the appropriate Design Project Organization, the QCRU records group ensures a control number is assigned to all FCRs and secures a copy to the affected master drawing and then records the FCR reference number on the affected controlled craft drawings in the field.

A Drawing Information System is in existence that provides a computer printout that gives the drawing number, revision number, drawing title and issue date of each drawing.

The NRC CAT inspector in five separate field locations for different craft disciplines selected a total of 30 drawings and obtained from each, the number, title, revision numbers and FCR number (if any). This drawing information was compared to the master drawings to determine if the crafts had the latest revisions and FCRs.

The print room personnel retrieved the identified drawings and they were compared with the information from the craft location drawings. A series of discrepancies was determined:

a. Two of the drawings in the field were not of the latest revision, while others indicated deficiencies relating to FCRs:

(1) Drawing No. 3RE-1240-00-01 Rev. 6 (should be Rev. 7)

(2) Drawing No. HEU-ICF-MPHG-0042SH2 Rev.0 (should be Rev. 1)

(3) Drawing No. 88M1RF-MPGH-1202 Rev. 1, did not have a copy of FCR No. H-2630 stapled to the master drawing as required by QCP-10.2. A copy of the FCR was stapled to the drawing in the work area. The FCR was later found in the QCRU area and had been received on Sept. 20, 1982, eight days previously.

(4) Drawing Nos. 5 AW-0813-RV-2 Rev. 4, 3 BW0422-NK-01 Rev. 8, and 5 AW0911-10-13 Rev. 10 did not have current FCRs numbered E-2013, M-3611 and I-218 stapled to the master drawings in the file area as required by Quality Control Procedure-10.2 Revision 8 Article 6.3.7.

(5) Drawing No. 5 AW-8014-RV-9 Rev. 12 located in an electrical work area in the field had FCR-E-2231 number on it. A check of the master drawing and the FCR indicated that this FCR was incorrectly identified and should have been on drawing No. 5AW-0812-RV 9.

In addition to the drawing check, the master log of all FCRs in the vault was reviewed and 20 FCRs were selected and reviewed for proper approvals and to determine if a copy of the FCR was attached to the master drawing. The FCRs were found attached to the master drawings with the exception of one, FCR NO. E2615, which should have been stapled to two drawings but was not stapled or identified on drawing No. 9KW-2740-WE-01 Rev 3.

Region II has previously identified drawing control as an unresolved item and it is currently being pursued by the Region.

7. Audits

Procedure QASP 7.1 Rev.10 describes the process used by the Quality Assurance Unit at the site to conduct audits of quality-related construction activities and of systems, components or structures and defines audit personnel responsibilities. This procedure was reviewed in detail and found adequate to conduct audits of construction activities. The audit schedule for the interval March 16, 1981 to March 15, 1982 was reviewed and it was determined that approximately seventy-five audits were accomplished in this time frame. QASP. 7.1 Rev.10 requires that "applicable elements of the QA Program should be audited at least annually or at least once during the life of the activity." However, it was determined from a review of audits completed that the following areas were not audited in the 12 month interval:

| Area | Audit Interval | Late Period |
|---|---|---|
| Field Fabrication Orders | Nov. 1980 - March 1982 | 5 months |
| Weld Repair | Dec. 1980 - Feb. 1982 | 3 months |
| Equipment Installation-Electrical | Nov. 1980 - Jan. 1982 | 3 months |
| Audit Preparation & Review of Field Procurement Documents | Dec. 1980 - March 1982 | 4 months |
| Transfer of Items | Dec. 1980 - March 1982 | 4 months |
| Stop Work Authority/Allegations | Nov. 1980 - March 1982 | 5 months |

Ten audit reports were reviewed to determine the nature of findings and the timeliness of closeouts. To track open audit item deficiencies, a computer form is utilized. A review of this form indicated that there is considerable delay in the closing out of open audit items. The following items were taken from the most recent print-out of Sept. 22, 1982, that indicates the lateness of closures:

| Audit No. | Description | Date Opened |
|---|---|---|
| BN-C-81-07 Def.-2 | No design criteria on EN DES drawing series 3RW0905 for the fabrication/installation of bolt assemblies for the HVAC Valves. | 3-2-82 |
| BN-E-81-18 Def.-3 | No instructions, procedures or drawings available at the site imposed by the QCP which provided the acceptance/rejection criteria for certain activities performed during equipment installation inspections. | 2-09-82 |

| Audit No. | Description | Date Opened |
| --- | --- | --- |
| BN-C-90-07 Def.-7 | Procedure/instructions for the inspection and documentation of the installation of ANSI B 31.1 fire protection piping have not been established and/or defined by written procedures/instructions. | 10-10-80 |
| BN-G-81-18 Def.-1 | Anchors are in violation of the anchor spacing requirements. | 11-30-81 |
| BN-1-80-02 Def.-2 | Neither the drawings nor the inspection procedure contain acceptance criteria for the threaded pipe connections. | 7-01-80 |

In addition to the audits conducted by the Quality Assurance unit of licensee construction activities, periodic audits are conducted of onsite contractors. These contractors are Raymond International, Johns Manville and ITT-Grinnel. An area that has not been audited by the licensee QA Unit in the past four years is the ITT-Grinnell hanger design group. This group consists of a supervisor, eight engineers and a draftsman and is performing hanger design and modification work. In the past year they have designed five hangers in addition to the modification work that was required for continuity of construction. This design work was done under the ITT-Grinnel Quality Assurance Program.

8. Licensee Oversight of Contractor Activities

There are no major contractors at the Bellefonte site performing quality related work. All the personnel on site from the project manager to craftsmen and laborers are employees of the TVA. There are two small contractors on site performing quality-related work. They are Raymond International and Johns Manville. The work of these contractors is covered under their respective Quality Assurance Programs and the activities of these contractors are reviewed by designated sections of the site organization. Quality Assurance Procedure 7.2 Rev. 1 requires that the Project Manager or designated representative shall ensure that certain requirements for surveillance of site contractors be delineated in site procedures for each contract and revision. Such procedures were in existence for Johns Manville and Raymond International.

9. Auditor Qualification and Training

The qualifications of the licensee's auditors and lead auditors were checked and records that were reviewed demonstrated that ANSI-45.2.23 1978 was being met.

The training of the auditor group was reviewed. It was determined that there was no overall planning schedule for the training and retraining of the Quality Assurance personnel other than a 6 week schedule of training for the period 8/20/82 through 9/30/82. In light of the three new personnel assigned to the unit since June of 1982, the lack of a comprehensive training schedule could impact their development. An interview with the QA unit supervisor indicated that there was no planned training program developed for individuals newly assigned to the unit nor was there a formal system that requires retraining.

An absence of formal branchwide training for Program Quality Assurance Personnel was indicated in TVA audit No. M81-11 of November 19, 1981 and a program procedure, QASP 2.2 of September 13, 1982 has been issued but the program has not been developed to indicate the individuals responsible for the training, the content of the training courses and the schedule for training.

## III. PROJECT MANAGEMENT

### A. Objective

This review of project management, job descriptions and controls was directed towards verification that the organizational structure, staffing and controls are in place to ensure a quality product in conformance with codes, standards and commitments.

### B. Discussion

#### 1. Organization

The overall responsibility for managing the Bellefonte Project is vested in the OEDC Project Manager. He has been delegated authority by the OEDC Manager to act in his behalf for the overall planning and completion of the total project. The OEDC Project Manager, his staff, and the Bellefonte engineering group are located in West Knoxville.

The site management organization at Bellefonte is directed by the Project Manager who has responsibility for constructing the plant in accordance with design and quality assurance requirements. He has assisting him the Construction Superintendent, who has responsibility for constructing the project and the Construction Engineer, who has primary responsibility for quality control for onsite work. In addition to these two principal managers the Chief of Project Management Services has direct responsibility for a number of project services.

The TVA - Knoxville organization performs the design engineering function for Bellefonte and there is minimal onsite design activity. With the exception of a few small contractors, TVA manages all site construction and all the craftsmen and laborers are employees of TVA.

#### 2. Job Descriptions

Interviews were conducted with the senior managers and their responsibilities and activities were compared with the current job descriptions. The Project Manager's job description was reviewed and found to be consistent with the QA Topical Report in respect to quality assurance responsibility and incorrect as to current organizational line of reporting. The Construction Superintendent's job description was reviewed and was found to be consistent as to his present duties. A review of six other job descriptions indicated that they were in substantial agreement with present responsibilities.

3. <u>Management Involvement</u>

Interviews with the OEDC Project Manager and onsite management personnel indicated they are all actively engaged in managing the project, are active in resolution of site problems and are highly visible to plant personnel. There are scheduled periodic staff meetings to share site information and to resolve specific construction problems or concerns.

The site also issues daily construction reports describing on-going site activities and a comprehensive, monthly construction progress report that describes specific construction status including a quantitative and narrative summary. In addition to the construction progress, the report includes monthly summaries of Field Change Requests, NRC items of noncompliance, audit summaries and nonconformances.

4. <u>Trend Analysis</u>

Procedure QASP 7.2 Rev. 4, Trend Analysis, describes the trend analysis program. The QA Supervisor is responsible for the accumulation of the data for construction generated NCRs and audit report deficiencies. The site QA unit prepares a quarterly and semiannual report which reports adverse trends, highlights problem areas and reports on the status of previously identified trends. These reports are transmitted to the Project Manager and to other concerned organizations. The report analyzes the categories of defects and attempts to reach conclusions as to the causes.

A study of the July 1, 1981, January 1, 1982 and July 1, 1982 semiannual Quality Trend Analysis reports, shows an increase in components assembled incorrectly from 329 to 202 to 442, cables that were severed or damaged from 20 to 48 to 56 and records improperly completed from 60 to 114 to 123. Although these trends are evident from the report, there is no evidence that there was any specific followup or corrective action by the individuals involved in construction to improve the quality of workmanship and/or record keeping in these problem areas.

## IV DESIGN CHANGE CONTROLS AND CORRECTIVE ACTION SYSTEMS

### A. Objective

The purpose of the assessment in this area was to review program implementation with emphasis on actual safety-related hardware as installed in the field, as well as records involving design change controls and any nonconforming conditions involving installed hardware.

Samples were selected in several technical disciplines to check program implementation, and to ensure site procedures, site interface procedures, and TVA design interface procedures satisfy NRC requirements and licensee commitments. Additionally, a sample of records were reviewed to note how nonconforming conditions were identified, dispositioned, and the extent to which corrective actions were taken.

### B. Discussion

#### 1. Program Requirements

##### a. Design Change Controls

The Office of Engineering Design and Construction (OEDC) Procedure 3QPR-1, Revision 0, "Design Control", establishes QA Program Responsibilities relevant to design control for the Bellefonte Nuclear Plant (BNP). Quality Assurance elements in the design control program include the following:

Design Changes
Scope of Design Control Measures
Interface Identification and Control
Inclusion of Quality Standards
Regulatory Requirements and Design Basis

The BNP Final Safety Analysis Report (FSAR) contains commitments to implement ANSI N45.2.11, "Quality Assurance Requirements for the Design of Nuclear Power Plants." This standard requires that procedures be employed to ensure that design activities are carried out in a planned, controlled, orderly, and correct manner. It further requires that design changes be justified and subjected to design control measures commensurate with those applied to the original design.

In accordance with the above commitments, Quality Assurance Procedure (QAP) 3.1, Revision 6 defines the requirements for preparation, control, and documentation of "Field Change Requests" (FCRs), and establishes the basic methods for control of TVA design and manufacturers' drawings addressed in BNP-QCP-10.2, Revision 8, "Drawing Control" at the BNP site. Engineering Change Notices (ECNs) are "Off-Site" initiated design changes and are controlled in accordance with Engineering Design (EN DES) Procedure 4.02.

b. Corrective Action Systems

Design activities and changes to correct identified conditions adverse to quality are to be in accordance with issued procedures which incorporated the requirements of OEDC Procedure 15QAI-1, Revision 0, "Determining, Reporting, and Correcting Conditions Adverse to Quality."

Quality Assurance Program actions for Conditions Adverse to Quality (CAQ) that are documented on Nonconformance Reports are as defined in QAP-15.1, Revision 8 and QAP-16.1, Revision 2.

Although TVA had placed these procedures in effect on June 30, 1982, at the time of this assessment, they had not been implemented at the BNP site as required by 15QAI-1, Revision 0. When this problem was identified by the NRC CAT inspector, licensee representatives initiated QCIR 25,716 dated September 23, 1982, to initiate action to revise site procedures to implement the requirements of the Division of Construction QAP-15.1 and QAP-16.1 (latest revisions). Additionally, a similar problem was identified by Region II as a violation in NRC Inspection Report 50-438, 439/82-23 (dated August 26, 1982).

The current Quality Control Procedure (QCP) BNP-QCP-10.4, Addendum Number 3, Revision 8, "Nonconforming Condition Reports" established controls to document and disposition reportable nonconformances relevant to design activities and design controls at the site. By this procedure a reportable nonconformance is a significant condition or an item that cannot be corrected within the scope and requirements of the specification, drawing, or code and has to be referred to Engineering Design for disposition. A significant condition requires one or more of the following:

1. Significant investigation to determine the cause of the condition
2. Significant redesign, repair, or rework of an item
3. Significant evaluation of the QA/QC program implementation
4. Significant evaluation for determining generic implication

A nonconformance that is not a significant condition or an item that can be corrected within the scope and requirements of the specification, drawing or code is dispositioned according to the requirements [illegible]ted in BNP-QCP-10.26, Revision 4: "Quality Control Investigation Reports" (QCIRs).

2. Program Review

a. Field Hardware Review

Field observations of hardware for design change controls, and/or nonconforming conditions, including rework, were accomplished as follows:

- Observation of secondary shield wall concrete placement in progress
- Observation of concrete testing in-process at the testing lab
- Tour of concrete batch plant facility during operation
- Observation of the installation of two W36x260 girders for the polar crane
- Random review of numerous concrete chipping operations, both in-process and completed
- Observation of two hanger installations, including welding, ASME Class II
- Observation of in-process weld inspection
- Observation of numerous completed anchor bolt installations, as well as many installations in the process of being reworked
- *Random review of completed mechanical and HVAC equipment ductwork pump and hanger support installations for specific documented deficiencies, rework status (if applicable), and work being performed as a result of a design change
- Tour of shop fabrication facilities
- Observation of two cable tray and conduit installations
- Observation of several completed cable tray installations in the process of being reworked
- Random review of completed electrical equipment installations, including switchgear, motor control centers, and local electrical panels for specific documented deficiencies, rework status (if applicable), and work performed as a result of a design change
- Observation of instrumentation installation beneath the reactor vessel
- Review of two electrical equipment installations in the field to equipment qualification documentation
- Tour of buildings to note storage conditions for safety-related equipment, including selected motor-operated valves, local electrical panels, mechanical equipment, and selected switchgear

*NOTE:

During this assessment, while touring the Diesel Generator Buildings, several large hangers were noted to be partially supported by Unistrut connections. Information was provided by the licensee which indicated that, for connections up to and including ½-inch, Unistrut connections could be used in lieu of ½-inch concrete expansion anchors. The following drawings were reviewed to verify the "in-place" hanger configuration and hanger connections:

IKE-MPHG-A204 Sheet 2
IRG-MPHG-A008 Sheet 1
IRG-MPHG-A014 Sheet 1
IRG-MPHG-A014 Sheet 2

This review did not incorporate the effects of buckling relative to the hangers supported by these Unistrut connections. Also, the effects of flexibility on the hanger configuration were not reviewed.

b. Record Review

Samples of records of field activities were reviewed to determine whether or not program requirements were being met relative to design change controls and/or nonconforming conditions as follows:

Four procurement contracts
Ten receipt inspection documents
Maintenance records for the diesel generators and the batteries
Two concrete placement records
Four structural steel support installations
Two installation records for the access platforms to the main coolant pumps
Three cable tray and conduit installations
Two cable pull and cable termination installation records
Two electrical hanger installations
Two electrical and mechanical equipment installations
Three hanger installations
Three anchor bolt installations including torque/tension correlation data
Two piping and valve installations

As previously stated, the NRC CAT inspector reviewed program implementation with emphasis on checking actual hardware as installed in the field, as well as the records that represent the field installed hardware. Thus, documented deficiencies were tracked from the records to the field, and deficiencies identified in the field were traced back to records.

3. Program Implementation

As a result of this hardware and documentation review, specific activities were compared to the program requirements to assess the adequacy of design change controls and corrective actions systems at the BNP site.

a. Design Changes and Scope of Design Control Measures

Over one-hundred fifty design change documents were reviewed to ascertain consistency with site procedural requirements. These documents compared a selective sample of Support Modification Requests, Support Variance Sheets, Field Change Requests, and/or Engineering Change Notices (initiated by EN DES). An additional seventy-five Design Information Requests were also examined.

(1) Support Modification Requests, Support Variance Sheets, Field Change Requests, and Engineering Change Notices

Documents reviewed and activities observed were found to be processed and reviewed in accordance with the applicable site procedures.

However, a review of some fifty Field Change Requests (FCRs) indicated forty-seven had received prior telephone approval. Several of these FCRs were the result of nonconforming conditions. To satisfy program requirements, it is important to ensure that when work is performed and inspected to a verbally approved FCR, and then a final approved FCR is issued, the work has been inspected in accordance with this final approved document.

(2) Design Information Requests (DIRs)

Design information requests per BNP-QCP-10.21, Revision 1, "Design Information Requests," are to document information concerning interpretations of design drawings and/or specifications supplied by the Design Project Organization (DPO), and to document DPO concurrence with site requests that do not affect changes to design requirements. However, DIRs have been used to process design changes, establish procedural requirements, define repair procedures, and establish accept/reject criteria for the installation of equipment.

Additionally, by BNP QCP-10.21, paragraph 6.4, when DPO disposition provides information which exceeds the procedural limitations or results in nonconforming conditions, a QCIR is to be issued.

Twenty DIRs of a sample of seventy-five DIRs exceeded the procedural limitations specific to the use of the DIR. For example, DIR E-071 states that the minimum conduit size is indicated on the drawings and "may be increased without effecting a change to the design drawings." Likewise, by DIR E-012, changes in the designated thickness of structural tubing for electrical hangers above the minimum specified does not necessitate initiating a drawing change. These practices are not in accordance with BNP FSAR commitments and BNP program requirements to assure design changes are appropriately processed. These two examples are also indicative of engineering evaluations that have not properly considered the dead weight loadings prescribed by the applicable drawings.

DIR E-033 allows the drilling of holes in the Main Control Room panels to support installed cables with apparent disregard for the seismic qualification of the equipment. DIR E-064 similarly allows holes that were cut in panels and boxes to be plugged by welding similar material in the holes to restore the panels and boxes to their "original" NEMA integrity. These two examples indicate a lack of adequate criteria to ensure that the qualification of the equipment has not been jeopardized.

DIR E-137 establishes procedural requirements for the use of flexible conduit within a rigid conduit installation. DIR E-076 establishes installation requirements for terminal block mounting plates in embedded boxes. These two examples appear to be more than an "interpretation" of design requirements.

DIR E-029, DIR E-048, and DIR E-092 address repairs for damage to Class 1E cable. In fact, QCIR 10,804 was dispositioned to repair damage to cable insulation in accordance with the procedure addressed by DIR E-092. Other QCIRs have been dispositioned to repair damage to cable insulation in accordance with DIR E-029.

DIR 0-29 delineates specific installation criteria for various uses of expansion anchors. DIR 0-43 provides an alternate torque testing method for grouted anchors other than that specified by the site specification requirements. These requirements should have been appropriately incorporated into the applicable site procedures used for the torque testing.

Ten other examples of similar uses of the DIRs were found and discussed with licensee representatives. No QCIRs were found to be issued against the DIRs in accordance with BNP QCP-10.21.

These uses violate the site procedural requirements. Additionally, several examples reflect inadequate engineering evaluations. Transmittal of design and design change information in this manner does not satisfy NRC requirements to ensure the design bases as specified in the license application are correctly translated into specifications, drawings, procedures, and instructions.

b. Corrective Action Systems

BNP-QCP-10.26, "Quality Control Investigation Reports" and BNP-QCP-10.4, "Nonconformance Reports" are the two controlling procedures at the site for dispositioning conditions adverse to quality and for addressing corrective actions.

Over five-hundred QCIRs and over two-hundred nonconformance reports were reviewed to the procedural requirements. Dispositions were noted for technical adequacy.

Examples of unacceptable engineering dispositions to QCIRs and NCRs to "Accept-As-Is" were found without adequate and/or any justification. Failure to take adequate corrective actions has resulted in several examples of repetitive noncompliance.

Examples are as follows:

(1) NCR 1614 involves the pull testing of grouted anchors. Proof loading for grouted anchors became effective on January 17, 1981 when imposed by Construction Specification G-32. Equipment to pull test grouted anchors was not available until August 10, 1981. Seismic supports employing grouted anchors were installed during this period without the benefit of proof loading. Disposition of the NCR, per memorandum, is to "use-as-is because since proof loading was initiated, only 1 of the 47 anchors tested has been defective. Similar results would be expected for the anchors which were not tested." However, by procedures employed at BNP, grouted anchors, unless noted on the drawing, can be used in lieu of expansion anchors on a one-for-one basis. Thus, to satisfy the requirements of NRC Bulletin 79-02, some type of random testing should have been performed to ensure proper installation of these anchors.

(2) NCR 1154 indicates that concrete anchors and studs were manually welded to detail weld procedure SM-P-1R2 of Construction Specification G-29C. However, SM-P-1R2 weld procedure is not prequalified for Type A108 material contained in the anchors and studs, nor is it permissible per AWS D1.1. Disposition of this NCR was to use-as-is since "the procedure is technically similar to that which should have been used and will produce satisfactory and adequate welds between the materials involved." However, no verification by testing or analysis was performed to ensure satisfactory and adequate welds between the materials involved were made.

(3) NCR 1631 documents the failure of cement received on-site to meet the tricalcium aluminate (C3A) content of 10.5% as indicated by the supplier's certified mill test reports (CMTRs). Justification, per a memorandum, states, "...use-as-is since none of the concrete using the cement was placed in hot weather and since all of the concrete contained fly ash." No corrective action was initiated.

Subsequently, NCR 1804 was initiated to document that contrary to the contract requirement with a supplier of a guaranteed average 28-day mortar strength of 5400 psi, numerous concrete samples (dating back to June 6, 1975) failed to meet the required average when tested by the on -site Singleton Materials Lab. Some tests vary by as much as 900 psi lower than the 28-day strength documented on the CMTRs from the supplier. Disposition, per memorandum, is to "use-as-is since the project quality control effort overcame that apparent variation in cement strength indicated by mortar test results." No corrective action was initiated.

During the review of CMTRs for recent cement shipped to BNP, when questioned as to why all CMTRs were duplicate, the licensee representative stated there was an additional problem with the cement supplier. Another NCR, NCR 2000 was initiated to document this problem involving the cement supplier. Construction Specification G-2 requires the supplier to furnish CMTRs representing no more than 400 tons. However, numerous examples were given where a single CMTR represented a quantity in excess of 400 tons. The NCR states "separate CMTRs were received with each truck load but were duplicates of the original test conducted on the cement." This, in addition, is contrary to ASTM C-150 requirements. The recommended disposition was to use-as-is since the compressive strength requirements of the concrete had been met and the site test lab results had been acceptable. Again, no corrective action was initiated with the supplier other than to carefully monitor future shipments.

In accordance with BNP program requirements, corrective action should have been initiated to ensure the specification requirements imposed upon the supplier were properly satisfied. Repetitive nonconformances indicated that a review of the supplier's program was necessary, and should have been performed.

(4) NCR 1145 documents leaks in the protective coatings in the passive sump area. Disposition was to use-as-is as "the number and size of cracks are such that significant amounts of inleakage will not take place even under maximum flood conditions. There is no possibility of outleakage from the passive sump because of the ground water head that exists." When questioned as to what relevance this disposition has to the crack problem that was identified, licensee representatives answered that a new NCR was to be initiated to address this concern. However, no repairs to the deficient areas had been performed in over two years since this nonconformance was identified.

(5) QCIR 3?96 documents acceptance of eight buttonheads for Tendon No. 214BD. Disposition per Inryco Engineering Form NC/CA No. F791-8FC states "buttonheads are marginally out of specification and are judged acceptable." Again, no NCR was initiated and no engineering review was performed to determine on what basis "marginally out of specification" may be judged acceptable.

(6) QCIR 2408 documents a condition in which a dutchman for the Incore Monitoring System is skewed or off-set. Babcox and Wilcox relinquished resolution of the problem to TVA. The QCIR states "a study by TVA revealed that the condition in question is acceptable and that rework is unnecessary." However, no NCR was initiated to ensure a proper engineering (EN DES) review of the problem was performed in accordance with procedural requirements and that the condition in question is acceptable.

(7) QCIR 25,298 documents parts missing from safety-related HVAC equipment such that maintenance could not be performed. The disposition states that there are no maintenance requirements and no "QCIR condition exists." This is contrary to vendor recommendations. Thus, no maintenance was performed, nor have the parts been replaced. Additionally, QCIRs 24,525, 24,526, and 24,527 document conditions where fan guard covers on equipment needed to be removed to perform maintenance. The disposition states "covers can be removed." However, no maintenance was performed as the covers apparently could not be removed.

Ten other similar examples of apparently unacceptable dispositions to QCIRs and NCRs were also noted and discussed with licensee representatives.

Results of this assessment indicated several methods to document nonconforming conditions without a QCIR or NCR. A minimum of ten different procedures were found to include forms for documenting deficiencies prior to initiating a QCIR. Seventy-five of these various documents were reviewed. Most of these involve storage or surveillance activities. It was found that deficiencies are repeatedly documented, with corrective action applicable on a case-by-case basis. For instance, examples of motor operated valves and electrical equipment were noted in the field and in records to be without continuous heat. Vendor recommendations usually require some type of heat applied to the equipment to prevent environmental degradation of the equipment. When the problem is identified, the corrective action taken is usually to energize the heater or make some provisions to apply heat to the equipment. However, the equipment may go months without the heat application, depending upon the maintenance schedule. Thus, some type of "program" corrective actions need to be addressed to prevent continued recurrence, especially applicable to these types of deficiencies.

These examples represent unacceptable dispositions of nonconforming condition reports without sufficient engineering justification and indicate a failure to take adequate corrective actions to correct nonconforming conditions.

Related to the issue of unacceptable dispositions to <u>QCIRs</u>, an unresolved item (item #438, 439/82-16-03, "Invalidation of Quality Control Documentation") was previously identified by NRC Region II involving numerous QCIRs that were invalidated, and was made a violation (item #438, 439/82-30-01) during the time of this inspection.

c. <u>Rework Activities</u>

Over two-hundred and seventy-five documents relative to rework, either initiated as a result of a nonconforming condition or intiated as a result of a design change, were examined. These records included rework performed in accordance with the Temporary

Installation/Omission form, the Sequence Control Chart, the Work Release, the Indefinite Status Control Form, the Quality Control Inspection Form, and/or the appropriate nonconforming condition or design change document.

(1) Temporary Installation/Omission Form

The "Temporary Installation/Omission Form", (TIO) per BNP-QCP-10.8, Rev 3. Add. 1, is used to document the establishment of a nonpermanent condition in a system or structure because it is necessary to bypass or omit components or equipment to facilitate construction or testing of installed equipment.

However, TIOs have been used to perform permanent plant work, sometimes prior to engineering approval. For example, TIO E-919 documents the change-out of a switch module in the Main Control Panel 1IX-IM-022 with a similar switch module per unapproved Field Change Procedure KM7136/99. TIO E-982 documents the installation of permanent counterweights for ERCW pump motors 1A1-1 and 1A2-A. TIO E-1554 documents permanent work performed prior to the receipt of termination cards for quality inspection documentation per FCR E-2310.

Fifteen similar examples for the use of TIOs from some seventy-five TIOs reviewed were discovered and were discussed with licensee representatives.

(2) Sequence Control Charts and Work Releases

Sequence control charts (SCCs) by QCP 10.36, Revision 0, Addendum 2, are generated to control installation activities where work sequencing, hold points, QA requirements, and transmittal of information to the crafts that is not adequately prescribed in other procedures.

"Work Releases" by QCP-10.6, Revision 13 are applicable to all drilling, chipping, cutting, welding, rework...related to permanent features unless otherwise noted. Rework, by paragraph 4.5, is defined to be the repair, replacement, or revision of permanent plant equipment or materials to the extent that the status of completed quality control inspections would be affected.

The use of the sequence control charts and the use of work releases may have resulted in several instances where nonconforming conditions were identified and repaired, but adequate inspection and engineering reviews were not incorporated to satisfy the original installation requirements. Also, QA records affected by many of these rework activities have not been appropriately documented on the applicable work release forms.

Four examples are as follows:

(a) On September 21, 1982, during a tour of the Auxiliary Building, Chemical and Boron Recovery System RC Bleed Transfer Pump 1NB MPP 001-N was noted to be inverted, in violation of standard rigging practices, resting on electrical wires to the motor connection box which were crimped. The crimping of these wires exceeded the allowable Minimum Bend Radius.

An SCC, 1NB-M179 had been issued on September 15, 1982 to move the electrical motor from the pump base as the coupling alignment could not be achieved due to the stud bolts holding this motor in place were bent or crooked. QA documentation for this pump and motor indicated that installation was satisfactory. No QCIR or NCR had been written to document the problem condition of stud bolts (2) being bent and requiring replacement and, in fact, no QC inspection was specified on the applicable SCC for the removal or reinstallation of the pump.

Thus, inspection criteria for the reinstallation of the pump was less than the original criteria specified for installation. To satisfy program requirements, an NCR should have been initiated prior to the removal of the installed pump to assure proper engineering review and correction of the nonconforming condition.

(b) SCC 1KC-M167 documents the procedure for restoring the original shaft in pump 1KC-MPMP-001-A to an acceptable condition. A Babcock and Wilcox letter, P-1686, dated March 31, 1982 provides the recommended repairs for the nonconforming conditions. However, it was forwarded to the purchasing agent with a copy attached to the SCC without evidence of proper engineering evaluation.

By BNP procedural requirements, site-initiated QCIR and an NCR should have been generated to ensure proper removal, repair, and reinstallation of the shaft for the pump in accordance with the original installation requirements.

(c) Work Release 33,884 documents actual reinforcement bars cut during the performance of rework. Sketches were made and QCIR 19069 was initiated. Subsequently, NCR 1802 was written, but the sketches of the actual reinforcement with surface cuts were never provided to EN DES. However, acceptance criteria for the cuts were provided by EN DES as a disposition to the NCR to "determine the degree of repair, if any." Furthermore, the disposition provided generic acceptance criteria for similar nonconformances, rather than evaluation on a case- by-case basis.

This disposition does not reflect an adequate engineering review to satisfy the applicable ANSI N45.2.11 commitments. That is, to ensure reworked conditions that are nonconforming have received a review commensurate with the original installation and that adequate design controls have been utilized.

(d) Rework of seismic control assembly ORE-MPHG-0183, RO was performed to Work Release 35,772. QCIR 24,251 was written to document the fact that Work Release 35,772 had been signed off, but the applicable QA records had not been invalidated. A review of the pipe sleeve for this assembly indicated RTV sealant to be installed within the sleeve area and outside of the adjacent pipe. However, the RTV sealant did not completely penetrate the sleeved area. The Sealing Inspection Checklist for this sleeve indicated an adequate length of sealant through the sleeve. Discussions with licensee representatives indicated the inspector was not really sure of his responsibility relative to the installation of the RTV sealant. However, the base plate was reinstalled, and the deficient condition was not repaired.

Work releases also were noted during this review which did not require invalidating original QA records which were affected by the rework. Work Releases 33,197, 33,198, 33,199, 35,507, and 35,508 do not properly reference the original concrete placement test and inspection records. Several other examples of this problem were discovered and discussed with licensee personnel.

These uses of the TIOs, SCCs, and the work releases to perform rework appeared inconsistent. These uses, in many cases, circumvented the applicable ANSI and site procedural requirements for appropriate engineering review, inspection, and identification of nonconformances for prompt corrective action.

A separate but similar problem relative to the use of SCCs (reference NRC inspection report 50-438, 439/82-23, violation "Failure to follow procedures for planning and performing inspections and for controlling inspection documentation") was identified in August 1982 by NRC Region II. This violation involved issuance of two SCCs without proper quality control approval, operations on one of the SCCs were performed out of sequence and each of the SCCs were not filed such that they could be readily retrieved.

(3) Other Systems to Perform Rework

Other systems (such as the indefinite status control form and the quality control inspection form) were found to be utilized in accordance with site program and procedural requirements. However, during the review of these various rework systems, it was noted that rework performed to the various programs is not tagged or identified unless it may have been required by

QCIR and/or NCR conditions. No tracking system was found to identify and control on going rework. Additionally, a number of "nonconforming" items are not tagged or marked as required by site procedures.

d. Design Changes Necessitated by Nonconforming Conditions

Section 3QCS-1 of the Program Requirements Manual requires that the Bellefonte Nuclear Power Plant conform fully to ANSI N45.2.11. Section 8 of this standard requires that design changes be justified and subjected to design control measures commensurate with those applied to the original design. This includes changes that may result from a disposition of nonconforming items.

Corrective action implemented as a result of Quality Assurance audit BN-G-81-14 (deficiency 3) allows engineering design changes to be processed after verbal notification. Corrective action proposed and implemented by the audit states, "if EN DES responds to a condition, after verbal notification, by making appropriate changes to drawings and specifications without initating an NCR, then the QCIR has been satisified."

Thus, Quality Control Investigation Reports (QCIRs), identified by the audit, which document nonconforming conditions, have been dispositioned and closed without initiating a nonconformance report that requires engineering review commensurate with the original design.

By this corrective action, the procedural requirements are not sufficient to ensure adequate engineering reviews are performed for those conditions that cannot be corrected within the scope and requirements of the specification drawing, or code.

ANSI N45.2.11 requires that procedures ensure that for those nonconforming conditions that require an engineering review (EN DES), a review commensurate with the original installation is performed. Also, the Quality Assurance program must have the controls to ensure design changes have been incorporated, and that the work has been performed to the latest document.

e. Design Interface Identification and Control

Site-design interface procedures were compared to site program requirements. The identified problems in this report indicate that a much stronger interface needs to exist between EN DES and the BNP site. Interface procedures must ensure that design changes and dispositions to nonconformance reports are appropriately processed. Many methods exist to process design changes, to perform rework activities, and to identify nonconforming conditions. The multiplicity of systems tends to result in a number of occurrences where proper engineering review and associated quality activities are not properly performed.

f. Quality Control Procedures and Inclusion of Acceptance Criteria

Quality Control Procedures are site documents governing construction and inspection activities. Although the procedures contain acceptance criteria, the actual acceptance criteria may be spread through several documents. Additionally, acceptance criteria are transmitted via memoranda from EN DES and listed as an attachment to the procedure. Many times, the attachment is not referenced within the context of the procedure. QCPs should more clearly define acceptance criteria.

g. Regulatory Requirements and Design Basis

During this assessment, it was noted that there was no specific program utilized by the site to ensure FSAR commitments are satisfied by site procedures and that required changes are initiated and appropriately processed. Deviations to FSAR commitments are as follows:

(1) Density of Concrete for Shield Walls

Section 12.3.2.2, "Shield Walls," states. "the poured concrete shield walls throughout the plant are ordinary concrete with a minimum density of 144 $lb/ft^3$." Site testing procedures, however, incorporate no minimum acceptance criteria for density. Unit weight tests are performed in accordance with ASTM C-172, "Standard Method of Sampling Fresh Concrete." However, this unit weight is for wet concrete and specifies no accept/reject criteria.

Mix design qualification data reviewed indicated a wet unit weight less than the 144 $lb/ft^3$ specified by the FSAR. The original design basis of 144 $lb/ft^3$ also applies to concrete in those areas of the shield walls being reworked.

(2) Conformance of Cement to ASTM C-150 Requirements

Section 3.8.1.2, "Applicable Codes, Standards, and Specifications" references ACI 359, "Proposed Standard Code for Concrete Reactor Vessel and Containments," copyright 1973. Section 3.8.6.1, "Materials," states "cement conforms to ASTM Specification C-150-72, Type I or Type II, depending on available supply." Type I cement is in use at the BNP site.

Not listed as an exception to TVA Construction Specification G-2, Section CC-5221.1 of the ACI-ASME 359 Code (1973) requires the Constructor to ascertain conformance with the applicable requirements of ASTM C-150, "Specification for Portland Cement." This includes the appropriate tests for standard chemical properties.

No on site verification tests to ascertain conformance to ASTM C-150 were performed by the Constructor. Acceptance of cement is based on the verification test performed for the tricalcium-aluminate (C3A) content which is not a required test for type I cement by ASTM C-150. In view of the repetitive problems encountered with the acceptance of cement, including the C3A content, these required tests should have been performed in accordance with FSAR commitments.

(3) Qualification of Aggregates to ASTM C-33 Requirements

In section 3.8 of the FSAR, relative to aggregates, on page 3.8-15, the FSAR states, "Each source of aggregate supply is inspected by TVA geologists prior to construction and their recommendations on potential variations in the aggregate are considered in establishing the project testing frequency for wear, potential reactivity, and soundness." Additionally, by Section 3.8.1.6.1, aggregates must conform to ASTM Specification C-33-71a, "Standard Specifications for Concrete Aggregates." ASTM C-33-71 requires that the potential reactivity of the aggregates be evaluated in accordance with the aggregate qualification tests required by the ACI-ASME 359 Code (1973). No aggregate qualification tests had been performed for potential reactivity in accordance with the applicable requirements.

## V. ELECTRICAL AND INSTRUMENTATION CONSTRUCTION

### A. Objective

The purpose of the assessment in this area was to determine whether safety-related electrical and instrumentation components were being installed and inspected in accordance with NRC requirements and licensee commitments; whether procedures, instructions and drawings used to accomplish these activities are adequate and whether quality-related records accurately reflect work and inspection activities.

### B. Discussion

#### 1. Electrical Cable Installation

##### a. Scope of Inspection

Three categories of installed electrical cable were inspected (power, control, and instrument). Physical inspection of cable in each of these categories was made to ascertain compliance with applicable design and installation criteria relative to size, type, location/routing, bend radius, protection, separation, identification, physical loading and supports. Samples were selected from both units in the reactor, auxiliary, and control buildings.

The NRC Construction Appraisal Team (CAT) inspectors observed the following cables which were installed in cable trays or conduits:

Power cable: INS-ECA5-13A, IND-ECA-1A, 2AC-ECA5-1A, 2KC-ECA5-26A, 1CA-ECA5-1A, 2CA-ECA5-1A. (sample size was about 1500 feet)

Control cable: 1CA-ECA3-11B, 2NV-ECA2-310B, 2NV-ECA3-312B, 2NL-ECA3-113A, 1NL-ECA3-102A, 2NM-ECA2-5A. (sample size was 1400 feet)

Instrument cable: Cable/wire associated with safety-related instrument components - mostly in the cable spreading room and in the control room. (sample size was about 300 feet)

Additional random inspections of power, control, and instrument cables totaling over 2,000 ft were also completed. Inspection of in-process cable installation was not accomplished, due to lack of craft activity in this area.

##### b. Cable Spacing in Tray

Ampacities for cable installed in trays require derating based on their installed configuration.

TVA General Construction Specification G-38, Section 3.2.1.3, Paragraph c, states in part, "All medium voltage (MV) power cables (5-15KV) larger than No. 2/0 AWG shall be placed on trays in grouped, three-phase circuits... The minimum spacing between adjacent three-phase circuit bundles or between a three-phase circuit bundle and ungrouped No. 2/0 AWG cables shall be determined as outlined in Figure 3.2.1.3-1." However, the following cable trays contained improperly spaced (too close) medium voltage power cables:

| | |
|---|---|
| TY5-A569-B | Elevation 649'0" |
| TY5-A905-A | Elevation 649'0" |
| TY5-D55-A | Elevation 641'0" |
| TY5-D604-B | Elevation 660'0" |

c. Cable Bend Radius

TVA General Construction Specification G-38, Section 3.2.1.3, Paragraph b, states in part, "Beginning with Bellefonte Nuclear Power Plant, cable trays must not be filled above the side rails except at intersections and where cables enter or exit the tray." Cable tray TY2-CJ83-B had been filled so that cables exceed the upper limits of the tray side rails.

TVA General Construction Specification G-38, Section 3.2.1.2, Paragraph c, states in part, "The cable bending radius is equal to the outside diameter multiplied by the factors tabulated in table 3.2.1.2-1. In no case shall the radius of the bend be less than that obtained by using the minimum factor ...." Electrical cables were installed with less than the allowable minimum bend radius in the following locations:

TY5-A649-A, Elevation 649' (Three type WNE-1 cables where they enter a 6.9KV switchgear cabinet near location 5R in the auxiliary building)
TY5-A561-A, Elevation 649'
TY5-A561-B, Elevation 649' (Three type WNE-1 cables from conduit 1A5-14088)
TY4-AA91-A, Elevation 669'
MCC 2Ab/2ED - EMCC - 51, Elevation 649' (Cable No. 2ED-ECA4 - 218 and No. 2ED - ECA4 - 217 where they enter a 480 V MCC)

Another bend radius problem, pertaining to tray radius versus minimum cable radius, was identified as a violation by NRC RII (Rept. Nos. 50-438/82-22 and 50-439/82-22, dated 8/12/82). TVA documented this problem in NCR No. 1889, dated 8/16/82.

d. Cable Protection

The context of the Bellefonte SAR, Section 8.3, Onsite Power System, and of the TVA General Construction Specification No. G-38, Installing Insulated Cables Rated up to 15,000 volts, indicates that cable shall be protected by routing in raceway.

TVA specification G-38, Section 3.2.1.3, Paragraph e, states in part, "Cable ties may be used where required to maintain a neat orderly arrangement of cables or to maintain the required minimum spacing between medium voltage circuits...cable ties may also be used to provide cable support by fastening the cables securely to the rungs of ladder type trays in vertical configurations." However, several cables run in tray TY2-AG51-A were supported by cable ties attached to pipe supports outside of the tray surface.

The NRC CAT inspectors also observed a number of instances where relatively long lengths of cable were not supported or protected by raceway. This condition was usually found between conduit and tray, and between raceway and equipment (typically electrical equipment cabinets). As an example, where a five-inch conduit is stubbed through the ceiling in the auxiliary building at elevation 625 ft, three one conductor 400 MCM cables are installed so that they rest on a 2½-inch pipe before entering TY5-AA47-A. This unprotected run is about 6-8 feet long. Additionally, three other similar cables are run from nearby conduit to within four inches of a pipe before entering TY5-AA47A. Unsupported and unprotected cable runs (those not in raceway) are considered to be a poor construction practice and a weakness in cable system installation.

e. Division/Train Color Coding

TVA Bellefonte Final Safety Analysis Report, Section 8.3.1.3, Paragraph 1, states in part, "The onsite power system equipment and associated wiring is identified so that two factors are physically apparent to plant operating and maintenance personnel:

(1) That equipment and wiring are safety-related, and

(2) That equipment and wiring are properly identified as part of a particular division of separation."

However, the NRC CAT inspectors observed that the following cable trays contain class IE cable identified with both train A and train B color coding:

| | |
|---|---|
| TY2-AE59-B | Elevation 649'0" |
| TY3-A568-B | Elevation 649'0" |
| TY2-CJ2-A | Cable spreading room |
| TY2-A567-B | Elevation 649'0" |

It was noted by the NRC CAT inspectors that some of the above problems were related to poor color coding practices. The color coding stripe is usually applied to segments of the cable parallel to the cable length but sometimes too narrow to be readily visible after the cable is installed in tray. Additionally, some red color-marked cable has been used as yellow color-marked cable after over-spraying with yellow.

Sometimes, the yellow does not completely cover the previously applied red color. This condition further increases the color coding problem. The NRC CAT inspectors consider present cable color coding practices to be a weakness.

2. Electrical Cable Terminations

a. Scope of Inspection

Inspection of completed electrical cable end terminations was performed on the following cables:

Power cable terminations: 1CA-ECA5-10B to end, 1CA-ECA5-1A to end, 1CA-ECA5-45S to end, 1EG-ECA5-511B from end, 1EG-ECA-5-502A from end, 1EG-ECA5-512B from end.

Control cable terminations: OIA-ECA2-102 from & to end, 1ND-ECA2-261B from & to end, 1NC-ECA3-128A from & to end, 1MC-ECA3-19 from & to end, OQA-ECA2-1756B from & to end.

Instrument cable terminations: About forty terminations inside control room instrument panels and cabinets, including terminations to Reactor Protection System and Engineered Safety Features Actuation System components.

b. In-process Termination

The NRC CAT inspectors observed the in-process termination of Cable 2KE-ECA5-86B. This is a medium voltage cable (5-15 KV) which was to be terminated at 2KE-EMB-004A-B, the intake pump motor junction box. The inspectors accompanied two TVA-EEU (Electrical) QC inspectors, who were to accomplish the in-process inspection. Performance and inspection of the termination was in accordance with TVA General Construction Specification G-38, TVA Standard Drawing SD-E12.5.4 and manufacturer's instructions supplied with the termination kit.

During termination activities, the NRC CAT inspectors noted that the manufacturer's specified distance of one-half inch between semiconductor stress grading and cable outer jacket appeared to have been exceeded. This was pointed out to the TVA-EEU QC inspectors and was confirmed by measurements taken that indicated this distance to be about three-fourths of an inch. The NRC CAT inspectors reviewed the applicable requirements and found that no tolerances were given for this distance. At that time the TVA-EEU QC inspectors stopped the termination of Cable 2KE-ECA5-86B.

The NRC CAT inspectors discussed this situation with the TVA-EEU QC inspectors and the TVA termination electrician. The electrician stated that he had performed as many as thirty medium voltage power cable terminations, and that this distance had never been questioned by the EEU QC inspectors. He also stated that "it is physically impossible to obtain a distance of only one-half inch between semiconductor stress grading and cable outer jacket due to materials involved, such as ground braid and the copper coil."

Both TVA-EEU QC inspectors had performed previous inspections of medium voltage power cable terminations. They were asked if this condition might exist on previously completed terminations. The reply in both cases was "yes, it might" because no one had ever questioned this distance before.

Records of completed medium voltage power cable terminations were reviewed. From these records a sample was selected, and the selected termination was cut open by an electrician to determine whether this condition may exist in other terminations. The HV tubing and ribbon adhesive were removed from "A" phase of Cable 2KE-ECA5-73B at Electrical Motor Box 2 KE-EMB-003A-B. Measurements taken by both the NRC CAT inspectors and the EEU QC inspectors indicated that the distance between semiconductor stress grading and cable outer jacket was about three-fourths of an inch.

TVA General Construction Specification G-38, Section 3.4.2, Paragraph b, states in part, "Termination of medium voltage (5-15KV) power conductors shall be insulated with terminating kits as specified in Section 2.2.2.1 and installed in accordance with standard drawings SD-E12.5.4 and SD-5.5-1 or SD-5.5.2 as applicable."

TVA Standard Drawing SD-E12.5.4, steps 1 and 3 state in part, "Prepare the cable for termination in accordance with instructions furnished with the termination kit ... complete the kit installation in accordance with manufacturer's instructions."

The NRC CAT inspectors observed the in-process termination of cable 2KE-ECA5-86B in which the manufacturer's specified dimensions between semiconductor stress grading and cable outer jacket were not maintained. The inspectors also observed that similar conditions exist for cable 2KE-ECA5-73B.

The above situation was discussed with TVA-EEU management. During this discussion, the NRC CAT inspectors expressed concern that a substantial number of medium voltage power cable terminations had been completed and accepted which did not meet the specified criteria. It was suggested that the matter of specified distances, allowable tolerances and technical significance be investigated.

3. Electrical Raceway Installation

a. Scope of Inspection

Four runs of installed cable tray, comprising 53 tray segments with an aggregate length of about 1000 feet, were inspected relative to support, location, separation, protection and physical loading. Samples were selected from reactor, auxiliary and control building areas. A random inspection of an additional 1,000 ft of cable tray was also completed.

The NRC CAT inspectors observed eighteen runs of installed electrical conduit, associated pull boxes and fittings. Total footage of the selected samples was 900 ft. A random inspection of an additional 500 ft of conduit was also completed.

Six QC inspectors and one raceway craftsman were interviewed during the above inspection.

b. Identification

TVA Bellefonte FSAR Section 8.3.1.4.4 Paragraph 10 requires cable trays to be identified as to voltage level, building areas and tray Node Number. TVA General Construction Specification G-38, Section 3.6.3 paragraph 2 requires markers to be located on at least one exterior side surface at intervals not to exceed 15 feet. The NRC CAT inspector observed a number of trays with missing or damaged voltage and/or node markers. These included TY4-A651A, TY4-R58A, TY4-AA70B, TY4-AA62B, TY4-R82B, TY4-A647A, TY4-A651A and TY-A961B.

While it is recognized by the NRC CAT inspectors that normal construction activities will damage/obliterate these markers, and a routine maintenance program for this activity has been established, it is of concern that the number of missing or damaged labels will cause misrouting of safety-related cables.

c. Tray Attachments

Cable trays containing safety-related cable are attached to supports in a specific manner to meet seismic design requirements.

TVA Quality Control Procedure BNP-QCP-3.3, Section 7.1.2, states in part, "All cable tray shall be installed in accordance with EN DES approved installation drawings or field change requests (FCR)".

EN DES Drawing 5CW0862-RV-21, Detail A21, specifies that cable tray segments will be attached to seismic supports by use of hold down clips and 3/8" oval head screws with lock washers, and that hold down clips will be attached to seismic support bracket arms by use of a 5/8" hex bolt with flat washer, lock washer, and hex nut. Detail A21 references note 8 which specifies a torque value of 60-75 (ft-lbs) for 5/8" bolts used to attach tray section and fitting to supports.

The NRC CAT inspectors observed that tray segment TY4-P56A had not been attached to the bracket arm hold down clips, and that bracket arm/hold down clip bolts had not been torqued on tray segment TY4-R67B.

d. Interference

The inspectors observed pipe supports which extended into the following tray segment:

| | |
|---|---|
| TY4-A639A | Support # 1RI-A042F-R0 |
| TY4-AA72B | Support # 1RI-A581F-R0 |
| TY5-D604B | Support # 2RF-G017-R0 |
| | 2RF-G017-R0 |
| | 2RF-G017-R0 |
| TY-AA66B | ----- |

The inspectors also observed heavy construction materials and scaffolding placed inside the following cable trays and resting on Class IE cable:

TY5-A46A
TY4-A966B
TY4-A965B

The above items are considered to be poor construction practices.

e. Inspection Records

Class IE cables are routed in conduit supported by various types of hangers and supports including straps and channel "unistrut". BNP-QCP-3.7, R6, Electrical Hangers, applies to seismically qualified conduit systems. However, in Sec. 4.1 of this QCP, straps and slotted type channel "unistrut" used to support conduit is excluded from the definition of electrical hangers and, presumably, from the requirements of this QCP. The NRC CAT inspectors are concerned with the safety-significance and quality control of these straps and channel "unistrut" supports, especially in regard to the method of attachment and spacing. Additionally, some channel "unistrut" in conduit systems are attached to other support members by welding. Notes on drawings, series 4BB089-X2 and series 4RA0560-X2, indicate that documentation of inspection of these welds is not required. The NRC CAT inspectors are concerned that the welds may not be adequate since inspection results of these welds are not recorded.

4. Electrical Equipment Installation

a. Scope of Inspection

Installation inspection was made for the following electrical equipment: four motors, three penetration assemblies, three motor control centers, two switchgear units, three station battery rooms, two busways and two emergency diesel generators.

b. Motors

The installation of four motors and associated mounting hardware was inspected for such items as location, anchoring, grounding, identification and protection.

Auxiliary FW Pump Motor 1B-B: Motor ground wire not attached to motor.

Reactor Building Spray Pump Motor 1B-B: No protective cover or heat tape present.

Decay Heat Removal Pump Motor 002: No items of concern identified.

Auxiliary FW Pump Motor 1A-A: Motor not grounded.

c. Penetrations

The following installed containment penetration assemblies were inspected:

INI-EPEN-037-B (power)

INI-EPEN-064-B (power)

INI-EPEN-040A (instrument)

The location, type, mounting and identification were compared with installation drawings. QC checklists for the above penetrations and ten QCIRs relating to penetrations were reviewed also. The above penetration assemblies were made by Westinghouse under Contract 80K64-826959. In the area of the penetrations inspected, no items of concern were identified.

d. Motor Control Centers

The following 480 V motor control centers in the auxiliary building were compared to installation drawings relative to location, mounting, and identification:

IEI-EMCC-65A

2EI-EMCC-65A

2EI-EMCC-70B

TVA Quality Control Procedure BNP-QCP-3.13, Equipment Installation, Section 7.1.8.1, states in part, that "All bolts or nuts having a torquing requirement per EN DES approved documents shall be tightened to the specified torque with a certified torque wrench ... Any fastener not specifically addressed by EN DES or vendor documents shall be secured so that their removal requires the use of tools or so that the helical (split-type) lock washers, if required, are visibly seated."

NRC CAT inspectors observed that cabinet connection bolts were not tightened and lock washers were not seated in the following installed electrical equipment:

480V Motor Control Center 2EI-EMCC-65A, between Cabinets C and D

480V Motor Control Center 2EI-EMCC-70B, between Cabinets L and K

e. Switchgear

The following 6.9 KV switchgear was inspected and compared to installation drawings relative to location, mounting and identification.

1EG-EMVS-07B: No items of concern noted.

2EG-EMVS-07B: Cabinet connection bolts between compartments B and C were loose.

TVA Quality Control Procedure BNP-QCP-3.13, Equipment Installation, Section 7.1.8.1, states in part, that "All bolts or nuts having a torquing requirement per EN DES approved documents shall be tightened to the specified torque with a certified torque wrench ... Any fastener not specifically addressed by EN DES or vendor documents shall be secured so that their removal requires the use of tools or so that the helical (split-type) lock washers, if required, are visibly seated."

f. Station Batteries

Three 125 V Vital Battery Rooms (1F, 1D, and 2F) were inspected including the installed batteries, battery racks and associated equipment. The location, mounting and environmental controls were compared with applicable requirements and QC inspection records.

The NRC CAT inspectors observed that TVA Quality Control Procedure BNP-QCP-1.3, "Maintenance", and the associated vendor's instruction manual for large lead storage batteries, do not implement the FSAR commitment to IEEE standard 450-1972, Section 3.3.3, which requires a yearly check and record of:

Cell condition (detailed visual inspection)
Cell to cell and terminal detail connection resistance
Integrity of battery rack

g. 6.9 KV and 13.8 KV Busways

The Reserve Station Service Buses and the Unit Station Service Tranformer Buses were inspected to verify compliance with applicable specifications and drawings. Approximately 150 ft of bus were examined in various locations throughout the turbine and auxiliary buildings. Buses were checked for minimum spacing, installation integrity, and conformance to design configuration. In the areas of busways inspected, no items of concern were identified.

h. Emergency Diesel Generator

The electrical aspects of the Unit 1 emergency diesel generators (No. 1A and 1B), including control cabinet wiring, were inspected for location, mounting, separation, protection and identification. No items of concern were identified in this area.

5. Instrumentation

a. Instrument Components

The original intent of inspection in this area was to observe in-process installation activities and inspect completed work in the Reactor Protection System (RPS) and the Engineered Safety Features Actuation System (ESFAS). However, due to the limited work in progress and the fairly small amount of completely installed and QC-inspected components in these systems, especially components outside the control room, most of the component installation inspections were made on partially installed or installed components but without final QC inspection. Moreover, the ESFAS is being extensively revised due to a TMI-2 Action Plan Item.

The installation of five sensors/transmitters and accessory components in the RPS and the ESFAS were inspected:

Reactor coolant pressure (1NC-1PT-914)

Reactor coolant flow (1NC-1FT-9138-G)

Pressurizer level (1NC-1LT-004D-G)

Steam generator pressure (1SM-IPT-912-F) and (1SM-IPT-910-D)

Additionally, other installed components of these systems in the control room were observed, including buffer amplifiers, alarm units, optical transmitters and receivers, and trip logic units. Items such as location, mounting, identification and protection were compared with installation drawings. NRC Region II is aware of and is tracking this problem.

A selective sample of ten NCRs and QCIRs were reviewed relative to problems identified and proposed corrective action. One NCR indicated that a large number (about 500) of connector and support bracket assemblies for instrument components supplied by a vendor (Bailey Meter Co.) have defects such as cracked indicator housings, loose terminals and damaged terminal studs. NRC Region II is aware of and is tracking this problem.

The QC record system was reviewed and discussed with the Instrumentation QC Supervisor and members of his staff. It was noted that this organization has developed and uses inspection checklists for various inspection activities and to document inspection results obtained. These checklists are used in addition to the standard Bellefonte computer cards (slips) which usually indicate acceptability by a single check mark.

b. Instrument Tubing

The assessment in this area was made to determine if installation and inspection of instrument tubing had been accomplished in accordance with appropriate procedures and drawings. The inspector examined records associated with the installation of instrument tubing and tubing supports. A total of 196 instrument tubing records were reviewed. Of these, 184 had been invalidated. A total of 47 inspection records were reviewed for instrument tubing supports. Of these, 45 had been invalidated. The inspectors interviewed TVA-IEU (Instrument) management and the supervisor of TVA-HEU (Hanger) QC to determine the cause for invalidation of these records. The following is a synopsis of information gathered during these interviews.

A TVA audit (BN-I-80-04) was performed during the period of October 6, 1980 through March 19, 1981. The audit investigated elements of the quality assurance program associated with the installation and inspection of instrument tubing. Five deficiencies were observed by this TVA audit:

1. Material used for supports is ASTM A-36 instead of ASME-SA36.

2. Drawings used for inspection did not reflect the latest design changes.

3. Inspection criteria for tubing slope were not clearly defined.

4. Instrument used for measuring slope was not calibrated.

5. Tubing movements were not defined and tubetrack was not inspected.

In part C of the TVA audit report, the audit team concluded:

"As previously noted, the field inspection observed during this audit was the first performed by IEU and thus some problems could reasonably be anticipated. However, as deficiencies 2, 3 and 5 indicate, a great deal of confusion exists as to the exact inspection criteria to be used, i.e., QCP-4.3 or the tubing installation drawings."

"The QA program implementation for instrument tubing installation and inspection is considered inadequate at this time due to the confusion which exists, as stated above. Satisfactory resolution of the deficiences should provide an acceptably implemented QA program."

As a result of this TVA audit, Memo BLN-810417-107, dated 4/17/81, was initiated to suspend inspection activities and initiate a revision to BNP-QCP-4.3. Several revisions to BNP-QCP-4.3 have been issued since the date of the above memo. Additionally, responsibility for installation and inspection of instrument tubing and supports was transferred from TVA-IEU (Instrument) to TVA-HEU (Hanger) in August of 1981.

Audit deficiencies No. 2, 3, 4 and 5 which concern inspection criteria were all closed before October 14, 1981. Audit deficiency No. 1 was closed July 2, 1982. However, all of the invalidated inspection records previously mentioned were completed from March of 1982 through June of 1982.

Interviews with QC inspectors indicate that essentially all installed instrument tubing is unacceptable, and the QC inspectors still do not have the inspection criteria needed to verify adequate installation.

The NRC CAT inspectors expressed their concern that the quantity and continued number of design changes in this area had jeopardized the quality of the installation and status of the presently installed tubing. The continued invalidation of inspection records also raises concern about the adequacy of current QC inspections and/or installed tubing. NRC Region II is aware of and is tracking this problem.

6. Procedures

The NRC CAT inspectors examined approved TVA documents to verify that instructions, procedures and drawings used to accomplish electrical activities affecting quality contain the appropriate inspection/acceptance criteria. Electrical engineering unit QC inspections are performed in accordance with TVA Bellefonte Quality Control Procedures (QCP). The QCPs contain sections for both the inspection and acceptance criteria. The NRC CAT inspectors noted that inspections performed to these criteria alone would be less than adequate. Many of the QCPs reference additional documents, i.e., General Construction Specifications (G-Specs), EN DES Standard Drawings, and manufacturer's instructions. This information is to be reviewed by TVA QC inspectors before performing the inspection.

The additional documents mentioned above receive the same engineering, design and quality reviews as do the QCPs and therefore are acceptable references for inspection/acceptance criteria. The NRC CAT inspectors noted, however, that this reference to other documents caused some confusion among QC inspection personnel.

BNP-QCP-1.3, Maintenance, provides inspection guidelines for maintenance of permanent plant equipment. This procedure does not specifically address inspection of large lead storage batteries, nor does it provide inspection frequencies or inspection records for these items. Section 6.1.1 of this procedure states in part, "manufacturers recommendations for preventive maintenance shall also be implemented." The NRC CAT inspectors reviewed the CD Batteries Division, Eltra Co., Installation and Operation Instruction Manual and noted that, although informative, it does not implement all of the requirements of IEEE Standard 450, 1972, for type and frequency of battery maintenance inspections.

In some instances inspection/acceptance criteria have been placed in Standard Operating Procedures (SOPs). These documents are not referenced in the QCP nor do they receive the appropriate reviews. For example, SOP EEU-SOP-206, "Inspection and Maintenance of Electrical Equipment During Storage," Section 6.3, sets forth requirements for inspection, inspection frequency and inspection records for these items. This document is not appropriate for use as inspection/acceptance criteria.

The NRC CAT inspectors concluded that inspection/acceptance criteria are not appropriately defined in the Quality Control Procedures and that inspection/acceptance criteria have been placed in documents which are not appropriately referenced or reviewed. Work is in progress by a Bellefonte task force to review procedures with the intent to locate quality-related material in QCPs.

7. <u>Inspection Records</u>

The NRC CAT inspectors reviewed records generated for inspections performed in the following areas: cable tray, conduit, electrical cable installation, electrical cable termination, electrical equipment installation, seismic supports, instrument tubing, and instrument installation.

Assessment was performed in this area to determine whether inspection records have been properly prepared, maintained, and contain documented evidence of the inspection completion and results. Electrical inspection records are stored in the quality assurance records storage vault, and were identifiable and retrievable. Inspection records were completed in accordance with the applicable Quality Control Procedures. The records identified the QC inspector by signature or initial, the type of observation by definition or QCP reference, acceptability and initialed reference to documents pertaining to deficiencies. The NRC CAT inspectors expressed their concern to EEU supervision with regard to records provision for inspection results. Most electrical QC inspection records are in the form of a "verification card." This card does not make provision for data such as torque values, pull tensions and other applicable inspection results.

## VI WELDING, NONDESTRUCTIVE EXAMINATION (NDE)

### A. Objective

By direct observation and independent evaluation of work performance, work in progress and completed work, determine whether field welding activities associated with piping, hangers/supports, steel structures, and HVAC systems, are controlled and performed in accordance with NRC requirements, SAR commitments, and applicable codes and specifications.

To determine by direct observation and record review that welders and NDE personnel are adequately trained and qualified in accordance with established performance standards and applicable code requirements.

### B. Discussion

#### 1. Pipe Hangers

Pipe Hangers were reviewed by the NRC CAT inspectors to determine if welds for ASME-NF hanger/supports were made in accordance with applicable codes and specifications. Field-installed and QC-accepted hangers and supports were reviewed to determine if welding was accomplished in accordance with the 1974 Summer addendum of ASME Section NF and TVA's Procedures QCP-6.7, QCP-7.5 and G-29 M.

A total of 21 field installed hangers/supports were selected for review. It is understood that the hangers selected for review had previously been reinspected under NCR 1203 (QA Breakdown Deficient Fillet Welds) and reworked as required. Welds were reviewed by the NRC CAT inspectors for weld size, length, and surface appearance. The matrix of hangers included box, snubber, rod/strut, seismic anchor, and spring types.

In addition to reviewing the physical attributes of welds, hangers were also reviewed to confirm proper identification of welders. (The review to confirm compliance for location, material sizes, and types, configuration, anchoring, and functionality is covered in the section VII.B.2) The number of reinspections performed on each hanger assembly before final acceptance by TVA is not known. However, it appears that the selected hangers may have been reinspected several times before final acceptance by TVA.

Nineteen of the 21 hangers/supports exhibited acceptable welds in accordance with the 1974 Summer addendum of ASME Section NF and TVA's Procedure QCP-7.5 and G-29 M. Two hangers were not in compliance with the applicable codes and specifications. Hanger 1KE-MPHG-3308 exhibited one lug with an undersized weld. Drawing 1KE-MPHG-3308 specified a fillet weld size of 3/16 inch. Actual size was 1/16 inch to 1/8 inch under the minimum specified size. Hanger No. 2ND-MPHG-0066 exhibited one undersize fillet weld. A 1/2-inch weld was specified; actual weld fillet size was 7/16 inch for approximately 50% of the weld length. Both welds had been final QC inspected and accepted.

2. <u>Safety Related Hangers and Supports for Electrical Conduit and Cable Trays</u>.

A total of 25 hangers/supports were examined by the NRC CAT inspectors to determine if field welding had been accomplished in accordance with the structural welding requirements of AWS D.1.1 and TVA's Procedures QCP-7.5, QCP 3.7 and Specification G-29C. The bulk of electrical supports/hangers were fabricated using either square or rectangular steel tubing. The majority of the supports/hangers were shop fabricated and subsequently field-welded to embed plates or structural steel members using fillet welds.

Nine unistrut attachments examined by the NRC CAT inspectors exhibited 100% weld acceptance. These were fillet type welds between the unistrut and support structures.

Fourteen of the 25 hangers/supports inspected by the NRC CAT inspectors exhibited one or more unacceptable field welds. These welds were either undersize or had unacceptable weld contour.

TVA's open noncomformance report NCR 1888, was issued 7/16/82, basically to report undersize welds on cable tray supports, HVAC duct supports, and miscellaneous steel and involves reinspection of approximately 40,000 welds. As of 9/28/82, TVA had reinspected approximately 25,000 welds and had identified 13,750 unacceptable welds for a rejection rate of approximately 55%. NRC inspection results tend to confirm the reject rate for field welding on electrical cable tray and conduit supports/hangers experienced by TVA in its reinspection program initiated by NCR-1888. The undersize weld problem noted in NCR-1888 was reported to the NRC under 10 CFR 50:55(e) on 7/22/82. A detailed review of the undersize weld problems experienced by TVA at Bellefonte is covered below in Paragraph 11 "Undersize Fillet Welds".

3. <u>Heating, Ventilation, and Air Conditioning (HVAC)</u>.

Welds for safety-related duct assemblies, duct supports/hangers, flow balancing devices, floor mounted HVAC equipment, fire dampers, and HVAC containment isolation valves were examined to determine if welding had been performed in accordance with applicable codes and specifications.

The field welds associated with 14 HVAC hangers, 5 flow balancing devices, 3 fire dampers, 2 isolation valves, and 2 duct runs were examined by the NRC CAT inspectors.

HVAC hangers/supports are normally constructed from square or rectangular steel tubing, much like that used for electrical supports/hangers. HVAC hanger/support assemblies for the most part, are fabricated in TVA shops. Field welding of HVAC supports/hangers is usually limited to one or two welds that join the hanger/support assembly to the building steel, or plate embeds. Sheet metal duct sections, and air-balancing devices were normally fabricated by bolting, riveting, soldering, or brazing as standard practices by TVA in conformance with the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standard. Duct sections are field-welded to the hanger/support by perimeter welds to transition sections. Fire dampers installed in duct sections, usually between buildings or floors, are normally bolted to the duct sections. Flow-balancing devices, internal to the duct, are also bolted. The isolation valves were vendor supplied and field welded to the containment liner penetrations.

The brazing and soldering examined appeared to exhibit acceptable workmanship consistent with good standard practice of the sheet metal industry.

Structural welds on the HVAC hangers were visually examined for compliance with AWS Structural Welding Code D.1.1-75, TVA Specification G-29C, and Process Specifications I.C.1.2 and 3.C.5.2(b). A total of 14 structural welds were examined; 7 welds were found to be undersize approximately 1/16 to 1/8 inch. Extensive grinding on several welds was observed that may have contributed to the undersize weld conditions noted. See Paragraph 11, "Undersize Fillet Welds" for additional details.

TVA representatives compared the NRC list of HVAC hangers examined with hangers scheduled for reinspection under NCR-1888 [Cable tray supports, HVAC duct supports and misc. structural items] and reported that two of the welds - those on hangers 4099 and 4004 - had recently been reinspected under NCR-1888 and rejected as being undersize. The other five hangers observed to have under size welds were reported to have been on the list for reinspection, but as yet had not been reinspected.

Two HVAC isolation valves, 1VH-00821 and 1VH-00828, installed by field-welding to the containment pipe penetrations exhibited unacceptable weld contour. The weld joints in question join the valves to 36-inch-diameter, 0.375-inch wall thickness pipes, penetrating thru the containment wall. These welds require radiographic (ASME-MC) inspection. The radiographs for the two valves were viewed and were noted to contain images which appear as undercut. Visual examination of the weld surfaces reveal unacceptable weld contour in the form of an abrupt transition at the toe of the TVA field-weld and the adjacent fillet weld made by the valve vendor. These weld surfaces do not meet the requirements of ASME-MC, paragraph NE-4424. TVA representatives observed the weld surface conditions and agreed with the CAT inspectors findings.

4. Welding Activities in TVA Site Shops

Welding fabrication activities were reviewed in three TVA site shops to assess the overall level of workmanship and the conduct of shop activities. The Hanger Shop, Pipe Shop and the Miscellaneous Fabrication Shop were reviewed by the NRC CAT inspectors. In-process activities covered included documentation practices, shop blueprints, inspection records, welding, flame cutting, saw cutting, machining, bending and general metal preparation activities associated with safety-related hangers, supports, piping, restraints and other miscellaneous fabricated items.

Shop fabrication is being documented by the use of "Field Fabrication"(FF) packages. Field Fabrication documentation packages basically consists of shop blueprints for fabrication, inspection documentation for recording visual and nondestructive testing results, cut-sheets indicating the size of details, and a cover sheet listing drawing numbers, quality level, item number, quantity required, and signatures of the Construction Superintendent, Construction Engineer and the Project Manager. Inspection results are recorded on the FF examination record sheet and are signed by a QC inspector.

In general, the overall welding activities at the onsite shops operated by TVA are being conducted consistent with good shop practices. Shop supervisors and craft personnel appear responsive and knowledgeable in their assigned tasks. Field Engineering personnel appear to be providing an important service in assisting shop supervision in technical guidance and preparation of shop drawings.

The level of workmanship exhibited appeared to be acceptable and consistent with good shop practices.

5. Acceptance Criteria for Visual Examination of Structural Welds

During the NRC CAT inspection of field-welds on structural members it became evident through specification review and discussions with TVA personnel that as many as three, somewhat different, acceptance criterion for inspection of welding exist and are authorized for use. Construction Specification G-29C, contains two Process Specifications 1.C.1.2 and 3.C.5.2(b), which permits the use of three different visual acceptance criteria for welds. Furthermore, Quality Control Procedures for structural steel and the general notes on engineering drawings fail to specify, in many instances, the applicable criteria for visual acceptance of welds. This problem is also evident in many instances in the failure of the QC documentation to uniquely identify the acceptance criteria to be utilized for fabricated hardware. Under these conditions, welds not acceptable under one criterion could be accepted using another criterion, a condition that could cause ambiguity and allow variation in the level of quality specified. TVA representatives, when informed of the above, acknowledged the weakness and indicated the need to more clearly specify visual acceptance criteria.

6. Visual Examination of Piping Welds

A random sampling of piping welds associated with both Units 1 and 2 was conducted to determine if piping welds are fabricated in accordance with applicable codes and specifications. A total of 80 piping welds associated with five systems were examined. The size of piping examined ranged from 1/2 inch to 32-inch diameter. Two welds were identified as having mismatch of at least 1/8 inch (1NM-56S1 and 2NM-199). This is in excess of Code allowables specified in ASME III, NB, NC, ND paragraph 4232 for the pipe wall thicknesses involved (0.375 and 0.365 inch). These welds were field fabricated by TVA. Subsequently, TVA prepared Quality Control Investigation Reports (QCIR) on the observed conditions.

Two stainless steel welds (2NS-307 & 2NS-317S1) in 8 inch schedule 40 pipe appeared to have excessive weld shrinkage. The pipe diameter in the area of the welds were reduced by approximately 0.2 inch. The apparent cause of the shrinkage in one case was due to a cutout of the original weld and rewelding. Discussions with QC inspection personnel indicated the absence of visual examination criteria for shrinkage conditions as noted above. To provide additional control over weld shrinkage, especially after weld repairs, it appears appropriate that visual inspection criteria be provided to the TVA weld inspectors for use in this specific area.

7. Field and Vendor Welded Weld-o-lets

During the examination of field installed piping systems, two TVA-installed weld-o-lets were found that exhibited insufficient weld metal reinforcement. TVA representatives acknowledged the weld deficiency and prepared QCIRs for both weld-o-lets. The two weld-o-let welds are identified as 1KC-761A and 1KC-617E.

TVA representatives acknowledged that criteria were not available to justify weld-o-let installations having less than full reinforcement (as specified by the fixture supplier) and which would permit smaller welds for design conditions less than full fixture rating.

As a result of the above findings of insufficient weld reinforcement, an examination sampling plan for weld-o-lets only was implemented by the NRC CAT inspectors to determine if a larger problem with insufficient weld reinforcement existed. A random walkdown of piping systems was subsequently conducted.

Approximately 20 weld-o-lets were visually examined for weld reinforcement. Eight weld-o-lets installed on the component cooling piping system were observed to have insufficient weld-reinforcement. The 8 weld-o-let welds are identified as: 1KC-00927B, 1KC-00924B, 1KC-00924A, 1KC-00989, 1KC-00665, 1KC-00061, 1KC-00006, 1KC-00008. The 8 welds, identified above, were then reinspected by TVA. The licensee's reinspection confirmed that all of the 8 weld-o-lets failed to meet the minimum requirement for weld reinforcement. All 8 were fabricated offsite by National Valve and Manufacturing Company (NAVCO).

Looking further into this matter revealed that two NCRs (1471 and 1740) had been issued on this concern. The latest (1740), regarding 5 NAVCO weld-o-lets, was issued 2/10/82 and was still an open issue. It appeared that the BNP site personnel were waiting for EN DES to evaluate the reported conditions before proceeding. In view of the potential generic implications of the limited sample inspected by the CAT inspectors (8 deficient welds out of 20 inspected) and the number of possible affected weld-o-lets in BNP critical piping systems, it appears appropriate that prompt action be taken to fully scope the problem.

8. Visual Examination of Structural Steel Welding

The following structural welds shown on TVA drawing 4R W0425-X2-19, R2 were visually examined for compliance to AWS. D.1.1 and TVA Construction Specification G-29C: Weld No. 2697, 2698, 2699, 2701, 2704, 2705, 2706, 2707, 2709, 2692B,and 2692A. These welds are part of the feedwater and main steam restraint system and are located in Unit 1 reactor building.

No rejectable surface defects were observed during the above examination. One unfinished weld on a stiffener plate, adjacent to weld 2709, was observed to have an unacceptable fit-up (excessive weld gap). The TVA representative advised that the weld would be rejected and a QCIR would be prepared.

Also in the structural welding area a random sample of welds were visually examined that are part of a pipe support located in Unit 1, Valve Room A. These welds are shown on TVA drawing 4AW0805-X2-5, R8 and are part of the structure identified as MK 10, Detail A5, Sections C5-C5, B5-B5 and E5-E5. With assistance from TVA NDE personnel, approximately 24 shop fillet and groove welds were measured for compliance with TVA weld dimensions as shown on the above drawing. Several of the fillet welds detailed on sections A5 of the drawing were found to be undersize by 1/16 to 1/8-inch. A QCIR was prepared on the undersize welds observed. Information obtained later indicated that the structural welds inspected by the CAT were covered by NCR 1888, (Undersize Welds in Cable Tray Supports, HVAC Duct Supports and Miscellaneous Structural Items) issued on 7/13/82 and were being tracked for resolution.

## 9. Review of Radiographs - TVA Field Welds

A total of 56 welds were reviewed for radiographic acceptance. Approximately 450 individual radiographs were reviewed to complete the sample of 56 weld joints. Fifteen field-weld (pipe) joint numbers were randomly selected from TVA weld maps (identified per Table VI.1.) Radiographic film for these 15 weld joints was reviewed to determine if the radiographs exhibited acceptable film and weld quality in accordance with ASME III and V (1974, Summer addendum). All of the 15 welds had been previously accepted by TVA. An additional 41 radiographs of field (pipe) welds were selected for radiograph review. Table VI.2. identifies the selected field-welds. The selection was made from TVA's computer listing of completed and accepted welds. Thirty six (36) welds are in Unit 1, the balance of the 20 welds are in Unit 2.

The diameter of the pipe ranges from 0.50 to 42.0 inches. The wall thickness ranges from 0.109 inch to 2.875 inch inches. Both x-ray and gamma-ray (iridium-192) techniques were employed. Four of the radiographs were made using the x-ray technique. The balance of the radiographs was made using gamma-ray techniques.

Radiographs for welds 1NL-00006A, 1NL-0030, 1KE-04141S1, 1KE-4178, 2SV-00048, and 2SV-00049 exhibit marginal film sensitivity in that on at least one view the 4T hole in the penetrameter was barely visible. The radiographs for the above welds required critical examination to perceive the 4T hole. It must be noted that the wall thickness for the above welds ranged from 0.133 to 0.562 inch. All of the above welds were shot using (iridium-192) gamma-ray techniques.

The 4T hole in radiographic film for weld No. 1NC-0036A (View A-B) was not discernible. Review by TVA's NDE Level III resulted in confirmation of the finding for this weld. Subsequently, a QCIR was prepared and TVA representatives stated that the weld would be reradiographed.

The subject radiographs of concern (see comments in table VI.2) were reviewed by TVA's NDE Level III.

Radiographic film quality (density and film sensitivity) were made to the requirements of the 1974 Summer addendum of ASME V and TVA's radiographic procedures QCP-7.1 and 3.m.3.2(C). Radiographic acceptance for weld quality was based on the requirement of the 1974 Summer addendum of ASME III for Class 1, 2 and 3 welds, ANSI B31.1, and TVA's radiographic procedure 3.M.3.2.(c) for radiographic steel material in excess of 0.75 inch. Paragraph T-243, Article 2 of ASME V permits radiography of steel thicknesses less than 0.75 inch using a (iridium-192) gamma-ray source provided the procedure is proven satisfactory by actual demonstration.

Approximately 38 welds had wall thicknesses less than 0.75 inch. Seven of the 38 welds (nearly 18%) with wall thicknesses below 0.75 inch exhibited marginally acceptable RT technique. One radiograph was unacceptable and was re-shot as previously noted.

While Article 2 of ASME V clearly permits use of gamma-ray sources below certain specified minimum thickness ranges, the ASME Code clearly acknowledges that with attention to proper radiographic technique acceptable radiographic (4T) sensitivity can be obtained.

However, as indicated above, evidence of 7 of 38 radiographs being marginally acceptable indicates that improvement is needed with TVA's radiographic technique at BNP using iridium-192 for under 0.75 inch pipe wall thickness. RT procedures using gamma-ray sources to radiograph welds under 0.75 inch should be reviewed, and changed if necessary, to enhance the capability to discern the required sensitivity hole in the penetrameter. Factors such as source size, film speed and exposure time should be included in the procedures to limit the options left up to the Level I RT technician and to provide more control of the techniques using gamma-ray sources.

10. Radiographic Review - NAVCO Shop Pipe Welds

Radiographic film for 21 weld joints (see Table VI.3) was made available to the NRC CAT inspector for viewing at the Bellefonte site. The film was sent from NAVCO, in Pittsburgh, PA, to BNP. Approximately 200 individual films were provided for the 21 weld joints. The diameter of the pipe ranges from 2.5 to 14.0 inches. Wall thickness ranges from 0.203 inch to 1.625 inches. Of the approximately 200 radiographs reviewed one or more radiographs for 8 welds failed to meet ASME Code and TVA Process Specification 3.M.3.2(c) requirements.

Section V, Article 2, Paragraph T-234 of the 1974, Summer addendum, specifies film density requirements. For radiographs made with a gamma-ray source, a density of 2.0 minimum for single film viewing is specified and a film density of 2.6 minimum for composite or double film viewing; each radiograph shall exhibit a minimum density of 1.3. The maximum film density is specified as 4.0 for either single or double film viewing. The actual density readings for the radiographs viewed are shown on Table VI.4.

Further review of this matter indicates that NCR-1291 (NAVCO Spool Piece Radiography Deficiency) had been issued on 11-13-80 and reported to the NRC under 10 CFR 50.55(e) on 11-14-80. The subject of NCR-1291 deals with three shop welds found by BNP site personnel that have radiographs with film density valves that do not meet the requirements of the ASME Code. The conditions reported in NCR-1291 were reviewed by other TVA personnel; visits were made to NAVCO and samples of film were viewed for nonconforming conditions. After this review, TVA closed out NCR-1291 on 6-11-81 by stating that the NAVCO film density problem was an isolated case of improper density and that some radiographs had been incorrectly interpreted in the area of film overlap.

In view of the fact that the NRC CAT inspector found one or more films for 8 of 21 shop welds that fail to meet ASME Code requirements, as noted above and in Table VI.4, it appears that the TVA finding that the nonconforming film was an isolated case may not be valid and should be pursued in greater depth.

11. Undersize Fillet Welds

Commencing about May 1980 a problem with undersize socket welds arose at the Bellefonte Plant (Ref. NCR 1188). As a result, approximately 9400 socket welds were reinspected. During this same time period, undersize welds on safety-related supports were discovered. As a result, approximately 20,600 welds have been reinspected (Ref. NCR 1203). A 10 CFR 50.55 (e) report was prepared to document the undersize weld problems identified as a result of NCRs 1188 and 1203.

Approximately two years after the preparation of NCRs 1188 and 1203, NCR 1888 was prepared identifying an undersize fillet weld condition in structural steel (HVAC, Electrical, Misc.) safety-related members. (see Table VI.5). Approximately 40,000 structural welds have been identified as potentially being undersize. As of 9/28/82; 25,000 of the 40,000 suspected undersize welds have been reinspected.

The NRC CAT examination of welds in pipe supports, HVAC supports, and electrical supports confirms TVA findings as they relate to the undersize fillet weld problem. The NRC's review and detail examination of approximately 800 welds confirms, with very few exceptions, that those welds that have been reinspected by TVA QC have been properly classified.

The NRC's review of approximately 800 welds and examination of present field welding activities reveal that a high percentage of the welds examined and found to be undersize had their surfaces ground. It appears that many of the welds may be undersize because of grinding, and not as a result of having deposited insufficient weld metal. During the NRC CAT inspection activity in the field performing examinations and observing on-going construction work, it was noted that a high percentage of the welds are still being ground despite TVA management's specific instructions to the contrary. The NRC's observation of in-process welding indicates that many of the welds are being ground to obtain a weld surface that is visually acceptable. Although limited grinding is normally necessary for some welds, the high percentage of welds exhibiting ground surfaces may be indicative of more basic problems relating to performance of welding. See Paragraph 12, "Review of Welder Field Performance and Welder Qualification" below for further details in this area.

Approximately 70,000 fillet welds require reinspection and possible weld repair or engineering analysis/justification (see Table VI.5). Discusssions with TVA representatives and NRC CAT inspection results indicate that for ASME III classification of welds (Ref. NCRs 1183 & 1203), those identified as being undersize are being rewelded to obtain the required fillet weld size. Safety-related (non-ASME) structural welds are being reinspected and the as-welded dimensions (undersize welds) submitted to EN DES for evaluation and resolution.

The magnitude (more than 70,000 welds) of the reinspection program requires extensive resources relating to QC, construction, and engineering at levels ranging from the crafts to upper management. Resolution of the undersize weld problem appears to be provided, for the most part, by individuals attempting to independently manage the problem in their own area of responsibility as it relates to the weld problem. Despite this approach, the NRC CAT inspectors have observed that these efforts have produced necessary and positive improvements in the rate of weld acceptance. The acceptance rates for welds inspected for the time period January 1982 to the present is shown below in data supplied by TVA.

| Weld Type | Welds Accepted approx. | Welds Rejected approx. | Total | % Rejected |
|---|---|---|---|---|
| ASME Piping | 4,400 | 55 | 4,455 | 1.25 |
| Pipe Hangers | 18,506 | 436 | 18,942 | 2.3 |
| Structural | 5,895 | 275 | 6,170 | 4.5 |
| | | | 29,567* | |

*Approx. 2,900 visual inspections made per month

12. Review of Welder Field Performance and Welder Qualification

During conduct of the piping run examination, welder identification numbers on piping run welds were recorded. From the total of 80 piping welds examined, 12 welds were selected for purposes of welder qualification review. Inspection documentation for the 12 selected welds was reviewed to determine the scope and type of information contained on these records and if the information regarding welder qualification noted could be correlated. A comparison of the welder identification noted on inspection records was made with the welder's identification on the weld joint in the field.

The welder (pipefitters) qualification records of those welders shown to have made the above mentioned 12 weld joints were obtained and reviewed to confirm proper qualification to perform the particular weld and if the welder qualification met the requirements of the applicable ASME IX and/or AWS D.1.1 Codes. A listing of the welder identification and associated weld joint is shown on Table VI.6(a).

Information relating to type of materials, material thickness, type of welding material, welding process, date that welding was completed, and welder identification was compared with similar information contained in the welder qualification records.

Also a review of welder qualification records for 10 electrical, 6 sheet metal, and 8 ironworker welders was performed to determine if they were properly qualified. A listing of these welders are shown on Table VI.6(b).

A tour was conducted of the training and test facility for training and certifying welders. Interviews were held with individuals responsible for training, and certification of welders and with the head of the Personnel Department.

No violations or deviations were identified during the above reviews. Based on the interviews, discussions and an overall assessment of site welding, several observations are provided for consideration.

a. It appears that there is no limit to the number of times a new hire can attempt to pass the required test for weld qualification, and that many of the welders now employed at BNP, while having passed the entry test, may have limited experience or skills consistent with that required for welding at a nuclear power plant.

b. The BNP weld training group appears to be marginally staffed to provide sufficient monitoring of in-process field welding.

c. Consideration should be given to having TVA welder training personnel involved from time to time, to witness field performance of welders. Such training personnel could attest to skill level and the advisability of maintaining certification/qualification.

d. The present system at BNP for processing new-hire welders, for the purpose of taking the preemployment welding test, appears to have limited safeguards to ensure that the individual taking the welding test is indeed the individual processed by the Personnel Office. It is thought to be relatively easy, because of the lack of a positive identification method (such as photo-identification) for another person to produce an acceptable weld test specimen for the person actually hired. This potential also exists under the present level of safeguards whereby regular welding employees retake qualification tests or attempt to obtain additional welder qualifications.

13. NDE Inspection and Personnel Qualifications

Qualification records were provided by TVA for 18 persons listed as certified to perform various nondestructive examinations. Also records for one individual in training status were included in those provided. Four of the individuals were certified Level I, Radiography; the remaining 14 were certified to Level II in one or more of the following techniques:

| | |
|---|---|
| Radiography | Magnetic Particle |
| Welding Inspection | Ultrasonic |
| Liquid Penetrant | Bubble Leak |

The records were examined for general conformance to the requirements of the TVA QA Training Program Plan Sections III-1 and III-2, dated 6/1/82.

The records, as provided to the NRC CAT inspectors, on five individuals did not contain the required supportive documentation with respect to past experience in the assigned discipline. The names of the five individuals whose files were incomplete have been provided to TVA.

In-process radiography (RT) was observed on the third shift by a NRC CAT inspector. Several radiograph shots were observed in the process of setup and exposure. Four Level I RT inspectors (and one trainee) were observed doing this work and discussions were held to assess their general working knowledge of fundamentals. The Level II RT supervisor was also interviewed during these observations.

No serious deficiencies were identified during the above described interviews and observations, however, it is suggested that the RT technicians (Level I) receive additional working-level assistance from those having a broader base of experience in radiography such as the assigned Level II or others capable of providing day-to-day guidance and training. One area that stands out as being particularly in need is the inability of Level I technicians to effectively assess the quality of weld surfaces prior to doing any RT. Discussions with those involved indicated limited experience in determining if weld seams/joints were acceptable from a surface standpoint before proceeding with RT.

Interviews were also conducted with NDE personnel on both the first and second shifts. Three interviews were held in conjunction with the performance of three in-process liquid penetrant examinations (PT) and one magnetic particle examination (MT). Four in-office interviews were also conducted with NDE personnel. These interviews were conducted to assess the individuals' knowledge of NDE principles and practices in their specific NDE disciplines. Information relative to their past work experience and training was also obtained.

These interviews indicate that the majority of those contacted had relatively limited prior NDE field experience; however, TVA's NDE training program (consisting of 6 months of NDE field experience as a trainee followed by formal training in NDE and certification to Level I) appears to be an effective program for qualifying and upgrading personnel with limited NDE experience.

Magnetic particle examination of weld 2KC-01472S1, (ASME Class 3) was witnessed. Process Specification 3.M.2.1(c) was utilized to perform the inspection of the subject weld. During MT examination of the subject weld, a linear indication was observed in the base material approximately 1/4 inch from the edge of the weld. This indication was evaluated as a base material indication as opposed to a weld metal indication. This MT examination and its evaluation were found acceptable.

Process Specification 3.M.2.1(c) specifies that for ASME Class 1 weld examinations, the area bounded for examination of the weld also includes the base material 1/2 inch on each side of the weld. For ASME Class 2 & 3 welds, Process Specification 3.M.2.1(c) is silent regarding defining the area of interest for weld examination. This deficiency was discussed with TVA's Level III who confirmed that the Process Specification 3.M.2.1(c) is inadequate in that it fails to properly bound the area for Class 2 & 3 welds and that steps will be taken to correct the deficiency.

TABLE VI.1 -RADIOGRAPHIC REVIEW OF TVA PREPARED FILM

[Welds below for radiographic film review were randomly selected from the piping sampling plan]

| Weld Map No. | Unit No. | System | ASME Class | Weld No. | Pipe Dia. | Wall Thickness | Comments |
|---|---|---|---|---|---|---|---|
| WM1NM-4 | 1 | Spent Fuel Cooling | 2 | 1NM00066 | 12.0 | 0.375 | Acceptable |
| " | " | " " " | 2 | 1NM00079 | 10.0 | 0.365 | " |
| " | " | " " " | 2 | 1NM00080 | 10.0 | 0.365 | " |
| " | " | " " " | 2 | 1NM00079D | 10.0 | 0.365 | " |
| " | " | " " " | 2 | 1NM0050T1 | 4.0 | 0.237 | " |
| WM1NS-4 | 1 | Reactor Bldg. Spray | 2 | INS00168B | 1/2 | 0.109 | " |
| " | " | " " " | 2 | INS00165A | ---- | ---- | " |
| " | " | " " " | 2 | INS00153G | 2.0 | 0.154 | " |
| WM1SM-4 | 1 | Main Steam | 2 | 1SM00254Q | 2.5 | 0.276 | " |
| " | " | " | 2 | 1SM00281D | 2.5 | 0.276 | " |
| " | " | " | 2 | 1SM00254F | 2.5 | 0.276 | " |
| " | " | " | 2 | 1SM00257 | 8.0 | 0.719 | " |
| " | " | " | 2 | 1SM00258D | 8.0 | 0.719 | " |
| " | " | " | 2 | 1SM00249 | 8.0 | 0.719 | " |
| " | " | " | 2 | 1SM00271 | 32.0 | 1.340 | " |

## TABLE VI.2 RADIOGRAPHIC REVIEW OF TVA PREPARED FILM

[Welds below for radiographic film review were selected randomly from TVA computer listing of RT accepted welds].

| Weld No | Unit No | System | ASME Class | Pipe Dia | Wall Thickness | Comments |
|---|---|---|---|---|---|---|
| 1NL00006 | 1 | Core Flooding | 1 | 14.0 | 1.406 | View B-C Slag |
| 1NL00007R1 | 1 | " " | 1 | 14.0 | 1.406 | Acceptable |
| 1NL00006A | 1 | " " | 2 | 1.0 | 0.133 | Acceptable; Very Faint 4T Hole - View C |
| 1NL0007AS2 | 1 | " " | 2 | 1/2 | 0.109 | Acceptable |
| 1NL00019AS1 | 1 | " " | 2 | 1.0 | 0.133 | Acceptable |
| 1NC0030 | 1 | Reactor Cooling | 1 | 4.0 | 0.457 | Acceptable; Very Faint 4T Hole - Views A-B & C-D (Acceptable) |
| 1NC00036 | 1 | " " | 1 | 4.0 | 0.457 | Acceptable |
| 1NC0036A | 1 | " " | 1 | 4.0 | 0.457 | Can't see 4T hole View A-B QCIR prepared for reshoot (Unacceptable) |
| 1IM313T1 | 1 | Instrumentation | 1 | 3/4 | 0.154 | Acceptable (X-Ray Source) |
| 1IM00303 | 1 | " | 1 | 3/4 | 0.154 | " " " |
| 1IM00302 | 1 | " | 1 | 3/4 | 0.154 | " " " |
| 1IM00318R1 | 1 | " | 1 | 3/4 | 0.154 | " " " |
| 1IM319R1 | 1 | " | 1 | ? | ? | " " " |
| 1KE01123A | 1 | Component Cooling | 3 | 36 | 0.375 | " " " |
| 1KE04128 | 1 | " " | 2 | 6.0 | 0.280 | " " " |
| 1KE04128BS1 | 1 | " " | 2 | 6.0 | 0.280 | " " " |

TABLE VI. 2 continued

| Weld No | Unit No | System | ASME Class | Pipe Dia | Wall Thickness | Comments |
|---|---|---|---|---|---|---|
| 1KE04137 | 1 | Component Cooling | 2 | 12 | 0.375 | Acceptable (X-Ray Source) |
| 1KE04141S1 | 1 | " " | 2 | 6 | 0.280 | Very Faint 4T hole (Acceptable) |
| 1KE04213S3 | 1 | " " | 2 | 12 | 0.375 | Acceptable |
| 1KE04221S1 | 1 | " " | 2 | 16 | 0.375 | Acceptable |
| 1KE04178 | 1 | " " | 2 | 6 | 0.280 | Very Faint 4T hole, View D-A (Acceptable) |
| 2ND00227 | 2 | Decay Heat Removal | 1 | 14.0 | 1.406 | Acceptable |
| 2ND00228 | 2 | " " " | 1 | 12.0 | 1.312 | Acceptable |
| 2ND00247 | 2 | " " " | 1 | 3.0 | 0.438 | Acceptable |
| 2ND00248 | 2 | " " " | 1 | 3.0 | 0.438 | Acceptable |
| 2ND00263 | 2 | " " " | 1 | 3.0 | 0.438 | Acceptable |
| 2NV00196 | 2 | Make Up | 2 | 1.0 | 0.179 | Acceptable |
| 2NV00683 | 2 | " " | 2 | 6.0 | 0.719 | Acceptable |
| 2NV00684 | 2 | " " | 2 | 6.0 | 0.719 | Acceptable |
| 2NC00005 | 2 | " " | 1 | 38.0 | 2.875 | Acceptable |
| 2NC00007 | 2 | " " | 1 | 25.0 | 2.500 | No Lead Markers I.D. Vibro etched |
| 2NC00008R1 | 2 | " " | 1 | 32.0 | 2.810 | " " " " " " |
| 2SV00045 | 2 | Safety Vent (Main Steam) | 2 | 6.0 | 0.562 | Acceptable |
| 2SV00048 | 2 | " " | 2 | 6.0 | 0.562 | Very Faint 4T hole, View B-C (Acceptable) |

TABLE VI.2 continued

| Weld No | Unit No | System | ASME Class | Pipe Dia | Wall Thickness | Comments |
|---|---|---|---|---|---|---|
| 2SV00049 | 2 | Steam Vent (Main Steam) | 2 | 6.0 | 0.562 | Very Faint 4T hole, View D-E (Acceptable) |
| 2SM173R1 | 2 | Main Steam | B31.1 | 30.0 | 1.588 | Acceptable |
| 2SM172 | 2 | " " | " | 30.0 | 1.588 | Acceptable |
| 2SM197 | 2 | " " | " | 32.0 | 1.340 | Acceptable |
| 2SM00246 | 2 | " " | " | 10.0 | 0.844 | Acceptable |
| 2SM00266 | 2 | " " | " | 12.0 | 1.00 | Acceptable |
| 2SM00187R1 | 2 | " " | " | 42.0 | 1.685 | Views C-D, Slag (Acceptable) View D-E & F-G Inclusions (Acceptable) |

## TABLE VI.3 - RADIOGRAPHIC REVIEW OF NAVCO PREPARED FILM

| Weld No | Unit No | System | Pipe Dia | Wall Thickness | Year Fab'd | Comments (1) |
|---|---|---|---|---|---|---|
| 1NV389 | 1 | Make Up | 2.5 | 0.276 | 11/78 | V 2-3, V 3-4; not per Code. |
| 1NV406 | 1 | Make Up | 2.5 | 0.76 | 5/78 | Acceptable |
| 1NV414 | 1 | Make Up | 2.5 | 0.276 | 9/78 | Acceptable |
| 1NL32 | 1 | Core Flooding | 14.0 | 1.406 | 10/77 | V 3-4 and film gap in overlap area; not per Code. |
| 1NL34 | 1 | Core Flooding | 14.0 | 1.406 | 10/77 | V 4-1 and film gap in overlap area; not per Code. |
| 1ND124 | 1 | Decay Heat | 14.0 | 0.438 | 12/76 | V 2-3, V 1-2, V 3-4, and film gap in overlap area, not per Code |
| 1ND534 | 1 | Decay Heat | 14.0 | 1.406 | 3/78 | V 1-2, V 2-3, V 3-4, not per Code |
| 1ND563 | 1 | Decay Heat | 14.0 | 1.406 | 4/78 | Acceptable |
| 1ND160 | 1 | Decay Heat | 10.0 | 0.365 | 2/77 | Acceptable |
| 1CR598 | 1 | Start-up & Circ. | 6.0 | 0.280 | 10/78 | Acceptable |
| 1CR667 | 1 | Start-up & Circ. | 4.0 | 0.337 | 2/79 | Acceptable |
| 1CR680 | 1 | Start-up & Circ. | 6.0 | 0.432 | 3/79 | Acceptable |
| 2CF55 | 2 | Feedwater | 20.0 | 1.50 | 6/79 | V 2-3 and film gap in overlap area; not per Code. |
| 2CF78 | 2 | Feedwater | 22.0 | 1.625 | 5/79 | Film gap in overlap area; not per Code. |
| 2NV30 | 2 | Make Up | 4.0 | 0.237 | 6/79 | Acceptable |

Table VI.3 Continued

| Weld No | Unit No | System | Pipe Dia | Wall Thickness | Year Fab'd | Comments (1) |
|---|---|---|---|---|---|---|
| 2NV42 | 2 | Make Up | 2.5 | 0.203 | 9/79 | Acceptable |
| 2NV43 | 2 | Make Up | 2.5 | 0.203 | 9/79 2 | Acceptable |
| 2NV64 | 2 | Make Up | 2.5 | 0.375 | 9/79 | Acceptable |
| 2NV119 | 2 | Make Up | 6.0 | 0.718 | 4/79 | Acceptable |
| 2NV120 | 2 | Make Up | 6.0 | 0.718 | 2/79 | Acceptable |
| 2NV432 | 2 | Make Up | 2.5 | 0.276 | 10/79 | V 1-2 not per Code |

(1): See Table VI.4 for film densities that are not acceptable under ASME Section V, Article 2, Paragraph T-234.

## TABLE VI.4 - NAVCO SHOP RADIOGRAPHS - MEASUREMENTS(1) OF FILM DENSITY FOR SELECTED WELDS

| WELD NO. | PENETRAMETER SINGLE VIEWINGS ≥ 2.0 ≤ 4.0 | PENETRAMETER(2) DOUBLE VIEWINGS ≥ 2.6 ≤ 4.0 | SUBJECT SINGLE VIEWING ≥ 2.0 ≤ 4.0 | SUBJECT(2) DOUBLE VIEWING ≥ 2.6 ≤ 4.0 | COMMENTS |
|---|---|---|---|---|---|
| | ACTUAL AND REQUIRED DENSITIES | | | | |
| INV-389 | 1.72 - 1.93 | 4.28 | 1.46 - 1.94 | 4.14 - 4.34 | Notes 3, 4, 5 |
| INL-32 | 1.26 - 1.74 | | 1.25 - 1.81 | | Notes 3 & 5 |
| IND-124 | 1.16 - 1.50 | | 1.25 - 1.75 | 3.85(6) | Notes 3 & 5 |
| IND-534 | 1.22 - 1.45 | | | | Notes 3 & 5 |
| 2CF-55 | 1.95 - 2.53 | 4.23 - 4.90 | 2.00 - 2.20 | 4.37 - 4.50 | Notes 3 & 7 |
| 2CF-78 | 2.09 - 2.45 | | 2.39 - 2.58 | 5.30 | Note.7 |
| 2NV-432 | 1.30 - 1.44 | | 1.22 - 1.43 | | Notes 3 & 5 |
| 1NL-34 | 1.37 - 1.88 | | 1.18 - 2.01 | | Note 3, 5, 7 |

Notes:

(1) Density measurements made using a densitometer

(2) Each of the film for double film viewing shall be at least 1.3 density.

(3) Film does not meet density of 2.0 min. requirement for single film viewing.

(4) Film does not meet density of 4.0 max. requirement for double or single film viewing.

(5) Film does not meet density of 1.3 min. for double film viewing.

(6) Exceeds 30% density range permitted

(7) Gap exists between film in area of overlap.

## TABLE VI.5 - NONCOMFORMANCE RELATING TO UNDERSIZE FILLET WELDS

| NCR NO. | DATE ISSUED | CAUSE | TOTAL WELDS | REIN-SPECTED | ACCEPTED | REJECTED |
|---|---|---|---|---|---|---|
| 1173 | 4/16/80 | Improper Recording of visual Weld Records | | | | |
| 1188 | 5/5/80 | Undersize socket welds | 9451 | 9451 | 8783 | 668 (7.1%)* |
| 1203 | 5/21/80 | Undersize welds supports | 20,662 | 20,662 | 13,108 | 7554 (37%)* |
| 1563 | 8/13/81 | Inaccessible socket welds | | | | |
| 1968 | 9/1/82 | Undersize structural welds | | | | |
| 1888 | 7/13/82 | Undersize structural welds | 40,000 | 25,000 as of 9/28/82 | 11,250 | 13,750 (55%)* |

* Rejection rate

TABLE VI.6 - WELDER QUALIFICATION

(a) Review of pipefitter welder qualifications for piping run sampling plan

| Welder I.D. | Weld Joint No. |
|---|---|
| FAOK | WM-INS-4, Weld 86 |
| FATE | WM-IN5-4, Weld 87T1 |
| FAME | 2NM-8, Weld 199 |
| FAPT | ONM-1, Weld 19A |
| FAJO | 1KC-8, Weld 696M |
| FAPO | 1KC-8, Weld 697A |
| FBKU | 1KC-8, Weld 696F |
| FALT | 1SM-4, Weld 166A |
| FASD | 1SM-4, Weld 255 |
| FABG | 1KC-11, Weld 617E |
| FAXD | 1KC-11, Weld 760 |
| FADS | 1KC-11, Weld 762B |

(b) Review of welder qualifications for randomly selected iron workers, sheetmetal and electrical welders.

| CRAFT | WELDER I.D. |
|---|---|
| Electrical | EABQ |
| Electrical | EAAW |
| Electrical | EAAK |
| Electrical | EABD |
| Electrical | EABG |
| Electrical | EACA |
| Electrical | EACH |
| Electrical | EACM |
| Electrical | EACV |
| Electrical | EADO |
| Structural | IAAC |
| Structural | IAAE |
| Structural | IAAU |
| Structural | IABA |
| Structural | IABP |
| Structural | IACB |
| Structural | IAEN |
| Structural | IAEX |
| Sheet Metal | SAAD |
| Sheet Metal | SAAQ |
| Sheet Metal | SAAZ |
| Sheet Metal | SABI |
| Sheet Metal | SABQ |
| Sheet Metal | SABW |

## VII MECHANICAL CONSTRUCTION

### A. Objective

The primary objective for the assessment of mechanical construction was to determine the conformance of installed and QC accepted safety-related mechanical items to engineering design, regulatory requirements and to licensee commitments. Specific areas evaluated were piping, pipe supports/restraints, mechanical equipment and HVAC (duct, supports and equipment).

The secondary objective was to evaluate the adequacy and effectiveness of the licensee's QA/QC program in controlling, inspecting and documenting ongoing and completed work activities in each of these areas.

### B. Discussion

To accomplish the objectives stated above the following tasks were performed in each area:

- A detailed field inspection of a sampling of QC accepted hardware
- A review of procedures and documentation
- Discussions with responsible QC and Engineering personnel. These discussions served to determine overall knowledge of site procedures, inspection and acceptance criteria and to identify problems with procedures, design/field engineering/QC interfaces, inspector qualification and QC independence.

#### 1. Piping

a. Field Inspections

The NRC Construction Appraisal Team (CAT) inspectors selected a sample of installed piping system (sub-system) runs that had been accepted by QC. The following lines, totalling approximately 1,000 feet, were selected to include different systems, building locations, diverse configuration and sizes.

| System | Weld Map | Segment No. | Diameter |
|---|---|---|---|
| Reactor Bldg. Spray | 1 NS-4 | P14,16,20,34,25 | 8" & 2" |
| Main Steam | 1 SM-4 | P60-67 | 8" & 12" |
| Component Cooling | 1 KC-8 | P47-52 | 24" |
| Component Cooling | 1 KC-2 | P1,2,3,5 | 1" & 2" |
| Spent Fuel Pool Cooling | 1 NM-8 | P35-39 | 4" |
| Spent Fuel Pool Cooling | 2 NM-9 | P108,109 | 4" |

The above runs were then inspected in the field for proper configuration, identification of pipe and valves, surface condition, valve orientation, bolted flange connections, interferences and support/restraint location and function. The following documents provided the acceptance criteria used for the inspections:

BNP-QCP-6.8, Rev. 2 Add. 2, "Pipe Bending"
BNP-QCP-6.9, Rev. 3, "Valves"
BNP-QCP-6.10, Rev. 3 Add. 1, "Exposed Piping"
BNP-QCP-6.19, Rev. 1, "Bolted Flange Connections"
BNP-QCP-7.9, Rev. 10, "Fitup & Cleanliness"
BNP-QCP-10.9, Rev. 9, "Material Identification & Marking"
Construction Specification N4M-870, Rev. 6, "Field Fabrication, Assembly, Examination and Tests for Piping Systems for Bellefonte Nuclear Plant"
Construction Specification N4C-913, Rev. 0, "Support and Installation of Piping Systems in Category I Structures"
General Specification G-43, Rev. 6, "Installation of Piping Systems For Nuclear Plants"
Applicable Mechanical Piping Drawings
Applicable Weld Maps
Applicable Division of Engineering Design (EN DES) Stress Isometrics showing support locations and types
ASME Code, Section III (1974)

Piping is installed by the crafts and inspected by QC to the mechanical drawings. Supports/restraints are installed by the crafts and inspected by QC to support detail drawings. The NRC CAT inspectors utilized the EN DES stress isometrics for support/restraint locations and basic configuration instead of the mechanical and support detail drawings as a check that the piping was installed and supported/restrained as analyzed by the designers. Not all supports/restraints had been installed at the time of inspection.

Configuration, valve and pipe identification, support/restraint location, function and flanged joint makeup were good.

Valve 1KC-VTAC-44-A was installed and QC accepted with the operator in the vertical position, but the mechanical piping drawing shows the valve with the operator horizontal. Valve 1KC-1FCV-313A was installed and QC accepted with the operator installed one bolt (18 degrees) from vertical, but is shown on the mechanical drawing as mounted vertically. Paragraph 7.1.d of BNP-QCP-6.9, to which these valves were inspected and accepted, requires valves to be installed with the operator in the proper direction and attitude as shown on the location drawing.

b. Review of Procedures and Documentation

The following procedures related to the piping system walkdown for construction turnover were reviewed and discussed with responsible personnel:

BNP-QCP-9.2, Rev. 5, "Transfer of Permanent Plant Equipment, Systems, or Structures to the Division of Nuclear Power"

ID-QAP-1.2, Rev. 2, "Transfer of Responsibility for the Plant from OEDC to Power"

BNP-SOP-BLA7.7, June 17, 1982, "Transfer of Plant Features"

The following QC documentation records for the inspected piping runs were reviewed for completeness and accuracy:

| | |
|---|---|
| Exposed Piping Installation Inspection | Test No. 83 |
| Exposed Piping Closure Inspection | Test No. 85 |
| Bolted Flange Inspection | Test No. 97 |
| Valve Installation Inspection | Test No. 82 |
| Valve Tag Installation Inspection | Test No. 88 |

The NRC CAT inspectors found that, in general, procedures related to piping installation and inspection were adequate. However, BNP-QCP-6.10 appeared to need clarification in two areas. Paragraph 7.1.b (acceptance criteria) does not specifically state that surface defects should be documented, evaluated and dispositioned on a QCIR, but states that they should be reported to the Welding Engineering Unit for resolution prior to accepting the inspection. Paragraph 7.1.c.4 refers the inspector to design drawings, specification G-43 and the 3GA0059 series drawings for clearance criteria relative to thermal and seismic movements. However, G-43 and 3GA0059 do not specifically address seismic or thermal expansion except for penetration sleeves.

Several minor discrepancies were noted in the quality documentation that indicate some inattention by inspectors and/or a lack of clear guidance. Two inspection items on valve installation inspection cards for four identical valves were signed by QC as "acceptable" on two cards and "not applicable" on the other two cards. The valves involved were 1KC-VTAC-40A,-42A,-44A and 1-KC-FCV-313A. The inspection items were stem lubrication and installation of thread protectors.

Valve tag installation inspection cards for valves 1KC-VTAC-44A, 1KC-VTAC-F72A, 1KC-VCAC-E56A and 1KC-VJDC-4[illegible]A inspected in October 1981, referenced the revision and addendum to QCP-6.9 that was not issued until September 1982.

The preliminary Bellefonte program to address IE Bulletin 79-14 appears to be comprehensive and the site development efforts are being directed by a knowledgeable engineer with a stress analysis background.

The NRC CAT inspectors had two concerns about the construction turnover walkdown procedure QCP-9.2; no specific attributes to be inspected during the walkdown are identified, and QC inspectors are currently not included on the walkdown team. The turnover walkdown is an important quality feature in that deficiencies and damage caused by general construction activities and subsequent/non-safety installation can be identified on hardware that may have been properly installed and QC accepted earlier.

c. Discussions with QC and Engineering personnel

During the course of inspections and procedure/documentation reviews, approximately 6 personnel (field engineers, QC inspectors and lead engineers and inspectors) were interviewed.

In general, inspection and engineering personnel appeared knowledgeable of the procedures and installation and inspection requirements.

2. Pipe Supports/Restraints

a. Field Inspections

The following sample of 21 installed and QC accepted pipe supports/restraints were selected. Items were chosen to provide a variety of types, sizes, systems and locations.

| Support/ Restraint No. | Size | Type | Building Location |
|---|---|---|---|
| 1CA-MPHG-0009 | 6" | Stanchion | Reactor |
| 1CF-MPHG-0219 | 8" | Strut (Trap) | Aux |
| 0KC-MPHG-0239Sht.2 | 14" | Box | Aux |
| 1KC-MPHG-0001 | 24" | Box | Aux |
| 1KC-MPHG-0017Sht.1 | 24" | Snubber | Aux |
| 1KC-MPHG-0804 | 24" | Spring | Aux |
| 1KE-MPHG-0639 | 12" | Rod (Trap) | Aux |
| 1KE-MPHG-0770Sht.2 | 12" | Snubber | Control |
| 1KE-MPHG-3308 | 2 ½" | Strut (Lug) | Aux |
| 1ND-MPHG-0047 | 3" | Rod | Reactor |
| 1ND-MPHG-0551 | 14" | Snubber | Aux |
| 1ND-MPHG-0587Sht.1 | 10" | Spring | Aux |

| Support/ Restraint No. | Size | Type | Building Location |
|---|---|---|---|
| 1ND-MPHG-1022 | 4" | Box (Lug) | Aux |
| 1NL-MPHG-0005 | 14" | Spring (Lug) | Reactor |
| 2NV-MPHG-1293 | 2" | Box | Aux |
| 1GC-MPHG-0002 | 4" | Anchor | Diesel |
| 1KC-MPHG-0474 | 6" | Box (Lug) | Reactor |
| 1ND-MPHG-0022Sht.2 | 14" | Strut | Reactor |
| 1NV-MPHG-0585 | 2" | Strut | Aux |
| 2NB-MPHG-0066 | 4" | Anchor | Aux |
| 1ND-MPHG-0010Sht.2 | 14" | Snubber (Lug) | Reactor |

The above supports/restraints were inspected against their detail drawings for configuration, identification, location, fastener/anchor installation, clearances, member size and damage/protection. In addition, approximately 100 other unidentified supports/restraints, were observed for obvious deficiencies such as loose fasteners, improper clearances or angularity, damage and improper anchor spacing. Approximately 25 other unidentified restraints were examined specifically for acceptable welded lug to restraint gaps.

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

BNP-QCP-2.8, Rev. 9, "Bolt Anchors Set in Hardened Concrete"
BNP-QCP-6.13, Rev. 5, "Seismic Support Modifications"
BNP-QCP-6.17, Rev. 3, "Seismic Support Installation and Inspection"
General Construction Specification G-32, Rev. 7, "Bolt Anchors Set in Hardened Concrete"
General Construction Specification G-43, Rev. 6, "Support and Installation of Piping Systems in Category I Structures"
Construction Specification N4C-913, Rev. 0, "Support and Installation of Piping Systems in Category I Structures"
Dwg. 3GA0059-00, Rev. 9, "Notes for Field Fabrication & Installation of Piping and Supports in Category I Structures"
Dwgs. 3GB0062-00, 3B0063-00, 3GB0064-00, 3GB0067-00 3GB0068-00 and 3GB0053-00
Applicable Support Restraint Detail Drawings
ASME Code, Section III, Division 1, Subsection NF (1974)
FSAR Section 3.9
Grinnell standard Component Detail Sheets

In general, supports/restraints were installed in accordance with design documents. With the exception of two loosened/moved struts, no major discrepancies that would have affected system operation or integrity were identified. However, the following discrepancies were identified on the sample of 21 supports/restraints.

| | |
|---|---|
| 1KC-MPHG-0474 | Wrong side of lugs welded to pipe |
| 1ND-MPHG-1022 | Lug to support gap exceeds allowable |
| 1NV-MPNG-0585 | Strut loosened and moved along pipe |

In addition, the following discrepancies were observed on other supports/restraints:

| | |
|---|---|
| 1NVC-0641 | Strut loosened and moved along pipe |
| 1ND-0765 Sht. 1 | Locknut on strut loose |
| 1ND-0003 Sht. 2 | Locknut on strut loose |
| 1KC-0003 Sht. 1 | Snubber unprotected with cement grout on support cylinder |

b. Review of procedures and documentation

The documents above were reviewed and evaluated during field inspections for thoroughness, clarity, consistency and accuracy. In addition the Hanger Engineering Unit's (HEU) internal audit program, weekly plot of support/restraint inspection acceptance rates and support/restraint QCIR trending results were examined and discussed with HEU management.

Completed Support Inspection Checklists (Test No. 79) and referenced documentation (Anchor Support Variances, Work Releases, Quality Control Investigation Reports) for each of the 21 supports/restraints were reviewed for completeness and accuracy.

The quality documentation for these supports/restraints appeared to be adequate.

Several good practices were also observed. The computerized Pipe Hanger Information System appears to be an effective, useful means to track support/restraint inspection status. The fast turnaround on modifications and updating of support drawings allows inspections to current drawings with no outstanding change documents. To facilitate production and inspection acceptance of supports/restraints with minor discrepancies that can be corrected on the spot, and yet properly document the improper fabrication, a generic QCIR is utilized. Discrepancies such as loose or short fasteners, missing locknuts, etc. for many supports are thus logged on one QCIR which permits trending and evaluation of these items and yet many repeat inspections are avoided.

Two items of concern were identified by the NRC CAT inspectors. Acceptance criteria for supports/restraints are contained in numerous documents (at least 14 specifications, drawings, QCPs, vendor catalogues, etc.) in addition to hanger detail drawings and written directives, memos and variances. This makes it very difficult for QC inspectors to be aware of and correctly discern acceptance criteria for the approximately 30 inspection features for each support. The discrepancies identified during this inspection and the problems detailed in the following paragraph underscore the need for clear concise instructions and acceptance criteria.

The second item of concern involves an apparent lack of attention to identified problems in the support/restraint QC inspection program. TVA had identified problems with the QC inspection program in 1980 and 1981 which required changes to QCP-6.17, issuance of detailed checklists and reinspections of all hangers accepted prior to April 1981. The NRC Region II office has cited TVA twice for failure to follow procedures in the inspection of supports/restraints in December 1981 and June 1982. These citations were based on findings similar to those identified by the NRC CAT inspectors on installed and accepted hardware. The importance of this matter was highlighted to TVA management from Region II management in July 1982. The TVA response to the 1981 citation referred to an internal Hanger Engineering Unit (HEU) "next day" audit of QC accepted hangers as an action to prevent recurrence. However, at the time of this inspection no written program existed for these audits and results. In addition, although extensive data regarding the types, extent and severity of hanger discrepancies is available from QCIRs, no formal program exists to tabulate, analyze and react to this data. Two tabulations of QCIR discrepancies covering two different length periods in 1982 were provided, but their value alone is questionable and no evaluation had been made. Finally, in the TVA September 13, 1982 response to the June 1982 NRC violation, there is a statement that the internal audit "program is showing evidence of improvement based on the latest finding by the HEU audit team". Audit data was tabulated at the request of the NRC CAT inspectors.

Following is a summary of this data:

| Month | Supports Inspected Audits | Number Unacceptable | % Unacceptable |
|---|---|---|---|
| January | 38 | 8 | 21% |
| February | 24 | 5 | 21% |
| March | 20 | 3 | 15% |
| April | 25 | 4 | 16% |
| May | 27 | 2 | 7% |
| June | 48 | 9 | 19% |
| July | 73 | 32 | 44% |
| August | 86 | 24 | 28% |
| September | 37 | 13 | 35% |

None of the above reinspection failure rates are considered acceptable by the NRC CAT inspectors and they do not support the statement provided in TVA's response to the NRC.

Although a cursory review of the audit findings by these inspectors indicated very few items that could be potentially significant technical problems, the TVA QA/QC program has not aggressively pursued the QC inspection problems identified 9 months earlier (which were supported by subsequent TVA data) to determine if significant problems exist.

When the site performs the IE Bulletin 79-14 inspection some of these deficiencies could be identified.

c. Discussions with Inspection and Engineering Personnel

During the course of inspections and procedure/documentation reviews approximately 9 field personnel (engineers, QC inspectors and supervisory engineers and inspectors were informally interviewed.)

In general, TVA inspectors had a good knowledge of procedures except for some confusion in relation to specific acceptance criteria. TVA inspectors expressed concern over the volume and variety of acceptance criteria and related directives/information.

It is the opinion of the NRC CAT inspectors based on the findings in the support/restraint inspection program and as supported by inspector interviews, that the training program for HEU inspectors needs to be strengthened and expanded. It is the understanding of these inspectors that a new and expanded training program is currently under development by the HEU.

3. Mechanical Equipment

a. Field Inspections

The following sample of installed and QC accepted mechanical equipment was selected and inspected for proper location, identification, foundation/support configuration and condition, in place storage condition and damage.

| | |
|---|---|
| 1NV-MPMP-001A | High Pressure Injection Pump |
| 1ND-MCLR-004B | Decay Heat Removal Cooler |
| 1NB-MTNK-030 | Reactor Coolant Distillate Stor. Tank |
| 2NS-MTNK-003N | NaOH Tank |
| 2NS-MPMP-001A | Reactor Building Spray Pump |

After identification of some problems on this equipment, the following additional items were examined in the field:

| | |
|---|---|
| OWL-MTNK-024 | Tritiated Waste Holdup Tank |
| 2NB-MTNK-23N | Reactor coolant Bleed Holdup Tank 1A |
| 1NV-MCLR-005 | Seal Return Cooler |
| 1NB-MTNK-022 | Reactor Coolant Distillate Storage Tank |

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

BNP-QCP-6.3, Rev. 3, "Mechanical Equipment"
BNP-QCP-6.7, Rev. 10 "Inspection of HVAC Duct and Mechanical Equipment Supports"
Vendor Instruction Manuals and Drawings
TVA Mechanical, Miscellaneous Steel and Concrete-Equipment Foundations design drawings

No problems were identified in regard to location, identification, in-place storage or damage to mechanical equipment. However, the following problems related to foundation attachments were observed:

| | |
|---|---|
| 1NB-MTNK-030 | 1 nut 1 1/4 turns from tight. |
| 2NB-MTNK-33N | 2 washers not per detail drawing. No clearance on one side of sliding end vs 1/4 inch shown on drawing. |
| 1NB-MTNK-022 | 2 nuts backed off 1/2 to 1 inch. 1 Neoprene pad not installed at location specified on drawing. Sliding end foundation pad nut loose (north end). |
| 2NB-MTNK-23N | Washer missing. |

BNP-QCP-6.3 requires inspection verification that embedded anchor bolts are tightened per EN DES requirements. It should be noted that these items had been inspected between 1977 and 1980.

b. Review of procedures and documentation

The documents listed above were reviewed and evaluated during field inspections for thoroughness, clarity, consistency and accuracy.

The following QC documentation records for the initial sample of 5 items were examined for completeness and accuracy.

Sequence Control Charts
Equipment Installation Inspection - Test No. 81
Prior to Construction Test Equipment Inspection-
Test No. 84

The quality documentation for installation of mechanical equipment was on file, complete and appeared adequate.

The inspectors had concerns about the adequacy of acceptance criteria contained in BNP-QCP-6.3 "Mechanical Equipment", in the following three areas.

Paragraphs 6.2.e and 7.1.5.a specify tightening of embedded anchor bolts per EN DES requirements. The specific requirements or at least the specific source documents should be referenced to enable the inspector to establish the proper acceptance criteria.

Paragraph 6.2.e specified that where required for thermal expansion, anchor bolts will be left loose. What constitutes "loose", how to achieve that state and whether a means is required to retain the nut in the proper condition is not specified. As an example, the Decay Heat Removal Cooler, 1ND-MCLR-004B sliding end anchor nut was not loose, but it did appear to be less than fully tightened (gaps under one side of the cooler bracket). Engineering personnel were still researching the requirements in this area at the conclusion of the inspection.

Paragraph 6.6 requires the QC inspector to identify additional acceptance criteria documents and list them on the inspection card. What resources, if any, the inspector must research for this information are not given. No additional documents were indicated on any of the inspection cards reviewed by the NRC CAT inspectors.

c. Discussions with QC and Engineering personnel

During the course of inspections and procedure/documentation reviews, approximately 5 field engineers, QC inspectors and supervisory engineers and inspectors were informally interviewed.

Current inspection personnel indicated they were familiar with procedures and would seek assistance from Engineerng on questionable issues.

4. HVAC

a. Field Inspections

The following samples of duct, duct supports and equipment were selected and inspected in the field for proper location, configuration, identification and damage:

Duct map DM1VA, Rev. 2, Duct pieces 220-239 and 246-252
Supports OVC-119, 1VA-344, 1VA-3948 and 1VA-4013
Equipment:

| | |
|---|---|
| 1VA-MFAN-008 | Fan |
| 2VA-MAHU-140B | Air Handling Unit |
| 1VA-MFAN-184N | Fan |
| 2VA-MDMP-730A | Fire Damper |
| 1VA-NDMP-696A | Fire Damper |

As a result of problems identified during inspection of the above equipment, the following additional items were examined in the field:

| | |
|---|---|
| 1VA-MFAN-033A | Fan |
| 1VA-MFAN-133B | Fan |
| 1VA-MFAN-183 | Fan |
| 1VA-MFAN-131B | Fan |

Approximately 8 additional unidentified fans and air handling units were also examined.

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

BNP-CTP-6.4, Rev. 0, "HVAC Duct Test"
BNP-QCP-6.4, Rev. 3, Add. 2, "HVAC Ductwork"
BNP-QCP-6.7, Rev. 10, "Inspection of HVAC Duct and Mechanical Equipment Supports"
TVA Drawing 3BA0900-00, Rev. 5, "Mechanical Heating, Ventilating & Air Conditioning Sheet Metal Details"
SMACNA High Pressure Duct Standards (1969)
Applicable detail drawings

The general installation and configuration of QC accepted HVAC hardware appeared to meet requirements. One joint in the inspected duct run did have 4 loose companion angle bolts, but this did not appear to be a pervasive condition. Extensive use of sealant on all joints prevented thorough inspection of bolting conditions in some cases. Several discrepancies were observed in duct pieces that had not been QC inspected including additional access doors (not shown on drawings) with missing wing nuts, one joint with no gasket installed and numerous duct pieces that did not have the shop fabrication inspectors initials as required by QCP-6.4.

QC accepted HVAC equipment (fans and air handling units) did have a major problem with loose or missing foundation nuts/bolts as summarized below:

| | |
|---|---|
| 1VA-MFAN-133B | 2 loose nuts, damaged stud |
| 1VA-MFAN-183 | 1 nut loose, 1 nut missing |
| 1VA-MFAN-131B | 1 nut backed off stud |
| 2VA-MAHV-140B | 2 loose nuts |
| 1VA-MFAN-033A | 1 nut back off stud, 1 stud and nut cut off |

These items were inspected by TVA QC per QCP-6.3, "Mechanical Equipment", and are provided as further examples of the failure to follow inspection procedures.

TVA audit BN-M-82-08 did previously identify some of the above deficiencies which were being followed under the audit system.

b. Review of procedures and documentation

The documents listed above were reviewed and evaluated during field inspections for thoroughness, clarity, consistency and accuracy.

The following QC documentation records for the initial sample items inspected were examined for completeness and accuracy.

- Sequence Control Charts
- Duct Fabrication Inspection - Test No. 78
- Hanger and Restraint Installation Inspection - Test No. 79
- Duct Installation Inspection - Test No. 80
- Equipment Installation Inspection - Test No. 81
- Prior to Construction Test Equipment Inspection - Test No. 84

The required HVAC documentation with the exception of duct leak check test results, was on file in the vault.

The inspectors had several concerns with HVAC procedures and their implementation.

Prior to 7/22/82, no procedure existed to describe the methods for performing and documenting duct leak checks required by design drawings. The acceptability of tests already performed (approximately 50% of ducting) and the status of existing documentation (kept in a binder at an inspectors desk) have not been addressed by TVA. In addition, the new test procedure BNP-CTP-6.4 does not address the testing or inspection of boundary joints between separate test runs.

Sealant has been liberally applied by the crafts to many duct joints prior to installation inspection which makes verification of gasket and bolt installation difficult.

QCP-6.4, "HVAC Ductwork", lists 13 attributes of duct fabrication to be inspected in the shop. However, the inspection card, which only lists 5 sign offs, is not completed by the inspector at the time of inspection, but is signed off by the installation inspector after the duct has passed inspection and leak checking in the plant. This can be months or years later. The shop inspector is to indicate his acceptance by marking his initials on each duct section and, if at installation inspection no initials are visible, the piece is to be removed and reinspected at that time. The NRC CAT inspectors observed numerous installed duct segments (with sealed joints) that had no visible inspector initials. QC inspector stated that there had been concerns about the use of initials and that the methods of initialing segments had been changed to provide greater assurance that only properly QC inspected segments had initials. An inspection checklist not only serves as the required documentation that specific inspections were performed and by whom, but is an aid to the inspector in assuring that no features requiring inspection are overlooked. The duct fabrication inspection checklist should be utilized and signed off by the inspector doing the shop inspection at the time of inspection.

Following are examples of a lack of clear guidance to QC inspectors in regard to acceptance criteria. QCP-6.4 does not provide clear (quantified) acceptance criteria for "unacceptable damage" or "interference with other components or systems" (such as is detailed in Construction Specification N4C-913) which could affect the function of safety-related piping and structures. Detailed duct support drawings and QCP-6.7, "Inspection of HVAC Duct and Mechanical Equipment Supports" do not specify any measurement tolerance for the major "A", "B", "C" dimensions of hanger support steel. Detail drawings 3BA0900-00, "HVAC Sheet Metal Details", do not specify attachment details, i.e. weld size, for fire dampers or fire door attachment lugs. QCP-6.7 does not require torquing of unistrut bolts as is required for seismic pipe hangers and requires only half of the sample size for visual inspection of concrete expansion anchors specified for pipe hangers. QC Inspectors' diaries indicate that, as in the pipe support program, inadequate thread engagement of concrete anchor bolts is a frequently identified discrepancy. However, as minor discrepancies are fixed "on the spot" during an inspection (without documentation on a QCIR) and no QCIR trending has been performed, the existence or extent of any problems in this area have not been evaluated by TVA. QCP-6.7 specifies a maximum gap of 1/8 inch between baseplates and concrete surfaces where 1/2 inch diameter bolts are used. However, HVAC drawings reference an ENDES memo written in 1978 that allows gaps of 3/16 inch for all size bolts. The above examples are indicative of a need for management attention in the area to preclude serious problems in the future.

c. Discussions with QC and Engineering personnel

During the course of inspections and procedure/documentation reviews, approximately 5 field engineers, QC inspectors and supervisory engineers and inspectors were informally interviewed.

Responsible QC inspectors appeared to be knowledgeable and conscientious, but they confirmed the concerns expressed above by indicating that written guidance was not clear and that they were left to their own judgement in a number of areas.

5. General

Paragraph 6.3.2.1 of BNP-QCP-2.8, "Bolt Anchors Set in Hardened Concrete", specifies that each brand of self-drilling anchors (American and Phillips) "must be kept separate". During this inspection the inspectors and MEU QC inspectors observed boxes of both types of anchors (sleeves and expansion cones) mixed together. These were observed on several elevations. Assembly of sleeves and cones from different manufacturers would produce an installation that has not been properly qualified (tested) for design loads.

VIII. CIVIL AND STRUCTURAL

A. Objective

Determine by direct observation and independent evaluation whether work and inspection performance relative to the civil engineering area are being accomplished in accordance with specifications and procedures.

The specific areas evaluated were rock anchors/containment tendons, cadwelds, concrete chipping and drilling/cutting of reinforcing steel, concrete placement, structural steel and liner plate.

B. Discussion

1. Rock Anchors/Containment Tendons

a. The Unit 1 and 2 reactor building tendon galleries were toured and the corrective actions for NCR 1868 were verified to be completed. Several tendon grease can stem fittings were observed to be leaking varying amounts of tendon grease (up to 3 or 4 cups). The stem fittings originally installed to monitor groundwater inleakage have become grease leakage paths. Grease has been lost by two methods: cap nuts have been removed without authorization and leaking fittings between the 1/8 inch thick grease can and the stem fitting. TVA has previously observed leaking grease and has had to replace grease for a few vertical tendons due to the loss of grease. Three grease cans on the upper end of the Unit 2 containment wall tendons (vertical) were selected at random and their grease levels found to be above the anchorage hardware. TVA has not established adequate corrective actions to prevent or monitor tendon grease leakage. In addition, a permanent fix has not been established to preclude continued grease leakage through removed cap nuts or leaking stem/can fittings. TVA NCR 2020 was initiated during this inspection for resolution of this concern.

2. Cadwelds

a. Cadweld rebar splicing was not being performed at the time of this inspection. However, safety-related cadwelding will be performed on later portions of the Unit 2 secondary containment building. Cadwelder performance logs of Quality Control Procedure (QCP) 10.25 were reviewed for three of the four currently active cadwelders. Their records indicated low rejection rates and no abnormal trends were detected. Their qualification test records were also reviewed for proper bar size, number of tests, tensile test results, and visual inspection results.

b. QCP-2.6, Revision 5, Cadwelding Inspection, was reviewed for implementation of Construction Specification, G-52, Revision 1, Mechanical (Cadweld) Splices in Reinforcing Bars of Category I Concrete Structures, and regulatory requirements. The QCP was found to be adequate.

c. QCP-2.6, Revision 5 allows inspections to be performed on a group basis rather than continuous as was specified in previous revisions. This current practice may allow cadwelders upon discovery of a deficient cadweld to cut out and remove the defective cadweld before the QC inspector could note the failure. This potential problem can be avoided provided that cadweld locations are defined accurately enough to discern a difference between the original and replacement cadweld location. From a review of Unit 1 and 2 reactor building cadweld records, cadwelds made prior to 1979 were not located with suficient accuracy (using approximate or relative location). However, subsequent to 1979, including those made in 1982, the inspection records provide the necessary location accuracy.

3. <u>Concrete Chipping and Drilling/Cutting of Reinforcing Steel</u>

a. An extensive amount of concrete chipping is being performed throughout safety-related structures. The chipping of concrete is primarily for the installation of anchors or piping and instrumentation sleeves. Chipping usually extends beyond the first or second layer of reinforcing steel. The chipping, drilling, and cutting operations are controlled using work releases in accordance with QCP-10.6, Revision 13. To this date, computer listings indicate approximately 2000 concrete chipping work releases granted with only 20% to 30% of these with repairs complete. Although final project estimates are unclear (perhaps 30% of the total projected so far), the amount and degree of chipping has increased. The memorandum from F. E. Gilbert, Construction Engineer, TVA dated August 27, 1982 addresses the continuing concrete chipping situation, but does not address the potential structural adequacy affects the chipping , drilling, and cutting operations may have on structures. The findings and observations in the concrete chipping area indicate the need for much tighter controls over concrete chipping, drilling, cutting, and repair activities.

b. Six areas listed below in the Unit 1 and 2 reactor buildings and the common auxiliary building were reviewed for appropriate work releases or field change requests to control the work activities and, where necessary, drawing changes. Several of the chipped out areas were selected, however, there was difficulty in identifying the responsible engineering unit associated with the chipped area based only on location in the plant. There were few chipped areas, if any, identified with work release number or responsible unit. For the six areas selected, work releases were provided for the chip out activity and field change requests were found to be incorporated into the drawings.

| Unit | Area |
|---|---|
| 1 | Reactor Building; "D" ring interior; Elevation 627'9"; Azimuth 90°; (Civil) |
| 2 | Reactor Building; "D" ring interior; Elevation 625'; Azimuth 60°; (Civil) |
| 2 | Reactor Building; flat section of "D" rings; A,B,C,and D areas for pipe whip restraints; (Civil) |
| Common | Auxiliary Building; Elevation 629'; Column lines S and A-9; (Mechanical) |
| Common | Auxiliary Building; Elevation 639'; Column lines S and A-12; Junction of doorway and column; (Mechanical) |
| Common | Auxiliary Building; Elevation 600'; 5' East of column line R and 5' South of column line A-11; (Mechanical) |

c. In many cases, reinforcing steel has been damaged, cut, or nicked during the concrete chipping/drilling operations. TVA has identified numerous instances of cutting reinforcing steel without prior engineering approval. However, there are no provisions in the applicable QCPs (2.1, 5.3, 5.4, 5.5, and 10.6) for inspection for damaged or cut reinforcing steel after concrete chipping or drilling operations.

In addition, TVA Engineering (EN-DES), Knoxville, has not provided generic acceptance criteria for damaged reinforcing steel. Without this acceptance criteria, the site will have to forward all cases of nicked or damaged reinforcing steel to TVA Knoxville. This would be essentially all areas with concrete removed. A separate concern related to the cutting of reinforcing steel was previously identified as Unresolved Item 438/82-10-01 and 439/82-10-01 by NRC Region II. This Unresolved Item deals with the documentation and evaluation of cut reinforcing steel and the resolution is being followed by NRC Region II.

d. The chipped out concrete areas are being repaired using replacement concrete, grout, or mortar mixes in accordance with QCP-5.4 and 5.5. However, there are no provisions for post-placement inspection of repaired areas to ensure adequate workmanship quality. In addition, there are no post-placement inspection provisions for newly placed concrete. Two repaired areas were found which indicated poor workmanship. An aluminum can was found in a concrete patch area in the Unit 1 Diesel Generator Building in the ceiling, at Elevation 654' approximately 12' East of "M" line and 3' South of "D-3". Reinforcing steel is exposed in a dry-packed mortar repair area in the Auxiliary Building on Elevation 625' on the back side of the wall, in a pipe chase area between column lines (A6 and A7) and (T and U).

e. During tours of the plant several instances of water accumulation were found in chipped out areas in the floor slab. Poor housekeeping has allowed water and debris to be trapped in areas where concrete slabs have been partially chipped to the extent that exposed reinforcing steel were covered with water. The specific areas found were Unit 1 Main Steam Valve Room "A" (several locations) and Unit 2 annulus area on Elevation 625' at azimuth 147°30'.

4. Concrete Placement

a. During the period of this inspection concrete placement activities were witnessed for the Unit 2 secondary containment wall. The pre-placement inspection, batching, transportation and placing of concrete was reviewed for conformance to specifications and regulatory requirements and licensee commitments. The documents reviewed were:

QCP-2.1, Revision 9, Rebar, Embedments, and Concrete Formwork
5.2, Revision 4, Batch Plant Inspection
5.3, Revision 3, Concrete Placement
5.4, Revision 3, Concrete Curing and Repairing
5.11, Revision 2, Sampling, Consolidating, and Testing Concrete Compressive Strength Test Specimens
5.12, Revision 3, Concrete Slump and Air Content Testing

TVA Construction Specification, G-2, Plain and Reinforced Concrete

b. The pre-placement QC inspection for the secondary containment wall placement was witnessed and the following observations made:

(1) Reinforcing steel were properly located and secured.
(2) Concrete cover distances were maintained.
(3) Embedded plate locations were verified.
(4) Anchor studs were properly oriented with respect to angle and separation distance.
(5) Forms were free of standing water and debris and were adequately secured.
(6) The construction joint surface was prepared to expose the coarse aggregate.
(7) Section thickness was maintained.

c. Batch plant operations were witnessed and the strip chart recorder reviewed for conformance to mix design. Batching sequence of the concrete constituents met standard industry practice and batch timers were used and interlocked to prevent discharge from the mixer before completion of the mixing time. Batch plant operations were witnessed on October 15. With the batch plant operator present and performing batch plant operations, the QC inspector was observed by the NRC CAT inspector to be operating batch plant control(s). The QC inspector's seated location and familiarity with the control(s) operated indicated that this was a routine practice during batch plant operation. Although it is necessary for the QC inspector to be familiar with and aware of batch plant operations, a separation of quality control and construction activities is required. In the civil area, this practice seems to be an isolated case. No other instances were observed of QC inspectors performing construction tasks.

d. Transporting of concrete from the batch plant is by non-agitating four cubic yard trucks. No excessive delays were observed between discharge of concrete at the batch plant into the trucks and depositing into the forms. Concrete was supplied at a sufficient rate to preclude cold joints.

e. The three concrete placement crews were observed during placement operations and the number of crew members were sufficient to control the placement operation. The forms were found to be free of water and debris. Placement drop distances did not exceed the specified limit of 10 feet. Concrete was deposited in the center of the forms and avoided bouncing against reinforcing steel. Placement layers did not exceed the specified limits of 18 and 24 inches. Vibrator operation ensured thorough consolidation of each layer and the combining of layers. There was no excessive horizontal movement of concrete by vibration.

f. Concrete testing is performed at the batch plant from the mixer discharge stream. Tests for concrete temperature, slump, air content and unit weight were taken and met specified requirements. (See Section IV for discussion of unit weight.) The concrete curing room daily log sheet and conditions of the curing room were reviewed and requirements for temperature, fog spray, and free water on exposed surfaces were met.

5. Structural Steel

a. Six miscellaneous structural steel items in the civil area were selected for review. These included pipe supports and annulus structural steel. These supports were reviewed for conformance to drawing and specifications. Welding quality is discussed in the welding section. The miscellaneous structural steel items reviewed were:

Item No:

1. Annulus steel Unit 2- Drawings 4RW0535-X2-04, R9 and 4RW0535-X2-05, R4 between azimuth 56° 30' and 61°, under Elevation 646' floor slab.
2. Annulus steel Unit 2- azimuth 330°, under Elevation 675', above penetration number X125.
3. Annulus steel Unit 2-azimuth 335°, under Elevation 675', above penetration number X125.

4-6. Pipe supports- Main Steam Valve Room A, Drawing 4AW0805-X2-1,R12, MK-8, 34, and 46.

b. With the following exception the structural steel items listed above were verified to be in accordance with the drawings and specifications for member size, physical dimensions, proper bolting material, and type and location of welds.

(1) Structural steel item 1 above was found to have A325 bolts not torqued to minimum requirements. The craft foreman did not know the proper torque value for these bolts. QCP-2.15, Revision 0, Structural Steel Installation, provides torque values in the form of a test report filed in the records storage area. Since QCP-2.15 is used as an installation reference document for the craft personnel, the torque values for A325 and A490 bolts should be made more accessible to those performing the installation work.

Dimensional tolerances for structural item 1 were also found to exceed the ±1 inch limit. QCP-2.15 allows this limit to be exceeded as long as the tolerances of the structure it supports are met in accordance with DIR 0-53 dated May 21, 1981 (in this case, ±2 inches).

However, QCP-2.15 does not specify which documents are allowed for use as acceptance criteria. In this case, there was confusion in whether acceptance criteria of ±2 inches in a non-quality related document (Standard Operating Procedure) could be applied. Dimensional tolerances were not clɛ rly defined for the QC inspector.

(2) It was noted that some uninspected bolted connections in the Unit 2 annulus area were already painted over. This painting precludes a meaningful torque inspection.

c. In the review of QCP-2.15, Revision 0 a deficiency was noted in the process to verify as part of the final inspection that the correct item had been installed. QCP-2.15, Section 6.2.5 specifies three methods for this verification: (1) field fabrication and mark number, and the inspector's unique identifier or color coded strip to indicate fabrication inspection, or (2) physical dimensions and the unique indentifier or color coded strip to indicate fabrication inspection, or (3) markings or physical dimensions. Therefore an item could be accepted using method (3) based on physical dimensions only without an indication of fabrication inspection. There would be no provisions to ensure that the welds had been accepted.

6. <u>Liner Plate</u>

a. The inspection records for 21 weld joints of the primary containment liner plate (11 in Unit 1 and 10 in Unit 2) were selected for review. These joints included those from the dome, cylindrical wall, penetrations, and base mat. The weld numbers are listed below. The inspection records included: fitup and cleanliness, visual examination, magnetic particle examination, radiographic examination, and vacuum box leak testing. The records indicated that the acceptance criteria were met. Welds which fail initial radiographic examination were required to have radiographic examination performed on both sides of the defective area. The supporting documentation was reviewed and the requirement was found to be met. The Unit 1 liner plate welds were subject to essentially a 100% radiographic examination program.

The weld numbers of the weld joints selected for review are listed below:

| | Weld Number | |
|---|---|---|
| Area | Unit 1 | Unit 2 |
| Dome | 1R6-9136 | 2R6-7903 |
| | 8961 | 7948 |
| | 8861 | 7591 |
| | | 7274 |
| Cylindrical Wall | 5070 | 5609 |
| | 4773 | 4186 |
| | 4648 | 3917 |
| Penetrations | 8463 | 6378 |
| | 5619 | |
| Base Mat | R6-1-1237 | 692 |
| | 1363 | 661 |
| | 1356 | |

## IX QUALITY CONTROL INSPECTOR EFFECTIVENESS

### A. Objective

1. The objective of this portion of the inspection was to determine if quality control inspectors function freely in performing their tasks, without intimidation by craft personnel or supervision; inspection personnel are qualified and trained to perform their tasks; and quality control personnel have the organizational freedom to perform their tasks.

### B. Discussion

This portion of the inspection consisted of interviews with inspection personnel and their supervisors; reviewing inspection procedures and reports; reviewing education, experience, and certification documentation; and reviewing commitments made to Regulatory Guide 1.58 in the Topical Report and TVA correspondence resulting from NRR Generic Letter 81-01.

1. Interviews were held with 65 inspectors and supervisors selected randomly from the six QC inspection units. This resulted in discussions with more than 30 percent of the site inspection personnel. The discussion included the inspectors area of assignment, the inspectors background, training and education, his perception of how thoroughly inspectors were trained and prepared to perform inspections, and construction craft interface, including the presence of any form of intimidation.

   The interviews revealed that:

   a. QC inspectors were not intimidated by craft personnel or craft supervision.

   b. Action was started 2 years ago to effect organization changes within the engineering units, to separate the QC inspection group from the engineering group. Completing this action has been very slow; permanent QC supervisors for the instrumentation and control unit and the hanger unit had been assigned for less than 2 months.

2. Inspection procedures were reviewed to determine if they were complete, understandable, and established the correct inspection criteria and instructions. Inspection Procedures such as QCP-3.4, Electrical Cables and Jumper Installation (pulling) and Preparation (Terminating), and QCP-10.26, Quality Control Investigation Reports, were reviewed. In addition to this, procedures developed for each inspection area were selected for review by the NRC team members assigned to that area and discussed in other sections of this report.

3. BNP-QCP-10.26, Quality Control Investigation Report, identifies the program for documenting, dispositioning, and controlling known or suspected nonconformances.

It was determined during the inspection that there were several other ways to document construction problems. It was revealed that welding engineering Unit QC inspectors prepared a document, titled Discrepancy Report, that was reviewed and approved by Field Welding Engineering personnel before the discrepancy was documented as a QCIR and fully controlled. During the inspection it was stated by the Welding Engineering Unit Supervisor that in the future all safety related discrepancies would be identified in the QCIR program. It was also revealed that preliminary QCIRs were prepared by hanger engineering unit QC inspectors and were routed to engineering personnel before a control number was assigned.

These various means of identifying and resolving problems were reviewed along with the program for identifying problem trends to management in the quality assurance, engineering and construction areas. This is discussed in other sections of this report.

4. The records associated with quality control inspector employment, education, experience, and certification was reviewed. The date of employment was reviewed as it pertained to the certification to perform inspections for 44 of the 65 inspectors interviewed in the electrical, mechanical and hanger engineering units.

   The review revealed that 27 of 45 inspectors were fully certified in less than one month from their Bellefonte employment date. Eight inspectors of those interviewed in the mechanical and electrical areas were certified in one week or less.

   In addition to this, interviews and personnel jacket review revealed that at the time of certification, several inspectors had no previous experience in work or inspection of areas related to their assignments, even though the examination had been passed. (See Item 5 below).

   QC inspectors are certified to inspect specific procedures. A review of these procedures and inspector interviews revealed that the procedures do not contain all of the inspection requirements. This results in an incomplete inspector certification system. For example:

   > In the electrical area, not all of the inspection requirements that are required and used by the inspectors to verify the correct installation of cable are contained as referenced in the procedure to which inspectors were certified. (See Section V of this report)
   >
   > Hanger inspectors were certified to QCP-2.8 and QCP-6.17 although as stated in Section VII, of this report, the acceptance criteria for hangers, were found in several other documents not referenced in the QCPs to which the inspectors were certified.

This training and certification system was recognized by TVA to contain some weaknesses in 1981 and action was taken to develop a Construction Requirements Manual. The manual is intended to assimilate all of the inspection requirements for a particular work activity into one document. A schedule for completing and implementing this manual in the training and certification program was not available during this inspection.

5. Interviews revealed that TVA Procedure QAP 2.2, Qualification/Certification of Inspection, Examination, and Testing Personnel SQN, WBN, BLN, CSB-SME, and Procedure BNP-QCP-10.29, Quality Assurance Training Program, were the documents that were written to implement TVA commitments made in the Topical Report and in response to Generic Letter 81-01 concerning Regulatory Guide 1.58. A review was made by the NRC CAT inspector of the implementing documents relative to commitments made concerning inspector certification, experience, and education.

   a. Although the response to Generic Letter 81-01 (TVA letter L. M. Mills to D. G. Eisenhut dated 8/28/81) was different in format from the Topical Report, the wording and statements of compliance were the same. For brevity a summary of the pertinent statements in the letter is provided. The notes are included to describe pertinent requirements of ANSI N45.2.6-1978 or to describe the section of ANSI N45.2.6-1978 that is referred to by the regulatory position.

      In summary the letter states that:

      (1) General Statement

         "For design and construction our Certifications do not correspond to the levels established in ANSI N45.2.6. TVA's design and construction inspection, examination, and testing personnel are classified by disciplines (mechanical, civil, electrical, instrumentation, hanger, etc.) and certified by procedure to perform the functions identified in ANSI N45.2.6, Table 1, and L-1 and L-11."

         Note: The combination of education and experience requirements to perform the inspections defined in the table discussed above are provided in paragraph 3.5 of ANSI N45.2.6-1978 and for any person performing the functions of a L-11 requires a minimum of 1 year related experience with any technical training except an engineering degree.

      (2) Regulatory Position C.6 (Note: This refers to the Education Recommendations of Section 3.5 of ANSI N45.2.6)

         "Our current program is in compliance"

      (3) Regulatory Position C.10 (Note: This refers to Section 2.2 "Determination of Initial Capability" and Section 2.3 "Evaluation of Performance")

"We determine initial capability from the following criteria as defined in the procedure: Candidates education, experience, training, examination and/or capability demonstration. On-the-job participation in the work discipline is required of all candidates."

b. Interviews and review of the records discussed above relative to the commitments made by TVA revealed that:

(1) Inspectors have been certified, (9 of 25 inspectors reviewed in the electrical and mechanical units) that did not meet the requisite experience requirements, based on their educational background.

(2) TVA implementing documents did not define the combination of education and experience requirements to be met before inspector certification.

## X MATERIAL TRACEABILITY OF INSTALLED STRUCTURES AND COMPONENTS

### A. Objective

The objective of this portion of the inspection was to determine if selected material could be traced from the installed condition back to certification records and contract specification.

### B. Discussion

The control of selected material contained in the building structure (including hangers), in welds, and in piping systems was reviewed. The review consisted of randomly selecting structural beams, pipe hangers, weld rod types, and weld joint numbers and tracing the item or material selected to the purcnase contract and material certifications. Selections were made from each of the containment and auxiliary buildings.

1. Structural components (beams, plates, and hanger material).

Structural components with the exception of the unique piping hangers supplied by ITT Grinnel are purchased by contract to particular ASTM material specifications. Specific piece number were selected at random and traced satisfactorily to the contract and certified material test reports for the following material:

| Component | Contract | ASTM Standard | Amount |
|---|---|---|---|
| Plate 1 5/8" (Restraint Material) | 826283 | A-588 | 120 $ft^2$ |
| | 826535 | A-588 | 240 $ft^2$ |
| I Beam | | | |
| 14 x 233 lb | 787009-007 | A-588 | 300 ft |
| 14 x 90 lb | 775926 | A-588 | 840 ft |
| Plate | | | |
| 1/4" | 771428 | A-36 | 3200 $ft^2$ |
| 1/2" | 771075 | A-36 | 2400 $ft^2$ |
| 1 1/2" | 771469 | A-36 | 600 $ft^2$ |

Beam

| | | | |
|---|---|---|---|
| 45 - 50$^{o}$ Azimuth<br>W14 x 246 lb | 87385<br>(Shipment 56)<br>Heat 27352 | A-36 | 2 Beams<br>100 ft 7 inches |
| W36 x 160 | 86385<br>Shipment 8 | A-36 | 112 ft 7.5 inches |
| 172 W 723 | 786144-004 | A-36 | 180 ft |

Structural tubing

| | | | |
|---|---|---|---|
| | 775714 | A-500 | |
| 3 x 3 1/4 | Ht 69098 | | 6600 ft |
| | Ht 37969 | | 600 ft |
| | Ht 37520 | | 600 ft |
| | Ht 37799 | | 2400 ft |
| 3 x 3 x 1/4 | 775363 | A-500 | 269 piece |
| | Ht 803557 | | |
| | Ht 10019314 | | 60 ft each |
| | Ht 944406 | | |

| Hanger Material | Contract | Number | Means of Certification |
|---|---|---|---|
| 2NV-MPHG<br>0322<br>item 3<br>Trapeze Assembly | 820732 | EBJ 514 | ITT Grinnel<br>Certification<br>Letter |
| 1 CA MPHG<br>0252<br>Item 1<br>Sway Strut Assembly | 820732 | EBH-063 | Certification<br>Grinnel<br>Letter |
| NV-MPHG<br>0585<br>Sway Strut<br>Assembly | 820732 | EBH-155<br>87 units | Grinnel<br>Certification<br>Letter |
| | 820732 | EBH-156<br>38 units | Grinnel<br>Certification<br>Letter |
| IND MPHG<br>0047 | 827808 | 182P262 | CMTR met A-36<br>requirements |

ITT Grinnell supplies the material for piping hangers and supports. Letters of certification are on file for the material. ITT Grinnell was last audited by TVA on March 15, 1978.

2. Weld Filler Materials

Welding filler materials were selected for review. Weld metal heat number are recorded on weld joint identification cards. This computerized system of control then identified the pipe or components joined by a particular heat number of filler metal. The contract and receipt inspection documentation (including the certified mill test report) was reviewed for the following welding material in use and found satisfactory.

| Rod Type | Size (Diameter) | Heat Number | ASME Specification | Contract | Amount Received |
|---|---|---|---|---|---|
| E8018-C3 | 3/32 | SN3C | SFA5.5 | 765806 | 528 lbs |
| E308-16 | 1/8 | IG32E-32 | SFA5.4 | 589852 | 30,200 lbs |
| E309 | 1/8 | 9L16B | SFA5.4 | 5230545 | 3,000 lbs |
| E7018 | 5/32 | A6099-1 | SFA5.1 | 523054-3 | 20,000 lbs |
| E9018.B3 | 1/8 | 47994 | SFA5.5 | 607888 | 4,000 lbs |
| E7018 | 1/8 | 4312245 | SFA5.1 | 507876 | 90,000 lbs |
| E7018 | 1/8 | 92163C | SFA5.1 | 607880 | 40,000 lbs |
| E7018 | 3/32 | 92122D | SFA5.1 | 607880 | 80,000 lbs |
| L308 | 3/32 | C4793 | SFA5.9 | 589854 | 4,000 lbs |

a. A tour of the weld rod issue stations revealed that:

(1) the stations were neat with no uncontrolled weld material in the areas.

(2) the oven temperatures were within the range specified for weld rod holding temperatures.

(3) the oven temperature measuring devices were within the calibration requirements.

3. Piping system components traceability

A sampling of safety related piping systems was made for material traceability. Random selections of small bore piping systems were made. Material joined at welds was traced satisfactorily through the weld identification drawings to the inspection, purchase, and certified material test report documentation.

| System | Heat No. | Component | Specification | Footage |
|---|---|---|---|---|
| Safety Injection | 462999 | Pipe | A312 | 1,542 ft |
| Chemical Addition | 743173 | Pipe | A312 | 750 ft |
| Containment Spray | 01285 | Pipe | A312 T304 | 400 ft |
| Passive ECCS Injection | 9490 | Pipe | A376 T304 | 900 ft |
| Safety Injection System | 455659 | Pipe | SA376 T304 | 387 ft |
| Passive ECCS Injection | 454933 | Pipe | SA376 T304 | 1469 ft |
| Component Cooling | BH-98 | Coupling | SA105 | 150 |
| Containment Spray | P126 | Fitting | SA182 F304 | 1 |
| Component Cooling | ZR 2T | Tee | SA105 | 1 |
| Spent Fuel Cooling and Cleanup | 2625-55 | Spool Piece | NAVCO Certification | 1 |
| Spent Fuel | MCZ45A | Elbow | SA403 | 1 |
| Safety Injection System | SN-6 | Valve (Target Rock) | | 1 |
| Safety Injection System | BXD49X | Elbow | SA312 TP304 | 1 |
| Chemical and Volume Control | | Spool Piece Serial 2624-232 | Certification Memo NAVCO | 1 |
| Spent Fuel Cooling and Cleanup System | 590Z | Weld-o-let | SA-182 F-304 | 1 |
| Safety Injection System | 73316 | Valve | SA 182 F-316 | 25 |

## XI. SITE PROCUREMENT, RECEIVING INSPECTION, STORAGE AND MAINTENANCE

### A. Objective

The objective of this portion of the inspection was to examine on-site procurement, receiving inspection of site and home-office procured items delivered to the site, storage and maintenance for safety-related equipment and material, related facilities and documentation to determine compliance with NRC requirements.

### B. Discussion

The approach used to collect data was to tour the site and observe site activities and facilities, to interview personnel, to select samples and material from various disciplines at various stages of work, and to inspect the documentation and the delivered equipment and material at the locations in storage or in place in the plant.

A total of 44 samples were selected to cover safety-related material and equipment for Mechanical, Electrical, Civil/Structural, Welding, Instrumentation and Control, and miscellaneous categories.

The procurement process (including site Requests for Delivery-RDs), receiving inspection (including documentation of TVA's approval for shipment at vendor's plants), storage in warehouses and yards, issue, in-place storage, and maintenance (including in warehouse and in place) were reviewed. Documentation for the samples was reviewed and the actual delivered hardware was examined at the site location of the equipment. Storage facilities were also inspected, including Class A,B,C and D facilities.

During the review of documentation for the 44 samples and the inspection of equipment, material and facilities, compliance with 10 CFR 50, Appendix B, the FSAR and Quality Control Procedures for Bellefonte, and compliance with quality-related aspects of procurement documents and specifications were used as acceptance criteria.

Based on the 44 examples reviewed, no significant deviations were noted in the areas of site procurement, receiving inspection, warehouse storage and facilities. However, deviations were noted in the area of in-place storage. Also, a concern was identified regarding the lack of records at the site and at vendor's plants regarding approval or disapproval of required test reports and other data by EN DES-Knoxville prior to release for shipment, receipt inspection, issue and installation in the plant. In addition, there is a concern regarding the accurate identification of all equipment requiring maintenance and the accurate and timely specifying of required maintenance and schedules for safety-related equipment both in storage and in place at the site. No deviations were noted in the control of maintenance for items identified as requiring maintenance, and computerized systems appeared to help provide for good control of maintenance. The activities of the Material Control Group and related records appeared to be better than average.

The results of specific inspections are as follows:

1. Inadequate storage and protection (from damage) of equipment in place in the plants.

   Some equipment was identified which was not covered appropriately. Equipment with excessive dust and dirt was also identified; water dripping on equipment; and in addition some damaged equipment from adjacent construction activities and water damage was identified.

   a. Examples

      (1) Contract 86163. Motor Operated Valve 1KEIFCV128A in Essential Raw Cooling Water System at location 610A05P for Unit-1. Covered with dust beneath plastic cover. Noted shaft and key corrosion. Screw missing from electrical compartment cover.

      (2) Contract 86163. Motor Operated Valve 2KEVUAC128A for Unit 2. Plastic cover partially off. Dusty all over. Shaft and key covered with dust. Screws missing from electrical compartment cover.

      (3) Contract 86133. Auxiliary Feedwater Pump 1CAMPMPIA for Unit-1 in Auxiliary Building. Temperature guage on pump bearing casing broken. Flexible cable to Resistance Temperature Detector severely damaged. (Both damaged items apparently due to nearby construction activities). Cover partially off of motor. Motor and pump covered with dust. Oil dripping from pump near coupling. Trash on top of motor-pump common base.

      (4) Contract 86133. Auxiliary Feedwater Pump LCAMPMP3Q for Unit-1 in Auxiliary Building. Equipment covered with dust under plastic cover. Extensive quantity of trash, loose bolts and nuts on top of common base for pump and turbine. Oil noted on the common base near hose connection.

      (5) Contract 86133. Auxiliary Feedwater Pump 2CAMPMP3Q for Unit-2 in Auxiliary Building. Area and equipment wet from dripping water. Plastic cover was torn and water leaked through to equipment. Dust on equipment beneath cover. Corrosion noted on common base.

2. Test Data and Reports

   Contracts often require vendors to transmit technical data and reports to Knoxville. Yet, the vendor's representative and the TVA inspector at a vendor's plant sign releases for shipment. Also, Receiving Inspection at the site accepts shipments. There is concern that knowledge of the acceptability of data supplied by the vendor to

Knoxville may not be available to the TVA inspector authorizing shipment from the vendor's plant and to the TVA receiving inspector at the site. Also, there is concern that equipment is issued, installed and QA/QC accepted without knowledge of approval or disapproval of test reports previously sent from the vendor to EN DES-Knoxville.

a. Examples

(1) Contract 826959. Instrumentation Penetration Assembly. It was noted that TVA QC Checklist and Shipping Release dated 6/18/80 at the vendor's plant showed that prototype tests and other tests were involved, and the form contained a note: "Release contingent upon the stress analysis report being approved by TVA prior to installation at BNP." However, the Receiving Inspection Checklist dated 7/2/80 showed Item Accepted with no mention of the release contingency noted above. An inquiry revealed that some of the penetrations had been installed.

When the NRC representative mentioned this to a TVA-BNP representative, QCIR No. 26,663 was prepared 10/19/82. Research of files revealed, by letter from TVA to Westinghouse Electric Corporation 5/14/80, that the Stress Report had been approved. The QCIR also stated in part under Recommended Disposition: "Review QA records (Receiving Inspection Checklist) for further conditions of unacceptability."

(2) Contract 830173. Flow Switches for Makeup Hydrogen Blanket. It was noted that the contract calls for such documents as Seismic Test Results, IEEE class 1E qualification results, and other data to be sent to TVA Technical Engineer (in Knoxville) without copies to the site. Also, data packages were to be sent to both TVA-Knoxville and the site.

However, it was noted that TVA Inspection Report, stamped 9/23/82, under Release to Ship, stated "Flow switches were released on TVA release 10926B, copy of which is being forwarded to Knoxville QEB with this report. This completes the contract with the TVA Pomona Office. There is no data required."

On discussion of this matter with TVA-Bellefonte site personnel, it was noted that the flow switches had been received, but it was not known whether or not data and technical reports had been sent to the TVA Technical Engineer as required by the contract, and also the status of approval or disapproval was not known.

b. Discussion

(1) On discussing this concern by telephone with TVA personnel in Knoxville, it was indicated that technical personnel in Knoxville review technical data, test reports and other documentation from vendors, and, if some aspect is not approved, then this would be included on a computerized list. Site personnel contacted were not aware of such a computerized list. Further discussion revealed that there is general concern at the site regarding the status of approval or disapproval of test reports and other data submitted by vendors to EN DES in Knoxville.

3. Identification of Equipment Maintenance during Storage

Equipment arrivals on site are reported by telephone to the on-site Engineering Disciplines that are responsible for determining and scheduling maintenance requirements. Often manuals containing maintenance information from the vendor go to the Knoxville office and not directly to the site Engineering Unit. In the absence of a master list from EN DES-Knoxville of equipment requiring maintenance and the absence of manuals/maintenance information from vendors, the site personnel are not sufficiently informed to permit accurate identification of equipment requiring maintenance and accurate specifying of required maintenance.

a. Example

Contract 830259. Air Handling Units for Control Building. Such safety-related equipments are expected to require maintenance while at the site. However, these units were received as noted by Receiving Inspection Checklist dated 10/8/82, with no indication that maintenance is required. Manuals that may include some maintenance information were not available. Discussion with site personnel indicated that maintenance activities and schedule had not been established for these units.

b. Discussion

Discussions with site personnel established that after material and equipment items requiring maintenance are identified at the site and maintenance activities with schedules have been established, then a computerized system is used to assure compliance with the maintenance schedules. However, in the absence of master list of material and equipment requiring maintenance and the absence of maintenance information, site personnel may not accurately identify all items requiring maintenance. Also, without manuals and/or other maintenance information, site personnel may not accurately specify maintenance to be performed and schedules. The NRC CAT inspector is concerned that required maintenance may be omitted from items in storage at the plant.

A. Persons Contacted

The following list identifies by title, the individuals contacted during this inspection.

Corporate Office:

Division Construction Manager
OEDC - Bellefonte Project Manager
Office of QA - Construction Quality Assurance Branch
Office of QA - Systems Engineering Branch
Office of QA - Design Quality Assurance Branch
Chief - Construction QA Branch
OEDC - Quality Assurance Manager Chief
ENDES - Quality Assurance Branch

Bellefonte Site:

Project Manager
Construction Superintendent
Construction Engineer
Assistant Construction Engineers (3)
Electrical Engineering Unit Supervisor
Assistant Electrical Engineering Unit Supervisor
Instrumentation Unit Supervisor
Welding Engineering Unit Supervisor
ASME Code Data Unit Supervisor
Quality Manager
Assistant Construction Superintendents
Principal Assistant Construction Superintendent
Quality Controls Record Unit Supervisor
Lead Auditors (4)
Quality Control Inspection Supervisors (3)
Engineering Associates (4)
OEDC - Representative - Hanger Engineering Unit
Construction Engineering Associates (15)
Administrative Officer
Project Training Officer
Communications Assistant
Civil Engineers (4)
Materials Testing Supervisor
Mechanical Engineers (2)
Lead Quality Control Inspectors (3)
Engineering Unit Supervisors (4)
Field Engineering Supervisors (4)
Field Engineers (4)
Field Hanger Design and Engineering Supervisor
Authorized Nuclear Inspectors (2)

Assistant Supervisors - Quality Control
Assistant Supervisor - Mechanical Engineering
Associate Engineer
Engineering Aides (65)
Stores Receiving Clerk
B & W Site Operations Managers

NOTE: In the course of the inspection, numerous craftsmen, inspectors engineers and supervisory personnel were interviewed who are not specifically listed.

B. Documents Reviewed

The documents listed below were reviewed by the inspection team members to the extent necessary to satisfy the inspection of objectives stated in Section I of this report. The specific procedures in the report are listed by title and revision number, if applicable, when they first appear.

1. Final Safety Analysis Report (FSAR)
2. Quality Control Procedures
3. Construction Test Procedures
4. Standard Operating Procedures
5. Field Construction Procedures
6. Quality Assurance Procedures
7. Quality Assurance Staff Procedures
8. Monthly Construction Status Report
9. Quarterly Trend Analysis Report
10. Semiannual Trend Analysis Report
11. Audit Reports
12. General Construction Specifications
13. Purchasing Procedures
14. Quality Assurance Program Policy
15. INRYCO Reports, "Elongation Discrepancies of Post-Tensioned Tendons," June 2, 1981 and October 3, 1981.
16. Engineering Procedures