UNITED STATES NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION

Division of Reactor Inspection and Safeguards
Special Inspection Branch

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Licensee: Tennessee Valley Authority

Facility Name: Watts Bar Nuclear Plant, Unit 1

Inspection at: Watts Bar site, Spring City, Tennessee

Inspection Dates: September 25-October 6 and October 16-27, 1989

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1. EXECUTIVE SUMMARY

1.1 Objectives

The NRC's Special Inspection Branch, at the request of the TVA Projects Division (TVAPD), Office of Nuclear Reactor Regulation (NRR), conducted an announced assessment of construction at the Watts Bar Nuclear Plant (WBNP), Unit 1 during the period September 25-October 6 and October 16-27, 1989. The assessment team inspected a broad range of installed hardware and structures and reviewed selected programs, procedures, and documents related to previous and current construction.

The NRC's objectives for this inspection were to (1) assess the general quality of construction at WBNP, Unit 1, (2) identify any significant construction deficiencies or problem areas that had not previously been identified, and (3) assess the site's current status, progress, and schedule of remaining activities required for fuel load. These objectives were met through a detailed inspection of completed installations in all major construction disciplines: electrical and instrumentation, mechanical, civil and structural, and welding and nondestructive examination (NDE). In addition, the team reviewed construction-related programs such as material traceability, procurement, design change controls, and corrective actions programs.

1.2 Scope

The scope of the team's inspections in most areas included all safety-related systems, structures, and components. However, the team reviewed only vendor welding and NDE because of the extensive welding reviews in other areas that have been performed by TVA and NRC in the recent past. In addition, the team's review of corrective action programs focused on WBNP's routine quality assurance programs and did not include the corrective action programs (CAPs) or special programs (SPs) discussed in WBNP's Nuclear Performance Plan, Volume 4. The team reviewed CAPs or SPs only to determine whether a CAP or SP had previously identified, or would identify when completed, specific deficiencies found by the team.

1.3 Findings

The team's inspection efforts and findings are discussed in detail starting with Section 2 of the report. Those items that remained open following the inspection pending additional actions by the licensee are listed in Table 1-1.

The team found that its findings from the inspection fell into four basic areas:

- o A poor general condition of the plant equipment.
- o Problems that were not previously identified.
- o A lack of understanding by site management of the work remaining.

- A lack of control of interfaces among the various corrective action programs.

1.3.1 General Condition of the Plant

The team identified many instances in which the hardware was not adequate. The large number of missing, damaged, or loose hardware components, disassembled structures, and deficiencies in vendor-supplied equipment contributed to the team's general impression that the plant condition is poor.

A large number of hardware deficiencies, and the potential for further damage because of the continuing weak control of ongoing work activities, made the team doubt TVA's ability to protect completed equipment and hardware installations during the remaining construction with current work practices. For example, the weak work controls the team found in the control room, resulted in potential damage to existing control board equipment, temporary relocation of improperly secured indicators, and the omission of certain quality control inspections.

1.3.2 Problems Not Previously Identified

WBNP site personnel were able to demonstrate that a CAP or condition adverse to quality report (CAQR) addressed, or would address when completed, many of the deficiencies in pipe supports, cable tray and conduit supports, and other areas. The CAPs are the programs to correct previously identified problem areas and are described in the Watts Bar Nuclear Performance Plan, Volume 4.

The team found a number of deficiencies that apparently were not previously identified by TVA. These included vendor equipment deficiencies such as:

- Undersized welds on tanks, heat exchangers, and filters;
- Seismically unqualified connections on the emergency diesel generator room fan-damper assemblies;
- Cable bend radius and other termination deficiencies in several electrical equipment items; and
- Unqualified use of heat-shrinkable tubing on electrical penetration leads.

Identified field construction deficiencies included:

- Loose bolts in structural steel assemblies and on mechanical and heating, ventilation, and air conditioning (HVAC) equipment; and
- Improperly installed operator components for the pilot-operated relief valves of each steam generator.

TVA attempted to demonstrate that an existing program, such as the equipment seismic qualification CAP, might eventually have identified some of the deficiencies. However, the insufficient detail in the programs failed to assure the team that TVA would eventually identify these problems.

1.3.3 Lack of Understanding by Site Management of Remaining Work

The licensee was not able to supply the team with sufficient information to support its estimated December 1990 fuel load date or to allow the team to independently develop a realistic estimate. The team based this conclusion on the difficulty experienced by licensee management in identifying reliable quantities for work remaining, the large number of items for which the amount of work remained unknown, and the uncertain scope of existing programs.

1.3.4 Lack of Control of Interfaces Between On-site Programs

The team found that integration and coordination of the various licensee corrective action programs, special programs, and related activities was not adequate to ensure that all required work activities and corrective actions would be correctly performed. The team also found weaknesses in the integration of activities between site organizations that provide requirements and site organizations that implement those requirements. Examples included inadequate engineering instructions to receipt inspectors, and a failure to establish a workable pass-down method for instructions for verification of the dedication of commercial grade items.

TABLE 1-1

LIST OF OPEN ITEMS

Item Number	Description	Section
50-390/89-200-01	Potential cracking of Melamine limit switch rotors in Limitorque operators	2.1.1
50-390/89-200-02	Unqualified installed configuration of Limitorque actuators	2.1.1
50-390/89-200-03	Inadequate maintenance criteria for battery intercell resistance	2.1.2
50-390/89-200-04	Missing hydrogen vent caps, broken thermometers, and acid spills	2.1.2
50-390/89-200-05	Adverse impact of water dripping on battery banks	2.1.2
50-390/89-200-06	Space heater for RHR pump motors not energized	2.1.3
50-390/89-200-07	Inadequate Raychem splices on penetration leads	2.1.4
50-390/89-200-08	Lack of protection for installed penetration leads	2.1.4
50-390/89-200-09	Lack of protective elbows on ASCO solenoid valve bleed port	2.1.5
50-390/89-200-10	QC verification of the ratings and post installation attributes of devices not performed	2.1.6
50-390/89-200-11	QC records inadequate for inspecting wiring in control room panels	2.1.6
50-390/89-200-12	QC records found to reference uncontrolled documents	2.1.6

TABLE 1-1 (Continued)

Item Number	Description	Section
50-390/89-200-13	Damage to transformers and excessive bending of vendor cables in diesel generator control board	2.2.1
50-390/89-200-14	Vendor wiring deficiencies in LOCA Hydrogen monitor	2.2.2
50-390/89-200-15	Vendor wiring deficiencies in motor control centers	2.2.2
50-390/89-200-16	Deficiencies in mounting hardware and configuration of transmitters	2.4
50-390/89-200-17	Deficiencies in mounting hardware and configuration of devices	2.4
50-390/89-200-18	Questionable design of moveable spacer on ERCW supports	3.1.1.1
50-390/89-200-19	Maintenance and surveillance of the auxiliary control air system	3.2.1
50-390/89-200-20	Procurement of parts to support the PM program	3.2.2
50-390/89-200-21	Uncertain installation clearance for regenerative heat exchanger	3.3
50-390/89-200-22	Generic implications of discrepancies on HVAC containment isolation valves and supports	3.4
50-390/89-200-23	Effect of change to component cooling water relief valve discharge	3.5.2
50-390/89-200-24	Undersized vendor welds on tanks, heat exchangers, and filters	4.3.1
50-390/89-200-25	Unacceptable radiographic indications for Tube Line pipe fittings	4.3.2

TABLE 1-1 (Continued)

Item Number	Description	Section
50-390/89-200-26	Use of expected concrete strength for areas with known strengths below design values	5.1.1
50-390/89-200-27	Bolts of incorrect material type used for removable beam connections	5.2
50-390/89-200-28	Bolts for connections not meeting ASCI requirements for torque	5.2
50-390/89-200-29	Ineffective corrective action for controlling attachments to masonry walls	5.5
50-390/89-200-30	Unavailability of procurement specifications	6.2
50-390/89-200-31	Ineffective identification of receipt inspection requirements	6.2
50-390/89-200-32	Inadequate commerical grade dedication practices	6.3
50-390/89-200-33	Ineffective coordination between site and corporate QA organizations	6.4
50-390/89-200-34	Uncertain safety classification of lay-up procedures	6.8.1
50-390/89-200-35	Ineffective corrective action for high humidity during lay-up	6.8.2
50-390/89-200-36	Concerns regarding plant lay-up program	6.8.3
50-390/89-200-37	Inadequate reviews and determinations for design changes	7.2.1
50-390/89-200-38	Inadequate reviews and determinations for corrective action documents	8.4
50-390/89-200-39	Inadequate coordination of all on-site corrective action programs	8.4

2. ELECTRICAL AND INSTRUMENTATION CONSTRUCTION

The team reviewed selected electrical equipment and components in critical areas of the plant to assess compliance with installation documents and the quality of construction. The selected Class 1E equipment included cables, conduits, trays, electrical enclosures, penetrations, switchgear, motor control centers, motor operated valve actuators, solenoid valves, pump motors, and 125 Vdc batteries. All equipment selected was critical to the safe operation and shutdown of the plant. The areas of the plant assessed included the Unit 1 containment, auxiliary building, cable spreading room, control room, and diesel generator building. The team examined various installation attributes affecting the performance of the installed equipment. The environmental qualification of electrical and instrumentation equipment was not reviewed during this assessment.

The licensee generated a number of documents to record and take corrective action regarding observations of the team. These documents are referenced where necessary in the discussions that follow.

2.1 Electrical Equipment Installation

To assess compliance with installation requirements, the team examined 54 items of installed electrical equipment, including:

- Two 6.9 KV switchgears
- Five 480 V motor control centers
- Seventeen circuit breakers
- Nine motor operated valve actuators
- Two 125 Vdc vital station battery banks
- Two 125 Vdc battery chargers
- One 125 Vdc static inverter
- Six pump motors
- Four electrical penetrations
- Four solenoid valves
- Two control room panels

The team examined the equipment, as appropriate and accessible, for correct identification, location, ratings, components, mounting configuration, hardware, wiring and terminations, physical and electrical independence, and protection from surrounding activities. The team identified various deficiencies that the licensee had not previously identified. In almost all cases, these deficiencies were not addressed by an existing licensee corrective action program (CAP).

2.1.1 Motor Operated Valve Actuators

The team examined a total of nine safety-related valve actuators. The samples chosen included valve operators of various sizes in several plant systems. The team found that, in general, both vendor and field-installed wiring terminating in the actuators conformed to the requirements of the installation documents. The following significant deficiencies affecting the safe operation and shutdown of the plant were noted.

The team identified four valve actuators containing limit switch rotors made of white Melamine material. The inspectors informed the licensee that NRC Information Notice (IN) 86-71, "Recent Problems with Limitorque Motor Operators," identified cracks in Melamine rotors near the point at which the rotors were pinned to the pinion shafts. The IN stated that cracking occurred because the rotors were not properly drilled for installing the rotor holding pin and that these cracks could have weakened the rotors.

The licensee had reviewed this IN and concluded that problems with Melamine limit switch rotors did not exist at WBNP. The basis for this conclusion was that Limitorque Corporation had shipped an instruction card detailing the proper drilling procedure for each replacement rotor, and in the future would no longer supply Melamine-type limit switch rotors. The team considered TVA's review of IN 86-71 inadequate because it addressed replacement rotors only, and not the original rotors provided with the valve actuators.

The licensee agreed to initiate a corrective action document to ensure that all existing Melamine rotors would be identified and evaluated for any damage or adverse impact upon the operation of appropriate safety-related valve actuators. This item remains open pending NRC review of the licensee's corrective action (50-390/89-200-01).

The team noted that, in four of nine cases, the Limitorque actuator and motor were oriented vertically, with the motor located beneath the limit switch housing. The team was concerned that during service conditions, including a postulated design basis accident, water could pour through unsealed openings (such as the conduit, conduit fittings, and actuator housing) and prevent the motor from performing its safety function. The licensee could not provide evidence to demonstrate that the actuators were qualified for their installed configuration.

The team informed the licensee that, based on inadequate documentation, Limitorque actuators installed in the vertical configuration were unqualified to perform their safety function during an accident. Despite this finding, TVA stated that they planned no further corrective action because Limitorque Corporation stated that the horizontal configuration was the most limiting installed condition. This item remains open pending further NRC review of this concern (50-390/89-200-02).

2.1.2 125V DC System

The team's examination of components of the 125 Vdc system indicated several significant deficiencies relating to the installation, maintenance, and testing of the vital station batteries. Details are noted below

The WBNP FSAR, Sections 8.1 and 8.3, indicated full compliance with the Institute of Electrical and Electronic Engineers (IEEE) Standard 450-1980 regarding the maintenance, testing, and replacement of large lead storage batteries at nuclear generating stations. Section 4.4 of this standard states in part, "when any intercell connection or terminal connection detail resistance value obtained in 4.3.3(2) exceeds its installation value by more than 20 percent, disassemble, clean, reassemble, and retest it." The team determined that typically, based on vendor information, the initial installation values for intercell resistance of station batteries would be about 25 microhms. TVA's commitment to IEEE 450, therefore, should have required battery maintenance at an intercell resistance of about 30 microhms. The licensee's surveillance instructions, however, required battery maintenance only if the intercell resistance reaches 150 microhms. The team noted that the licensee had not met their FSAR commitment to fully meet IEEE 450-1980. The team concluded that the intercell resistance value of 150 microhms specified as the threshold for battery maintenance did not comply with IEEE 450-1980 and could potentially have an adverse impact on the battery performing its safety functions. In response to this concern, the licensee initiated CAQR 870525 to document and resolve the team-identified deficiency. The licensee also stated that it would review other FSAR commitments for compliance. This item remains open pending NRC review of licensee's corrective action (50-390/89-200-03).

The team found missing hydrogen vent caps on cells 20, 43, and 14 of battery II and cell 37 of battery IV. The team also found abandoned, broken thermometers within cell 23 of battery II and cells 19 and 26 of battery IV. In addition, the team noticed evidence of acid and electrolyte spills on cells and support racks of batteries II and IV, which resulted in corrosion of intercell connectors, flaking of paint, and corrosion of associated battery racks. The team concluded that each of these deficiencies could have an adverse impact on the operation of the batteries. The licensee stated that appropriate corrective action was in progress. This item remains open pending further NRC review of the licensee's corrective action (50-390/89-200-04).

The inspectors noted water dripping from a construction joint in the concrete ceiling in battery room 2 above vital battery II. This condition resulted in a small accumulation of water on the battery cells, which could potentially dilute the electrolyte solution of the affected cells or corrode intercell connections. The licensee was in the process of fixing the roof over the battery room. Pending further NRC review of the impact of this deficiency on the batteries, this item remains open (50-390/89-200-05).

2.1.3 Pump Motors

The team performed a detailed examination of six selected pump motors and reviewed associated maintenance activities. The team concluded that the motors conformed to installation requirements for attributes such as type, size, configuration, and rating. However, the following deficiency was identified.

During examination of the Unit 1 residual heat removal (RHR) pump motors, the team noted that motor winding space heaters had not been energized to prevent moisture absorption during storage. Based upon a review of current schedules for system operation and testing, the team expressed concern that the motors would remain inactive and without appropriate motor winding moisture protection for some time. The team concluded that space heaters for vital safety-related motors should remain energized to protect motor windings from humidity. This item remains open pending NRC review of the licensee's corrective action (50-390/89-200-06).

2.1.4 Electrical Penetrations

The team examined six electrical penetrations for proper mounting, feed-through assemblies, cable leads, and protection from surrounding activities. Various significant deficiencies, described subsequently, were identified in regard to the penetration leads.

During examination of penetration 27 for Train A control power, the inspectors noted that the penetration leads had been extended by splicing leads to wire extensions. The inspectors observed, however, that the Raychem heat-shrinkable tubing on all lead splices had less than the two-inch overlap required by Conax manual IPS-1349. Several splices had overlaps in the range of 1/4 to 1/2 inch. The team concluded that the installed Raychem splices on the leads were unqualified to perform their safety function, and that this condition may exist on all safety-related penetrations. The licensee initiated CAQR WBP 890567 to address these concerns. Pending further NRC review of the licensee's corrective action, item remains open (50-390/89-200-07).

During examination of four penetrations including penetration 38 for process instrumentation control, the team noted that the penetration electrical leads and field wiring were not protected from surrounding construction activities. These electrical leads and field wires were exposed and not protected by any enclosure. The damage to the penetration leads was being caused by personnel stepping on them in the confined areas of the annulus. The team noted that, despite previous licensee identification of lead damage, the licensee had not yet implemented precautionary measures for protection of several penetration leads in the field. The team concluded that inadequate controls existed at Watts Bar to protect the integrity of the installed equipment. The penetrations having the damaged leads were determined by the team to be unqualified to perform their safety function. The licensee confirmed that corrective actions would be taken to physically protect exposed penetration leads in the field. Pending NRC review of the licensee's corrective action, this remains an open item (50-390/89-200-08).

2.1.5 Solenoid Valves

The team examined four selected Automatic Switch Company (ASCO) and Target Rock solenoid valves for conformance to installation requirements. The team identified the following two deficiencies in the mounting hardware associated with the ASCO valves.

- The team observed a 90-degree bend in the air hose connected to ASCO solenoid valve 1-PCV-1-30, which apparently blocked air flow. The licensee stated that the lack of configuration control provided by the installation drawing for this air hose resulted in the current installation. The licensee issued corrective action documents to resolve the deficiency.

- The team examined ASCO solenoid valves 1-FCV-43-23A and 1-FCV-43-23B and observed that, contrary to vendor instructions, no bleed port elbows were installed to protect the valves from loss-of-coolant accident (LOCA) spray or entry of other foreign particles. Entry of such particles would prevent the actuation of associated isolation valves. The licensee stated that the WBNP EQ packages for ASCO Models 206-381 series and NP8316 series limited the elbow requirement to valves subject to spray and having an operating time greater than five minutes. The team questioned the absence of the required elbows and the technical justification for the five minute requirement, as this requirement was not consistent with vendor recommendations. The team concluded that the affected solenoid valves, as found, may not perform their safety function during an accident. The licensee initiated CAQR 890536 to investigate and correct the missing elbows and provide technical justification for nonapplication of elbows in the field. Pending NRC review of licensee corrective action, this remains an open item (50-390/89-200-09).

2.1.6 Control Room Panels and Work Activities

The team reviewed the installation of panels, associated devices, and wiring terminations in the Unit 1 control room for conformance to installation drawings. Devices including hand switches, recorders, and indicating meters important to safety were randomly selected for review. The team also examined certain panel welds, witnessed ongoing work, and reviewed QC records for the work being performed. The team examined devices for identification, location, and nameplate data. Types of wires and their proper routing and terminations to terminal blocks and devices were examined. The team also reviewed temporary locations and protection of devices during grinding and welding of the panels. In addition, the team reviewed QC inspections for the above activities. The team identified several programmatic deficiencies regarding the installation and control of safety-related equipment in the control room. The following deficiencies were identified.

During review of devices in the control room, the team noted significant deficiencies in QC inspection activities and records. First, QC inspectors had not verified the ratings (voltage, current, and resistance) and post-installation attributes (such as connection of associated wires) of the installed devices. Second, Nuclear Construction (NC) Department engineers had, on their own initiative and without QC approval, eliminated certain QC inspection activities by marking "NA" (not applicable) on QC activity data sheets. As a result, the quality of the installed devices was indeterminate. Interviews with the licensee's QC staff revealed that the licensee's QC inspectors had expressed concerns to TVA about not being allowed to examine the ratings of these devices. This QC inspection step, however, was not restored by TVA.

In response to this team concern, the licensee stated that, effective immediately, QC staff will review all activities eliminated by NC for appropriate inspections and concurrence. The licensee also directed QC to verify ratings of all installed devices. In order to allow further independent verification by QC, the licensee implemented a procedure, QMI 810.1, which establishes the use and preparation by QC of a quality control inspection record. This item remains open pending NRC review of the corrective action (50-390/89-200-10).

The team concluded that data sheets used to document quality control inspections in the control room were inadequate. For example, data sheet 1 was being adapted by QC for several inspections, including wire bundles fabrication and installation, termination of two separate wire ends, and installation of jumpers. The team observed that the description of the inspection activities on the data sheet made it difficult to ascertain what activities had previously been performed and verified by a QC inspector. The team also noted various confusing annotations and footnotes on the data sheets, resulting from the inappropriate multiple use of these sheets. The licensee agreed to modify the sheets and identify the appropriate use for each sheet. Pending NRC review of the licensee's corrective action, this remains an open item (50-390/89-200-11).

During review of modifications to the control room panels, the team observed that inadequate protection of control room panel 1-M-6 resulted in deposits of filings on several containment ventilation isolation push button switches. The team was concerned that the filings observed falling between the push buttons and the switch housing could cause internal damage to the switches and compromise the actuation of associated equipment. In response to this concern, the licensee stopped work until the filings were vacuumed and the panel protected properly. In addition, the licensee stated that the switch contacts were not exposed to the particles because of inherent seals.

During review of work activities around the control room panels, the inspectors observed craft personnel sitting on handle switches in the horizontal section of control room panel 1-M-4 and possibly damaging the switches. The licensee stated that perimeter rails, wooden scaffold boards, and siltemp thermal wraps were now being applied to protect devices. The team also noted that several devices in temporary locations were not secured properly and in one case, hung by the connecting wires. The licensee stated that devices were now being secured properly.

During review of QC records in the control room, the team observed that QC records referenced TVA drawing 45W1640, Revision 3, for control board wiring details. This drawing referenced Westinghouse specification 952367 for additional wiring details. Both documents were apparently required to complete certain control board wiring installations. The team noted, however, that the referenced Westinghouse specification was not controlled for Watts Bar use. The team concluded that QC records referenced uncontrolled documents. The licensee reviewed appropriate QC records for the above deficiencies based on the NRC finding. Pending NRC review of the licensee's corrective action, this remains an open item (50-390/89-200-12).

2.2 Cables and Terminations

The team examined 21 installed Class 1E electrical cables in critical areas of the plant to assess conformance with installation documents. The team selected power, control, and instrumentation cables fabricated by different manufacturers. Cable was examined, as accessible, for identification, size, type, routing, bend radius, supports, physical and electrical separation, surface damage, and protection from surrounding activities.

The team also reviewed over 75 cable ends to assess conformance with installation documents. The team examined terminations for lug size and type, proper terminal point configuration, correct identification of cable and conductors, proper crimping of lugs or connectors, and absence of insulation or jacket damage.

2.2.1 Cables

In general, the team found that cables were installed according to acceptance criteria. The team identified no deficiencies in the areas of routing, electrical separation, and visible surface damage. The team noted that the licensee had not monitored pull tension during cable pulling activities; however, damage resulting from excessive pull tension is being reviewed and addressed separately by the NRC. In addition, concerns about the replacement of unqualified Rockbestos silicon cable for all harsh environments is being reviewed separately by the NRC.

The team identified several cable and conductor installations which did not meet installation requirements for bend radius of the cables. Exceeding bend radius has the potential of damaging cable insulation. The team observed bend radius deficiencies in cable 14PL-228-3718A, located in cubicle 8F2 of motor control center 1MCC-214-A1-A, and cable 14IV-2781A, located in motor operated valve actuator 1FCV-074-001A. In response to these concerns, the licensee provided a copy of the cable issues CAP. The team noted that the CAP provided requirements for comprehensive identification and resolution of field-installed bend radius deficiencies; however, the licensee had not yet implemented the subject CAP. The team could not determine if bend radius deficiencies would be reviewed on a generic basis.

The team examined terminations in diesel generator 6.9 kV control board DG-1A-A and observed that it lacked adequate support for the field cables to current transformers CVT1 and CVT3. The sagging cables were starting to damage the varnish tape and to bend the windings on the transformers. The team also noted bend radius violations on vendor cables in the control board. Examples included wiring to the 250 V breaker in the back panel and the lugged leads to the potential transformer beneath the 250 V breaker. The team highlighted this problem to the licensee as a potentially generic deficiency affecting other switchgear. Pending further review, this remains an open item (50-390/89-200-13).

2.2.2 Terminations

The team reviewed a large sample of cable terminations to confirm compliance with installation documents. The following paragraphs discuss the identified deficiencies:

- The team noted several vendor wiring termination deficiencies inside LOCA hydrogen monitor 1-H2AN-43-200. The monitor had about 30 terminations which did not meet the TVA G-38 electrical specification for wire extension through the terminal lug barrel. For example, the team observed that the wire protruded through the lug more than 1/16 inch, and that all strands of the wire were not terminated on the terminal screw. In addition, the team noted a sharp wire bend at terminal 48 on terminal board TB-4, which violated the bend radius criteria. The licensee prepared CAQRs WBP890544 and A-575961 to document and correct these deficiencies. The team also noted that these vendor deficiencies were not being addressed under any existing CAP. Pending NRC review of licensee corrective action, this remains an open item (50-390/89-200-14).

o The team observed several deficiencies in the bend radii of wiring installed by the vendors within motor control centers. These deficiencies existed on cables entering the load side of the breakers and appeared to be the result of insufficient spacing for cable installation. For example, the team noted vendor bend radius deficiencies in cubicle 8F2 of motor control centers 1MCC-214-A1-A and 1MCC-214-B1-B. The licensee indicated that existing CAPs do not address deficiencies in vendor-installed wiring, but agreed to initiate a CAQR to resolve existing deficiencies. This item remains open pending NRC review of the licensee's corrective action (50-390/89-200-15).

2.3 Installation of Raceway

The team examined cable trays, conduits, and associated enclosures (junction boxes, terminal boxes, and condulets) to assess conformance with installation documents. This review included 100 cable tray node installations in the control, auxiliary, and reactor buildings, which the inspectors examined for overfill, identification, separation, loading, hardware, and damage.

In addition to more than 19 conduits, the team reviewed associated boxes and fittings. The team examined field routed flexible and solid conduits to verify proper separation and support spacing, and assessed sealing of conduit entries, where appropriate.

2.3.1 Cable Trays

In general, trays were installed in conformance with installation requirements. However, the team identified cable tray nodes 3B2331, 3B2351, 3B2342, 3B2343, and 3B2322 as being overfilled. In addition, the team noted cables overflowing from tray nodes 3N309 and 3N478. However, the licensee showed the team that an existing CAP addressed such deficiencies.

2.3.2 Conduits and Enclosures

In general, the team's examination of Class 1E electrical raceway indicated that the licensee was installing these components according to installation documents. The team noted several deficiencies, however, with regard to damaged, loose, or disconnected flexible conduit, separation of hot pipes from raceway, and lack of sealing of raceway. The licensee presented corrective action programs to address these issues on a generic basis.

The team observed numerous instances in which flexible conduits were loose, disconnected, or damaged. The licensee confirmed that the existing electrical issues CAP required stainless steel flexible conduit to be reworked or replaced on a generic basis in safety-related systems. The team also noted deficient shims and washers in the mounting of junction boxes. The licensee confirmed that an electrical conduit support CAP would address this problem on a generic basis.

2.4 Instrumentation and Device Installation

The team reviewed 60 selected Class 1E instruments and devices for conformance with installation documents. The team selected level transmitters, flow transmitters, pressure transmitters, temperature detectors, solenoid valves, switches, hydrogen monitors, and indicators. The team did not review calibration and surveillance in the instrumentation area, because few instruments were under the operational calibration program. The team examined the selected equipment for correct nameplate data, mounting, orientation, wiring, environmental sealing, absence of damage, and conformance to installation documents. The following paragraphs discuss deficiencies identified.

The team identified numerous deficiencies in the mounting hardware and configuration of the installed transmitters. These deficiencies could affect the operation of the transmitters during seismic and accident conditions. For example, the team identified missing mounting bolts for flow transmitters 1-FT-63-102C and 1-FT-70-98; use of unqualified spacers on the Unistrut support for flow transmitters 1-FT-A-3A and 1-FT-1-28A; and use of incorrect mounting bolt holes in the mounting plates of pressure transmitter 1-PDT-30-43. Based on the team's findings, the licensee issued CAQRs to address these concerns. The licensee also stated that the equipment seismic qualification (ESQ) CAP and other CAPs would have identified these deficiencies. However, the licensee did not provide the team with any documents to show that the deficient components identified by the team were within the scope of an existing CAP. Pending further NRC review of the licensee's corrective action, this remains an open item (50-390/89-200-16).

The team observed that all flange studs and nuts were loose on the support tubes of level switches 1-LS-63-103 and 1-LS-63-104. These deficiencies could affect the operation of the switches under seismic conditions. In addition, the level switch covers were loose on both switches, and the pipe connection was loose between the flange and level switch 1-LS-63-103. The licensee issued Maintenance Request A656862 to correct these deficiencies. In addition, the licensee stated that it would add the cited examples to the scope of CAQR WBP 890502, which implemented a loose parts walkdown corrective action program.

The team reviewed Bailey valve positioner devices 1-PVC-1-5, 1-PVC-1-30, 1-PVC-1-23, and 1-PVC-1-12 to assess compliance with installation requirements. These devices had previously been reviewed and accepted by QC. The team observed that for all four devices, the operating rod from the valve to the Bailey valve positioner was loose. In addition, the Bailey operating rod lock nuts were loose, and the air line for the positioner to valve 1-PVC-68-340D was loose. The team determined that, in their current status, the positioners would not have performed their safety functions. The team determined that the pre-startup test program would subsequently have corrected the loose rods and nuts; however, the team was concerned that the positioners were found deficient despite QC acceptance. The licensee was in the process of repairing the deficient devices based on the team's finding.

The team identified numerous deficiencies in the mounting hardware and configuration of installed devices. The team determined that these deficiencies could prevent these devices from performing their safety functions under seismic conditions. For example, the team observed that mounting bolts of valve position elements 1-ZE-1-23 and 1-ZE-1-5A had inadequate thread engagement, limit switch 1-ZS-1-5A had a broken lock washer on one of the mounting bolts, temperature switch 1-TS-30-196A had a washer held by friction only between the Unistrut support and the switch contrary to installation drawings. Resistance temperature detector (RTD) 1-TE-68-24D was damaged in that it had a bend at its entry into the RTD well, and temperature device 1-TW-68-319 was loose where it screwed into its well. The licensee documented the specific deficiencies on maintenance identification sheets, and stated that the ESQ CAP would have identified these deficiencies. However, the team could not confirm that these components were addressed within the CAP. Pending further NRC review of the licensee's corrective action, this remains an open item (50-390/89-200-17).

The team noted that various transmitters had not been adequately sealed, contrary to installation requirements. The team determined that these deficiencies could prevent the transmitters from performing their safety function during an accident. For example, flow transmitter 1-FT-70-98 had a loose housing and the electrical connection assembly was not sealed. The licensee stated that its maintenance and environmental qualification programs would correct all such sealing deficiencies and issued MR A657308 to tighten the transmitter housing and connection assembly.

2.5 Conclusions

In summary, the team's examination of Class 1E electrical equipment identified significant installation deficiencies that had not been identified or controlled by an existing CAP or CAQR. These deficiencies included problems with potential cracking of Melamine limit switch rotors, orientation of Limitorque motors, protection of Kapton-insulated leads, nonconservative acceptance criteria for vital battery intercell resistance, inadequate battery maintenance and housekeeping, and space heaters not energized to protect pump motor windings. The licensee needed to confirm the qualification of installed equipment in regard to installation deficiencies.

The team also concluded that, because of the critical schedule of control room installations, the licensee did not observe proper controls to maintain the quality of construction in the control room. For example, the Nuclear Construction Department, on their own initiative and without the prior approval of the Quality Control Department, eliminated certain QC inspection activities. Inspection records were inadequate and critical devices were inadequately protected or controlled to avoid damage.

The team's review of cables and terminations indicated that work was done in accordance with installation documents. Although the team identified deficiencies in Raychem splices and Kapton insulated leads, the licensee had addressed repair of Raychem splices in its cable issues CAP and repair of Kapton leads in CAQRs WBP890302 and WBP 890436. The team found various existing problems that the licensee was not aware of in regard to vendor wiring and terminations, needing further licensee attention.

The team determined that the installed instrumentation had a significant number of discrepancies with regard to mounting configuration, loose or missing hardware, and sealing which affected the performance of their safety function. The licensee presented general CAPs to address field reviews for similar problems, but there was no evidence of generic corrective action and no evidence that the CAPs would have identified the specific team findings. The number of such instances made it difficult for the team to determine whether the licensee's ESQ CAP and loose parts walkdown program would correct all deficiencies. The team concluded that the licensee needed additional controls to encompass the significant number of nonconforming instances in the field.

3. MECHANICAL CONSTRUCTION

The team evaluated the installation and preventive maintenance of pipe supports; piping; mechanical components and equipment; and heating, ventilating, and air conditioning (HVAC) systems. The team inspected a sample of installed and QC-accepted hardware for each of these areas. In addition, the team conducted personnel interviews and reviewed certain programs, procedures, and relevant documents as necessary to support or clarify hardware inspection findings.

3.1 Pipe Supports

The team inspected a primary sample of 52 pipe support installations in detail to assess conformance with detailed design drawings and any applicable design changes and nonconformance reports (NCRs). The team selected these supports to encompass a broad cross-section of installed supports including:

- Various pipe sizes (1/2-inch through 14-inch diameter);
- Types of supports (struts, snubbers, springs, rods, and box guides);
- Systems (safety injection, reactor coolant, residual heat removal, essential raw cooling water, and chemical and volume control);
- Plant locations (auxiliary building, containment, and diesel generator building); and
- TVA piping classes (A, B, C, and G).

The team also examined for obvious discrepancies approximately 250 small-bore, non-engineered pipe supports (selected and installed from typical drawings) located on the auxiliary control air system and the diesel starting air system. The team randomly selected approximately 50 additional supports in various systems during plant walkthroughs and examined them for obvious discrepancies without using detailed drawings. The team also examined pipe supports on vendor-supplied skid-mounted equipment. In addition, the team inspected 20 of these supports to confirm location as specified on seismic analysis isometric drawings.

The team identified many discrepancies between the as-built installations and the design criteria. These discrepancies included undersized parts, clearance or interference problems, broken and missing locking devices, drawing errors, and missing and undersized welds. See Table 3-1 for a complete listing of the identified discrepancies.

The team noted 69 discrepancies on 48 supports. Of the 48 discrepant supports, 38 were in the primary sample of 52. The inspectors did not consider any of the discrepancies to be significant enough to impair the function of the supports. TVA had previously identified 50 of the 69 discrepancies. These problems were documented during the as-built walkdown inspection performed as part of the Hanger Analysis and Update Program (HAAUP) CAP. In addition, three discrepancies on a pressurizer sample line should be identified during a planned walkdown inspection, which is part of the instrument line CAP. Other plant walkdown inspections such as the loose, missing, or damaged hardware inspection or the final system and area walkdowns planned by TVA should identify several of the other noted types of discrepancies. The team interviewed responsible engineers and reviewed administrative and implementing procedures for the HAAUP as well as a representative sample of supports that were processed through the HAAUP reconciliation program. The team determined that this program should satisfactorily resolve the types of discrepancies identified by the team and TVA.

3.1.1 Essential Raw Cooling Water System

One discrepancy the team identified was a displaced movable spacer between an integral pipe lug and the support structure for essential raw cooling water (ERCW) support 17A586-1-20 in the diesel generator building. TVA identified this discrepancy, typical of eight similar supports, during the as-built walkdown. The team had two concerns related to this support discrepancy.

First, the movable spacer design allowed mechanics to rotate the spacer away from the pipe lug, permitting axial pipe movement for removal of an adjacent valve. However, the spacer was only retained in its design position by one bolt on one end. No locking device or installation torque was specified to ensure that the spacer would remain in its design configuration. As a result, the team considered that vibration from the ERCW system or the adjacent diesels could dislodge the spacers.

The team considered that the design of the movable spacer on the ERCW supports in the diesel generator building should be reviewed to determine whether additional locking measures are needed. In addition, if similar designs exist, appropriate actions should be taken to ensure that similar problems do not occur. Pending NRC review of licensee corrective actions, this is considered to be an open item (50-390/89-200-18).

Second, Maintenance Request (MR) A617861, prepared in August 1989 for removal of the adjacent valve, did not reference the alteration or restoration of this support. The team noted that, at the time work on the valve was to be done, the MR preparer may have known the support was discrepant and may thus have consciously omitted any reference to this support. However, special work controls for maintenance on this valve will be needed to ensure that the design configuration of this support is maintained.

3.1.2 Emergency Diesel Starting Air System

The team also found numerous discrepancies between the design and installed condition of supports for the emergency diesel starting air system. The specific observations are presented in the following paragraphs and are summarized in Table 3-2.

The team identified 22 instances in which the installed pipe clamps were not of the type depicted in the support detail drawings. In response to this concern, TVA stated that a previous revision of the support installation drawing general notes allowed the use of the existing 1-hole and two-piece clamps instead of the 2-hole clamps currently specified. Further, TVA stated that the use of the existing clamps would be reviewed to ensure compliance with the updated design criteria as part of Nonconformance Report (NCR) W-334-P under the instrument line CAP.

The team identified 12 supports which had loose or missing hardware. In response to this concern, TVA stated that these findings would be added to the scope of existing CAQR WBP 890402 and addressed in the WBNP loose, damaged, and missing parts walkdown program which was under development as corrective action for the subject CAQR.

The team also identified eight supports which lacked the specified 1/8-inch clearance between the pipe and U-bolt. The team was concerned whether the supports as installed could withstand loads in directions not intended by the original design of the support, as would occur with the U-bolt tight against the pipe. In response to this concern, TVA stated that the installed configuration of these supports was previously identified and evaluated and found acceptable in Significant Condition Report (SCR) WBNCEB8537. In addition, the licensee issued Engineering Change Notice (ECN) 6033, revising specific clearance details on installation drawings to ensure that new U-bolt installations would be made in accordance with design. TVA further stated that the subject SCR would be reviewed through implementation of the HAAUP CAP to ensure compliance with updated design criteria.

The team also identified one support which was not installed as required by the hanger location drawings. TVA generated CAQR WBP890573 to document the condition and stated that the disposition of the CAQR would include an evaluation of the extent of this condition.

3.1.3 Chemical and Volume Control System

The inspection of the selected supports for the chemical, volume, and control system (CVCS) yielded many discrepant conditions by comparison with as-constructed design drawings. The specific observations are included in Table 3-1. TVA also inspected the CVCS pipe supports to identify installation deficiencies in accordance with its HAAUP CAP. Of the 34 discrepant conditions identified by the team, only 2 significant items on support 1-62A-033 had not previously been identified by the TVA walkdowns. TVA committed to revise the walkdown package documentation for support 1-62A-033 to properly reflect the as-built conditions.

Additionally, two of the supports inspected were found to be disassembled. Support 62-1CVC-R014 was found disassembled and tied off in a manner that caused one of the vertical threaded rods to bend. MR A573307, initiated in July 1986, directed the removal and reassembly of portions of the support to allow examination of a pipe weld. At the time of this inspection, the MR was still open and the support reassembly had not yet been performed. The team reviewed the MR work package and noted that (1) there were no inspection steps included to ensure that the bent rod would be inspected for possible damage before reassembling the support, (2) there was no notation to the effect that support components were missing, and (3) there were no requirements specified for the storage of removed parts. In response to the first two concerns, TVA initiated a new MR, A-656759, identifying the current condition and work to be performed. In response to the third concern, TVA provided examples of current standard work procedures which require removed parts to be tagged and stored. Although the team did not fully evaluate the adequacy of this practice, it appears to provide a degree of control over temporarily removed support components.

An unmarked spring hanger assembly, later identified as support 1-62A-621, was found on the floor in the containment building. TVA found that MR A-602116, initiated in January 1987, directed the removal and replacement of the support to facilitate removal of a valve. At the time of this inspection, the MR was still open. In response, TVA stated that the spring hanger had been tagged when removed, but had not been properly stored. At the time the support was removed, the practice was to tag and store temporarily removed components. TVA stated that the spring hanger would be tagged and stored until work could resume.

Comparisons of pipe support locations with design seismic analysis isometrics were performed. In all cases, the support locations were within design specification tolerance. In addition, the as-installed locations would also be used during the HAAUP CAP pipe stress reconciliation effort.

3.2. Piping

The team selected two piping systems for inspection: the auxiliary control air system and the diesel generator starting air system. Pipe classifications were American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Classes 1, 2, and 3 and TVA Class G.

3.2.1 Auxiliary Control Air System

This safety-related system provides clean, dry air to plant safety-related valves and instrumentation. The team inspected the compressor pads for both trains, which included compressors, accumulators, dryers, pre-filters, after-filters, receivers, and all related piping and instrumentation. The team also inspected piping from the "B" train compressor to root valves 0-32-410 and 0-32-413 as shown on isometric drawing IOS-3322. Inspection attributes included support type and location, basic configuration, and component location. TVA typical pipe support drawings provided acceptance criteria.

In addition, the team examined the piping, support, and component installation for steam generator level control valve 1-LCV-3-173-B and main steam atmospheric dump valve 1-PCV-1-23, which use auxiliary control air for operation. The team walked down these lines from valves 1-LCV-3-173-B and 1-PCV-1-23 to root valves 0-ISV-32-408B and 1-ISV-32-435A. The team used acceptance criteria contained in TVA typical support drawings; isometric drawings IOS-2646, 2647, and 2652 and; TVA valve and tubing detail drawing series 47W600.

The team also compared the applicable design drawings to the installation of the train "A" header piping and containment isolation valves in the annulus and the containment isolation piping and valves for the nonessential control air piping in the annulus.

The team reviewed various maintenance records and discussed system maintenance activities with Watts Bar Maintenance Department personnel. These reviews were conducted because the auxiliary control air system was functioning and had been turned over to the Operations Department. The records reviewed by the team included preventive maintenance documents for compressors, dryers, and humidity alarms.

In general, the team found that the licensee had installed the auxiliary control air system piping and components according to design drawings and specifications. However, the team identified discrepancies between flow diagrams and installed equipment, inconsistent component train identification tagging, and damaged hardware. The inspectors also noted unauthorized substitution of rubber hoses for steel tubing and loose temporary supports on the compressor skids. See Table 3-3 for a complete listing of the identified discrepancies. TVA had previously identified the flow diagram and tagging discrepancies as generic issues requiring resolution. As a result, TVA was developing corrective actions.

During this NRC inspection, TVA was in the process of a major, long-term review and upgrade of the Watts Bar maintenance program. TVA was also reviewing maintenance activities for the auxiliary control air system in response to NRC Generic Letter 88-14. The team concluded that the draft commitments they reviewed, which resulted from TVA's review of the generic letter, should significantly strengthen the program if and when TVA implements them. However, the team's review of only a few maintenance documents resulted in identification of many weaknesses in the maintenance activities related to this operating system as illustrated by the following examples.

- TVA did not test air quality for particulates or hydrocarbons.

- TVA only performed dew point tests for moisture content on a quarterly basis. Many plants verify dewpoints three or more times weekly.

- The last two dew point tests, in March and June 1989, did not meet the test criterion of minus 40 degrees. However, the test documents contained no evidence of this inadequacy. The data sheet did not specify the acceptance criteria and did not have a clear signoff indicating that the acceptance criteria had been met. It should be noted that the moisture indicators on the nonsafety-related control air dryers supplying air to this safety-related system indicated high moisture during the entire duration of this inspection, and the moisture alarm on the operating train "A" auxiliary control air system was broken and tagged "out of service."

- Preventive maintenance (PM) records did not document the as-found and as-left conditions of the pre- and after-filter elements when mechanics performed filter PMs. This information is necessary to verify adequate maintenance intervals and to identify other system operational problems.

- PM records did not clearly indicate that filter dessicant had been replaced during the annual dryer PM.

- Compressor control solenoid valves 32-62 and 32-88 were not part of the PM program.

- The calibration procedure for moisture sensor 0-MS-32-83 only verified the switch setpoint. TVA did not calibrate or verify the accuracy of the sensor in the process line.

- The vendor technical manual for the dryer units supplied by Pall-Trinity recommended a six-month interval for after-filter element replacement. The Watts Bar PM program interval was annual.

- The Operations Department Area and Equipment Daily Checksheet for October 24, 1989, the only one examined by the team indicated that the auxiliary control air system dryers were out of service. The team found that the system compressors and the train "B" dryers were out of service, but that the train "A" dryers had been operating since at least September 29, 1989.

- PM records indicated that the implementation of scheduled maintenance for the "A" train compressor had exceeded specified intervals and experienced significant delays in completing yearly PMs.

Based on the number of weaknesses noted in the PM program during this brief review, the team concluded that the maintenance and operations activities related to the auxiliary control air system must be carefully examined by TVA to assure that this safety-related system is properly maintained and surveilled. In addition, the team believed that TVA should assure before startup and the upgrading of the PM and operational surveillance programs, that the safety-related components that use the system have not been degraded by the quality of air supplied to them. Pending NRC review of licensee corrective actions relative to these identified PM program weaknesses, this is considered to be an open item (50-390/89-200-19).

3.2.2 Emergency Diesel Starting Air System

The team inspected diesel starting air system piping for the four Unit 1 diesels (two diesels per generator) to verify that installation and material condition complied with design drawings and associated construction specifications. The piping included all lines from the starting air compressors to the diesel skid-mounted air receivers and from the air receivers to the starting motors. This represented approximately 610 linear feet of small bore pipe.

The diesel starting air system piping consisted basically of two sizes, 1-1/4-inch and 1/2-inch diameter. The team found that the 1-1/4-inch diameter piping generally adhered to design and construction requirements. However, numerous sections of the 1/2-inch diameter piping were damaged. The damaged piping, in most cases, had previously been identified by TVA and was the subject of MRs to effect repair. TVA initiated corrective actions for damage identified by the team that had not previously been identified by the licensee. Similarly, kinked and frayed metal braided flex hoses either had been identified by TVA for repair, or became the subject of corrective action was as a result of this inspection. Details of the diesel starting air piping observations are presented in Table 3-4.

The team reviewed the implementation of PM procedures for the diesel starting air system. The inspectors did not perform a detailed review of the technical adequacy and accuracy of these procedures, since TVA was planning to evolve from a construction PM program to a more comprehensive operational PM program in the near future. Records of the PM actions performed were reviewed to determine if the licensee was maintaining equipment in a state of readiness and to verify that the components and systems were not allowed to degrade once construction was complete.

In reviewing the PM program for the components, the team found that it contained adequate procedures and scheduling for the construction status of the plant. The procedures were brief, but they contained the necessary steps and references to allow performance by experienced craft personnel. Of the PMs reviewed by the team, most had been performed within their scheduled interval. The notable exception was PM 82-72 for the air start pilot regulator. Information provided by TVA showed that this five-year PM was scheduled to be performed in 1986; however, the necessary replacement parts had not yet been received by TVA. The team determined that procurement of parts to support the PM program warranted further attention by TVA. Pending NRC review of licensee corrective actions, this is considered to be an open item (50-390/89-200-20).

3.3 Mechanical Components and Equipment

The team inspected eight major safety-related pumps and five safety-related heat exchangers to assess conformance with design installation requirements. The team also examined in detail the compressors, dryers, receivers, and filters in both trains of the auxiliary control air system for proper installation. In addition, during plant walkdowns, the team examined various other components and equipment for damage and other obvious discrepant conditions. TVA structural and foundation drawings, vendor technical manuals, and vendor detail drawings provided the acceptance criteria used by the team. See Table 3-5 for a listing of the primary inspection samples and the identified discrepancies. The team also discussed the equipment seismic qualification (ESQ) CAP with responsible engineers and reviewed the pertinent administrative and implementing procedures.

The team identified 17 discrepancies on 7 of the 13 items in the primary inspection sample. In addition, the inspectors identified seven discrepancies on components in the auxiliary control air system. The team noted five additional discrepancies on five other plant components. See Table 3-5 for a listing of discrepant conditions.

Most of the discrepancies were in the following two general categories.

o Loose or missing pipe supports on vendor-supplied skid-mounted pumps (nine instances on four pumps).

- o Missing washers, loose or missing nuts and bolts, and inadequate thread engagement on foundation fasteners (17 instances on 13 items of equipment).

TVA had performed "trial run" inspections for the ESQ CAP and concluded that most of the discrepancies identified by the team would have been noted and resolved by this program. From a review of the ESQ program, the team determined that the specified walkdown inspection criteria were too general except for specific problems already identified on CAQRs.

The team discussed with TVA personnel the need for component-specific inspection and evaluation criteria. TVA committed to revise ESQ CAP implementing procedures to address this concern. TVA also committed to improve the ESQ team personnel training in this area. The team concluded that, if TVA incorporates the enhanced attribute checklists and training into the ESQ program, the ESQ CAP should identify and resolve the types of equipment and component discrepancies identified by the team.

The team identified a concern related to the regenerative heat exchanger installation. The applicable Westinghouse technical manual specified, in a section entitled "Special Instructions," that the heat exchanger had been designed such that only one end of the central shell was secured and all other shell ends were free to move to relieve thermal expansion induced stresses. The five "free" ends of the three shell heat exchanger were mounted to the support structure with bolted, split clamps. A review of vendor drawings suggested that there was a design diametrical clearance of 1/8-inch between the outside diameter of the shells and the inside diameter of the clamps. However, the vendor installation drawing only specified a nominal clamp inside diameter of 11 inches. Because the clamps were made of rolled plate with welded ears and were not machined components, the design clearances would be difficult to attain. Neither the vendor drawing nor the technical manual specifies any required installation clearances. Notes on the drawing indicated that TVA had removed the clamps and later reassembled them during installation of the heat exchanger. TVA instructions for the installation and inspection of the heat exchangers did not require any verification or recording of clamp-to-shell clearances or other special installation criteria. The team was concerned that, because of manufacturing and installation variables, the shell-to-clamp clearance may not be adequate to allow thermal expansion without overstressing of the supports. This item will remain open pending further NRC review of additional information (50-390/89-200-21).

3.4 Heating, Ventilation, and Air Conditioning (HVAC)

The team selected for inspection components of the reactor containment purge, supply, and exhaust system. Ducting, supports, and valves were inspected for size and orientation, structural member size, bolting, weld size and type, flange bolting integrity and torque, and damage. The team used as-constructed drawings for duct routing and support location, applicable TVA installation procedures, and vendor design and installation manuals (including drawings and instructions) to verify proper system construction. The ducting sample included approximately 1050 linear feet of seam welded steel.

The team inspected three pipe supports in the containment purge system to verify conformance of installation and material condition with associated support design detail drawings, construction specifications, and support component vendor catalogues. The team also selected for inspection 12 valves from plant drawings and selected an additional 12 valves during the team's general area walkdowns.

The team found that the general installation of containment purge air ducting complied with design drawings. The inspection focused on placement of the pipe and pipe supports. For the inspected portion of ducting, no deficiencies were identified. However, the team identified many discrepancies which were characterized as poor material condition of the inspected valves. The majority of the discrepancies involved loose and damaged electrical connections to the valves and bent air supply lines. The specific observations are presented in Table 3-6.

The team found loose nuts on 4 of the 40 valve body-to-duct flange studs on containment purge inboard isolation valve 1FCV-30-52. The team requested that the licensee retorque the stud nuts to identify the extent of the problem. Of the 40 nuts, 13 rotated on the initial torque pass of 76 ft-lbs and 20 rotated when the final torque of 190 ft-lbs was applied. Initial investigation by TVA produced no explanation for the loose nuts for rotation of some nuts upon the initial torque pass. In response to this team finding, TVA initiated CAQR WBP 890594 to determine the cause and extent of required corrective action.

The inspection of the containment purge system supports yielded two identical discrepancies on two supports. Supports 1030-A915-3-58 and 1030-A915-3-61 use two-bolt clamps. The team determined that the pipe clamp bolts were not tightened and that half of the clamp ring was not secured against the duct. TVA MR A642404 was currently being implemented and was controlling the work on support 1030-A915-3-61. TVA determined that support 1030-A915-3-58 was apparently disassembled because of erroneous information in work plan N8030AB. The work plan did not contain any steps which would have provided for reassembly of support 1030-A915-3-58. In response to the team's finding, TVA committed to include this deficiency in existing CAQR WBP890502. MR A642706 was also generated to reassemble support 1030-A915-3-58.

The team determined that the discrepancies found on the inspected containment isolation valves and supports could have generic implications. TVA must ensure that all similar valves and support components are installed to specified requirements to ensure their proper function and system operation. Pending NRC review of licensee corrective actions, this is considered to be an open item (50-390/89-200-22).

3.5 Area Walkdowns

To observe the general material condition of the plant, the NRC inspectors performed area walkdowns in the reactor containment, reactor shield building, auxiliary building, fuel building, diesel generator building, and a selected section of the turbine building. The attributes inspected included properly installed and torqued fasteners and equipment foundation anchorages, properly installed and routed instrumentation tubing, properly connected electrical cabling and wiring, and properly installed and routed vents and drains on pipes, pumps, and heat exchangers.

3.5.1 Fire Extinguishers in Containment

The team noted dry chemical fire extinguishers placed throughout the containment. TVA initially stated that the fire extinguishers were seismically mounted and were intended to remain in place during operation. 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 3 states, in part, "fire fighting systems shall be designed to ensure that their rupture or inadvertent operation does not significantly impair the safety capability of these [safety-significant] structures, systems, and components." The team questioned whether the extinguishers could withstand postulated accident conditions inside containment. TVA's investigation in response to the team's question showed that the extinguishers had not been qualified for the post-accident environment.

TVA committed to evaluate the environmental qualification of the extinguishers and to remove the extinguishers from containment when not needed to support work activities. As a result of the teams findings, TVA issued CAQR WBP890521 on October 5, 1989, and identified the lack of analysis which would demonstrate that portable fire extinguishers located in the reactor containment would meet the requirements of GDC 3.

3.5.2 Component Cooling System Pump Relief Valve Drains

The team noted that the licensee had routed the discharge pipes from several component cooling system (CCS) relief valves to the general floor area several feet from the nearest floor drain. The design reflected in the current revision of the WBNP FSAR, Section 9.2, indicated that the discharge of these relief valves was routed back to the CCS return line, thereby containing the CCS water, which is treated with corrosion inhibitors.

TVA provided to the team a WBNP modification that was performed based upon another TVA plant's SCR SQNMEB81518 R1. The SCR identified an inappropriate relief valve type specified for the original design. In lieu of installing the correct valve for the application, the modification routed the discharge to the open floor drain system. The team reviewed the modification and noted several deficiencies:

- The modification did not identify the FSAR sections which required amendment;

- The modification did not evaluate the effects on interfacing systems such as floor drains and waste processing; and

- The modification did not fully address the effect of the change on the system's design basis. The system was changed from a closed loop system to a potentially open system should the relief valves discharge into the open rooms.

In response to the team's concerns, TVA revised ECN 6591 to include a requirement to revise the FSAR and perform a calculation to determine the impact of discharging the chemically-treated water to the waste disposal systems. This item will remain open pending further NRC review of additional information (50-390/89-200-23).

3.5.3 Auxiliary Feedwater System Vent Valves

Piping for the auxiliary feedwater system contained many high point vent valves to permit system filling and draining. These valves were installed vertically with approximately two inches of open space above the valve disk, which was open to the local plant environment. Of the nine valves directly inspected, all had excessive amounts of granular and flaking rust accumulating in the open space above the valve disk and some had stagnant water. During operation of these manual vent valves, the pieces of rust would fall into the main piping system. The team was concerned that the rust could potentially have operational effects on system components such as auxiliary feedwater pumps, flow control valves, and check valves. In response to this concern, TVA committed to initiate a design change notice (DCN) to evaluate operational considerations for potential design changes.

3.5.4 Room Coolers

The team identified several area and room coolers which lacked required fasteners. In most cases there was maintenance in progress that, when completed, should have installed the fasteners. Additionally, one bolt on the 1AA pipe chase cooler was loose. Ongoing maintenance would not correct this condition. In response, TVA generated a maintenance identification sheet according to the requirements of the ESQ CAP.

The team also identified two apparent problems with the installation of the safety injection pump 1BB room cooler. The manufacturer's drawing shows the fan end bearing stiffener ribs in a vertical orientation. However, the ribs were installed horizontally. TVA reviewed the seismic qualification documentation for this and similar coolers and determined that the coolers were qualified assuming the stiffeners were horizontal. As a result of the discrepancy between the cooler drawings and their seismic analysis and as-built configuration, TVA initiated DCN P-06698-A to revise the drawing and bring it into agreement with the analyzed and installed condition. Additionally, two required bolts were not installed in the sheet metal flange due to an apparent interference problem with the stiffeners. The specifications call for bolts to be installed on a nominal 6-inch center.

3.5.5 Pipe Flange Alignment

The team noted that some pipe to equipment flanges were disconnected because of ongoing work activities. They also noted that one of the flanged connections on the discharge nozzle of a CVCS pump would require realignment for final fit-up. The team was concerned that excessive force might have to be applied to the pipe flange to realign it with the pump because the pipe had rigid supports and restraints installed.

The team reviewed TVA procedure WBN-CPI-8.1.8-M-200 D, Revision 0, "Fabrication and Installation of Piping (mechanical joints)," dated August 2, 1989, which included the allowable method for flange fit up and alignment. This procedure allowed flanges to be fit up and aligned with "no more external force than can be applied by hand (for pipe 4 inches or smaller in diameter) or using a two and one half foot rod." The procedure did not specify the diameter of the rod, the material of the rod, or how the force may be applied.

In response to the team's concerns, TVA provided its interpretation of the procedure. TVA stated that the intent of the procedure was to limit the amount of force required to align flange bolt holes for insertion of bolts or studs. TVA further stated that one man using a rod less than 2-1/2 feet long can align flanges. This would limit the force which can be used and was preferable to using power lifts which can accidentally exert excessive loads. QC personnel stated that the limitation of only one person aligning flanges had been a standard inspection practice; however, it was not documented in a procedure.

As a result of the team's concern, TVA committed to revise all fit-up and alignment procedures to limit performance to a single person and specify the type of alignment tool material.

3.5.6 Emergency Diesel Room Fans

The team inspected the eight diesel room exhaust fans and damper assemblies for obvious deficiencies. They noted that the fan to damper bolting arrangement varied among the eight identical units. TVA reviewed the manufacturer's drawings and found that they did not provide adequate detail to identify the acceptable bolting configuration. In addition, TVA determined that the fan and damper were not seismically qualified as an assembly, as TVA procurement specifications required, but rather as individual components.

As a result of the team's finding, TVA issued CAQR WBP890511, included this item in the ESQ CAP, and initiated a 10 CFR Part 21 reportability evaluation.

3.6 Conclusions

In general, the team found that the inspected mechanical components and equipment were installed in conformance with applicable TVA design and installation requirements. However, the team identified numerous design requirement discrepancies and hardware deficiencies. Examples included flange bolts which failed to meet minimum installation torque on a reactor containment isolation valve; unqualified fire extinguishers in containment; missing supports on vendor supplied skid mounted piping; improperly installed foundation bolts on mechanical equipment; unauthorized substitution of pipe support and valve parts; and loose, missing, and damaged fasteners on mechanical components and equipment.

The team found that TVA CAPs or special programs, concerning this area, had addressed many of the team identified hardware discrepancies. However, the team was concerned that the licensee might not have identified or adequately addressed some of the discrepancies if they had not been brought forward during this inspection.

TABLE 3-1

PIPE SUPPORT OBSERVATIONS

Support Number	Observations
62-1CVC-R103	Distance from center of pipe clamp to elbow weld is 1-3/8 inches. Isometric shows support is directly on weld.
62-1CVC-R152	There is a 1-inch offset from top of rod to bottom of pipe clamp.
	Drawing view labeled as facing East; should be labeled as facing West.
62-1CVC-R001	One bevel washer is installed backwards.
62-1CVC-R004	No discrepancies noted.
62-1CVC-V180	No manufacturer's label on spring can.
	Lock seal on upper rod to spring can stop nut is broken.
	Portion of upper rod inside spring can inhibit upward movement of spring (1/4-inch clearance).
62-1CVC-R009	One cotter pin is broken.
	Actual pin-to-pin distance is greater than that specified by drawing.
62-1CVC-R012	No discrepancies noted.
62-1CVC-R015	Upper and lower snubber angular offsets do not conform with drawing.
62-1CVC-R014	Support found partially disassembled, parts not located in immediate area, and one rod bent.
62-1CVC-R138	There are no clearances as indicated on as-constructed drawing for pipe-to-pipe strap.
	Placement of horizontal member on base plate is off 1/2-inch from drawing.
	Drawing indicated horizontal member cutout radius is 1-1/2 inches. Actual is 1-7/8 inches.

TABLE 3-1 (Continued)

Support Number	Observations
62-1CVC-R072	Weep hole in cylindrical spacer is not indicated on drawing.
	Drawing has drafting error showing two bolts with double nuts.
62-1CVC-R262	No discrepancies noted.
62-1CVC-R275	Safety wire is broken.
	Snubber bracket does not appear on parts list.
	Snubber/strut assembly is installed approximately 10 degrees out of line.
62-1CVC-R254	Strut slope from support to pipe is 2-3/4 inches.
	1/8-inch proximity between pipe clamp to and closest support causes potential interference.
	Distances from center of strut to center of angle beam is 13 inches. Drawing indicates 12 inches.
	Base plate for vertical member contains partial welded shim not shown on drawing.
	Welded shim as installed does not conform with design. (Grout was removed to permit inspection).
1-62A-021	Measured cold set pin-to-pin is 2 feet 6-1/2 inches. Drawing shows 2 feet 5-3/4 inches.
1-62A-022	Support is currently undergoing extensive modification.
1-62A-290	Drawing shows 2 inch clamp spacing. Actual spacing is 1 inch.
	Parts list item No. 3 indicates 3/8 x 6 x 6 inch plate. Actual plate is 1/2 x 6 x 6 inches.

TABLE 3-1 (Continued)

Support Number	Observations
1-62A-364	Drawing indicates measurement L is 8-7/8 inches (actual is 9-1/8 inches) and measurement E is 6 inches (actual is 5-1/2 inches). Spring hanger is unloaded (e.g., not at cold setting).
1-62A-361	Pipe clamp has oversize bolt holes (5/8-inch diameter hole for 1/2-inch diameter bolt). Distance from center of beam to center of pipe should be 9 inches (actual is 7-1/2 inches). Distance from end of upper member to center of pipe should be 14-1/4 inches (actual is 13-7/8 inches). Clamp offset along pipe centerline should be 1-1/4 inches (actual is 1-3/8 inches).
1-62A-034	Measurement from the center of the hole in the pipe clamp bracket to the center of the structural angle should be 9/16 inch (actual is 7/8 inch).
1-62A-033	Cold setting should be 12-1/4 inches (actual is 11-1/4 inches). Angular offset should be 1/2 inch (actual is 2 inches in the opposite direction). Angle of tube steel to plate center line should be 30 degrees (actual is 8 degrees). Angle of snubber centerline to pipe should be 2 degrees 20 minutes 21 seconds (actual is 8 degrees in the opposite direction). Drawing has wrong symbols for angle of snubber center line to pipe center.
1-62A-067	No discrepancies noted.
62-1CVC-R86	No discrepancies noted.

TABLE 3-1 (Continued)

Support Number	Observations
1-62A-316	Item No. 1 on parts list is specified as 9-1/2 inches long (actual is 8-1/2 inches). Position of vertical pin in bracket slot is not as shown in drawing.
74-1RHR-R201	Loose locknut on top of turnbuckle.
1-62A-621	Unmarked spring can assembly was found laying on the floor in containment.
62-1CVC-R046	There is no clearance between left strut (as shown on the drawing) and support 47A-435-1-47 clamp.
62-1CVC-R255	Clamp and strut are not aligned.
1-62A-008	No discrepancies noted.
1-62A-369	No discrepancies noted.
1-62A-331	No discrepancies noted.
62-1CVC-241	No discrepancies noted.
1-63-002	Clearance to adjacent support does not meet specification requirements. There is zero clearance between top of spring can and beam attachment.
1-ERCW-V127	No discrepancies noted.
1-68-364	Cotter pin is broken. The two pipe clamps shown as drawing item 6 are of different configurations.
1-74-11	Thread engagement for snubber body to forward bracket screws is inadequate (CAQR WBP890552 issued).
1-63-042	No discrepancies noted.
63-1SIS-R30	No weld detail is specified for overlap of brace to horizontal member. Several discrepancies exist between installed clamp details and the design drawing.

TABLE 3-1 (Continued)

Support Number	Observations
1-68-022	Spacer washer and cotter pin are missing from snubber. Clearance between snubber and 1-inch diameter pipe does not meet specification requirements. There is an undersized weld (1/4 inch specified vs. 3/16 inch actual) on one side of tubesteel to baseplate weld (CAQR WBP890550 issued).
1-68-003	No discrepancies noted.
1-63-453	Spacer plate, drawing item 9, is not installed.
63-1SIS-V54	Drawing item 2 is specified as a 5/8-inch load bolt, but the oversized load bolt actually installed is 3/4-inch. Since the hole in the welding lug is specified as 21/32-inch, which will not pass a 3/4-inch bolt without enlargement, this represents an unauthorized alteration of the welding lug.
1-68-026	The offset between the clamp and structure centerlines is not as shown on the drawing. Drawing erroneously indicates a 3/8 inch dimension for the notch in item 6 (actual is 1/4 inch).
1-63-030	No discrepancies noted.
63-1SIS-R90	Clearance to 1-inch seal piping does not meet specification requirements. Different pipe clamp is installed than is specified on drawing.
63-1SIS-R174	No discrepancies noted.
63-1SIS-248	No discrepancies noted.
63-1SIS-221	Baseplate size is specified as 9 inches by 9 inches; installed baseplate is 10 inches by 10 inches with correspondingly greater center-to-center anchor spacing.

TABLE 3-1 (Continued)

Support Number	Observations
63-1SIS-R50	No discrepancies noted.
63-1SIS-R142	Spacer plate installed was not shown on drawing.
63-1SIS-V179	Drawing specifies a size 8 beam attachment; a size 10 is actually installed.
	A 1 3/8-inch load pin is installed, although a 1 1/4-inch pin is indicated in the vendor catalog for the installed spring can and original attachment.
63-1SIS-V36	Drawing specifies a size 5 Bergen Patterson item 216, which consists of a size 5 welding lug part 220 and a size 3 clevis part 276. The WP-32 walkdown indicated that a size 4 item 216 was installed. Installed equipment actually consists of a size 5 part 220 and a size 2 part 276, which does not correspond to any assembly in part 216.
1-68-035	Drawing uses a confusing and erroneous weld symbol for the joint between item 4 and item 7.
	Weld at inside angle of item 2 to item 10 joint is missing.
	Drawing erroneously specifies fillet welds instead of flare bevel welds for item 1 to item 4 connections.
74-1RHR-R115	Strut turnbuckle locknuts backed off; strut is not bearing any load.
63-1SIS-R68	5/8-inch load pin is indicated by catalog; undersized load pin actually installed is 1/2-inch.
	Rod hanger is not bearing any load.
1-68-31	Clearance between snubber and conduit does not meet specification requirements.
1-62A-563	Half inch diameter hole burned through snubber extension tube.

TABLE 3-1 (Continued)

Support Number	Observations
17A586-I-20	Movable spacer rotated out of design position. Design is questionable, in that spacer is retained in place by only one untorqued bolt in one end. No controls exist in the maintenance request for adjacent valve removal to ensure restoration of support configuration.
1-043-AD-002	Pressurizer instrument line clamp is loose.
1-043-AD-003	Pressurizer instrument line clamp is loose.
1-043-AD-001	Tubing slides axially and laterally in clamp.
4392-3 on Iso. IOS-3322, Sheet 2, and second support downstream.	One of two bolts in each unistrut clamp is missing.

TABLE 3-2

EMERGENCY DIESEL STARTING AIR SYSTEM SUPPORT OBSERVATIONS

Support Number	Observation	Support Number	Notes
2-107-4135	1	2-107-4136	1
2-107-4137	1	2-107-4302	1
2-107-4303	1	2-107-4187	1
2-107-4186	1	2-107-4185	1
2-107-4182	1	2-1-4013	4
2-107-4183	1	2-107-4181	1
2-107-4132	1	2-107-4133	1
2-107-4134	1	2-107-4139	1
2-107-4184	1	2-103-4126	1
2-103-4127	1	2-103-4128	1
2-105-4310	1	2-105-4145	1
2-107-4138	2	2-2-3	2
2-103-1	2	2-103-2	2
2-103-3	2	2-5-4042	2
2-5-4041	2	2-5-4034	2
2-5-4032	2	2-6-1	2
2-6-2	2	2-6-3	2
2-2-1	3	2-213-1	3
2-213-2	3	2-5-4330	3
2-207-2	3	2-205-1	3
2-205-2	3	2-206-1	3

Notes:

1. Installation of 1-hole clamps or 2-piece clamps was not in agreement with current installation requirements.

2. Support components were loose, missing, or damaged.

3. Insufficient clearance observed between U-bolt clamp and pipe (1/8 inch required by current pipe support detail drawings, zero clearance observed by team).

4. Support not installed.

TABLE 3-3

AUXILIARY CONTROL AIR PIPING SYSTEM OBSERVATIONS

A. Discrepancies between flow diagram and actual installation

- o Dryer isolation valves 0-FCV-32-70A, -71A, -72A, -73A, -70A, -70B, -71B, -72B, and 73B are not shown on drawing.
- o Gauge 0-FI-32-76 is not shown on the diagram.
- o Thermostats ITS-32-5000A and ITS-32-5000B were not shown on the diagram.
- o Gauge 0-IPI-32-1000A was not shown on the diagram.

B. Irregularities and inconsistencies in identification tagging

- o The isolation valve for gauge 0-IPI-32-1000A had no identification tag.
- o The isolation valve for gauge 0-FI-32-76 had no identification tag.
- o "A" train motor MT-32-83 and PI-32-66 had white identification tags (indicating common, non-train equipment). Various compressor cooling water line components had both white and "A" train color identification tags.
- o The nameplates for the two identical dryer chambers were marked differently ("dryer 1 purge" and "dryer 2 pressure"); CAQR issued.

C. The prefilter installed in the inlet line from the nonsafety-related control air system is designated on the flow diagram as TVA Class G (non-ASME code, nonsafety-related). This prefilter is a critical element in ensuring proper functioning of the safety-related auxiliary control air system. Table 2-1 of the Control Air System Description, N3-32-4002, indicated that the prefilter was class "C".

D. Several instances of damaged material

- o The moisture sensor lamp at panel 1-L-19 was broken; CAQR MR A629390 issued.
- o The position knob on dryer stack isolation valve 94-B was missing; MR A629391 issued by TVA.
- o Moisture alarm sensor cable was disconnected on train "A". Cable is in high traffic area and can easily be inadvertently dislodged. Additional protection may be required. TVA issued MR A658003.
- o The air line tubing to main steam dump valve 1-PCV-1-23 pressure modulator on panel 1-L-420 was bent and sagging between supports and had deck grating tied to it; MR A658005 issued by TVA.

TABLE 3-3 (Continued)

E. Drawing 47W600-221, detail R221, specified 3/8-inch stainless tubing between solenoid valve and the valve positioner for solenoid valve on the air operator for main steam dump valve 1-PCV-1-23. Actually installed were rubber hoses with carbon steel nipples and unions.

F. Two sensing lines on each compressor (trains "A" and "B") were supported with temporary, improperly secured angle iron that was not shown on any drawings and was not marked as a temporary installation.

G. See Table 3-1 (pipe supports) and Table 3-5 (components) for a listing of additional discrepancies related to the auxiliary control air system.

TABLE 3-4

DIESEL STARTING AIR PIPING OBSERVATIONS

Drawing Number	Observation
H-586-2 sheet 103 R2	Horizontal tubing run below support H-128 was bowed.
H-586-2-sheet 107 R2	Vertical tubing run between supports 4137 and 4135 was bent.
	Horizontal tubing between supports 4188 and 4183 was bent.
	Horizontal tubing between supports 4135 and 4188 was contacting the support of the air receiver supply line.
	Vertical tubing run between supports 4135 and 4188 was contacting the fuel oil vent pipe.
H-586-2 sheet 215 R0	Flex hose braids were buckled.
	Relief valve 1-RFV-82-501A-A discharge was free and piping was not installed.

TABLE 3-5

EQUIPMENT AND COMPONENT OBSERVATIONS

A. Primary Inspection Sample:

Equipment	Observations
Safety Injection Pump 1A-A	Two missing U-bolt clamps on lube oil piping.
Safety Injection Pump 1B-B	Two missing and one loose U-bolt clamps on lube oil piping.
Containment Spray Pump 1A-A	None
Containment Spray Pump 1B-B	None
Centrifugal Charging Pump 1A-A	Three of four lube oil cooler foundation bolts loose.
	One loose U-bolt and one missing U-bolt nut on lube oil piping.
	No washer under turning element for torqued foundation nuts.
	No washers under gear assembly holddown bolts.
	Only two of four pump-to-pedestal bolts have lockwashers (one fore and one aft). Drawings do not clearly detail requirements.
Centrifugal Charging Pump 1B-B	Two missing U-bolts on lube oil piping.
	No washer under turning element for torqued foundation nuts.
	Only two of four pump-to-pedestal bolts have lockwashers (one fore and one aft). Drawings do not clearly detail requirements.
Residual Heat Removal Pump 1A-A	Pump seal vent opening not plugged as indicated in vendor manual. MR A-646938 issued.

Equipment	Observations
	One lockwasher missing on seal water heat exchanger to support bolt.
	Seal heat exchanger outlet nipple is bent approx. 3/8 inch over 5-inch length.
Residual Heat Removal Pump 1B-B	Pump seal vent opening not plugged as indicated in vendor manual. MR A646937 issued.
	One lockwasher missing on seal water heat exchanger to support bolt and support to motor support head.
	Teflon tape on seal heat exchanger pipe cap. MR A662614 issued.
Spent Fuel Pit Heat Exchanger 1A-A	None
Spent Fuel Pit Heat Exchanger 1B-B	None
Regenerative Heat Exchanger	No installation and inspection criteria to ensure that heat exchanger shells are free to move axially as required by design.
Excess Letdown Heat Exchanger	None
Seal Water Heat Exchanger	None

B. Other Equipment and Components

Equipment	Observations
Hydrogen Recombiner	One foundation bolt between unit and support skid missing.
Valve 1-RIS-1-620	Three of four operator-to-yoke bolts loose. MR A649139 issued.
Valve 1-PCV-68-340D1	Broken control air gauge, loose tubing fitting, and bent tubing.
Penetration Room Cooler 1B-B	One foundation nut missing.

TABLE 3-5 (Continued)

Equipment	Observations
Control Air Receiver #1	One foundation nut missing. Nonsafety-related MR A649138 issued.
Auxiliary Control Air Dryer Units-Trains A and B	No washers under foundation nuts over slotted holes in foundation.
Auxiliary Control Air Compressor A-A	One foundation bolt only extends to bottom of frame flange, not to top of skid as per vendor drawing.
Aux. Control Air Receiver A-A	Inadequate thread engagement on foundation nuts and one nut not fully tightened down.
Filter Regulator for Valve 1-PCV-1-23 (Main Steam PORV)	Inadequate thread engagement of mounting bolts.
Filter Regulator for Valve 1-PCV-1-12 (Main Steam PORV)	Inadequate thread engagement of mounting bolts.
Valve 0-ISV-3-174 (solenoid dump valve 1-LCV-3-174).	Small brass screw is used in valve air operator in lieu of bolt.

TABLE 3-6

VALVE INSPECTION OBSERVATIONS

Valve Number	Observations
1FCV-30-14 1FVC-30-15 1FCV-30-16 1FCV-30-40	Exhaust ports face upward for all four quick exhaust valves.
1FCV-30-50	Flex conduit to valve actuating solenoid is loose and twisted.
	Solenoid to conduit seal is loose.
	Air supply line is bent.
1FCV-30-51	Maintenance is in progress; actuator ports are not covered.
1FCV-30-52	Four valve body-to-flange nuts are found loose.
1FCV-30-53	On support for air regulator, thru-bolts do not fully engage with unistrut support nuts.
	Electrical conduit for valve actuating solenoid is not installed in its retaining clips.
	Air supply line is bent.
1FCV-90-109B	Flex conduit separated from condulet.

4. WELDING AND NONDESTRUCTIVE EXAMINATION

The team reviewed the welding and nondestructive examination (NDE) of 37 vendors and contractors to TVA, and reviewed the adequacy of WBNP's preservice inspection (PSI) program. The team inspected welds and weld details for vendor-supplied piping, pipe supports, tanks, filters, heat exchangers, electrical panels, and HVAC fans and dampers. The inspected welds included a representative sample in terms of different vendors involved, welding processes used, materials welded, and existing weld-joint configurations.

The team appraised NDE activities through:

- review of radiographs for vendor-fabricated welds;
- review of radiographs for shop-fabricated pipe welds including Westinghouse nuclear steam supply system (NSSS) welds;
- review of PSI procedures and personnel qualifications;
- inspection of the calibration status for NDE equipment; and
- witness of in-process NDE activities.

The team reviewed a sample of radiographic film in final storage in the vault of the licensee's facility. In addition, the team reviewed a sample of radiographic film and NDE documentation which was stored at the facilities of equipment and component manufacturers and suppliers.

4.1 Pipe and Pipe Support Fabrication

4.1.1 Welding Activities

The team reviewed activities related to fabrication contracts in the area of vendor-fabricated pipe and pipe supports welds. The team also reviewed radiographs for some of the reviewed pipe welds to assess their adequacy. Dravo Corporation supplied the shop-fabricated piping spools and Bergen Paterson Corporation supplied pipe supports and snubbers for the WBNP project. The team inspected 19 pipe welds and the welds on 3 pipe supports supplied by Bergen Paterson. See Table 4-1 for a listing of pipe and pipe support welds inspected.

During the visual inspection of the pipe welds, the team noted that some exhibited weld buildup adjacent to the welds. Discussion with TVA personnel revealed that, during the preparation for baseline inspection, TVA discovered that a number of welds on safety-related piping subassemblies had extra weld material near the welds. This unidentified material was later determined to be a weld buildup performed by Dravo in order to obtain proper dimensional tolerances. The weld buildup was not documented according to the quality assurance (QA) requirements and nonconformance report (NCR) W-4-P was issued by Dravo.

Further investigation by Dravo and TVA established that approximately 4,000 undocumented weld buildups had been supplied to WBNP. This condition was reportable under the provisions of 10 CFR 50.55(e), and the final report was submitted to the NRC by the licensee on May 14, 1981. As a part of the corrective action, Dravo conducted an extensive in-house search of their records in order to reconstruct all previously undocumented data. This information, which was reviewed and approved by Hartford Steam Boiler Company, Dravo's Authorized Nuclear Inspector (ANI), was submitted to TVA in the form of 70 corrected sketches. The sketches were subsequently incorporated into the existing weld data packages.

To determine if there were rejectable defects in the areas of possible weld buildups, TVA and Dravo also reviewed the radiographic test (RT) film of all shop and field welds. This film was of sufficient width to include any possible buildup area and was read again in accordance with Dravo procedure E2879-RT-1 (approved by TVA and Dravo's ANI). The review involved approximately 4,000 shop and 2,000 field welds, of which a minimum of 10 percent were also reviewed by TVA's ANI. No rejectable defects were found. Both Dravo and its ANI certified that, where required, Classes 1 and 3 Dravo shop girth welds were surface examined a sufficient distance from the edge to include any possible outside diameter buildups. TVA's procedure for surface examination ensured that this was also true for TVA field welds.

The team reviewed the documentation for its sample of 19 shop welds and requested that TVA repeat the radiography of two of those welds using seven-inch wide radiographic film to include the weld buildup. The team reviewed the new radiographs. No rejectable defects were identified in the area of weld buildup, and no problems were identified during the review of weld documentation. The team concluded that TVA had adequately addressed the weld buildup issue associated with Dravo-supplied piping spools.

The team also visually examined the welds on three pipe supports supplied by Bergen Paterson. No problems were identified during this examination. The welds met the requirements of the applicable fabrication drawings.

4.1.2 Nondestructive Examination Activities

The team reviewed the NDE activities for the vendor fabricated pipe welds. This review included 21 welds involving approximately 530 films. The films were also reviewed for weld buildup quality. The welds were fabricated by Dravo. See Table 5-1 for a listing of pipe welds inspected.

In general, the inspected NDE activities complied with the applicable codes and specifications. No weld deficiencies were identified in the inspected shop welds. However, the review of weld E2879-5F revealed that one area of the weld lacked adequate radiographic coverage. TVA reradiographed the area to provide adequate coverage. The team reviewed the new radiographs and found no rejectable defects.

4.2 Containment and Containment Penetration Installation

The team visually inspected approximately 250 linear feet of welded seam and the attachment welds for nine containment penetrations. The weld maps, weld detail drawings, and NDE reports were also reviewed for adequacy. In the area of NDE, the team reviewed 356 radiographic films for approximately 400 feet of welded seam. The containment liner was fabricated by CBI.

In general, the team found that the reviewed welding and NDE activities complied with the requirements of the governing code and construction specifications. However, the team identified a crater pit and slag indications during the visual examination of penetration numbers X-12A and X-57A. These indications could have masked the weld area during the required magnetic particle (MT) examination. TVA issued CAQR WBP 890516 in response to the team's finding. Investigating this condition, TVA removed the paint from the welds and determined that the weld areas met the required acceptance criteria. The team reviewed TVA's inspection results and concurred with this disposition. In addition, the team identified some radiographs with penetrameter shims in the weld area and several films that were not dated. However, the team found that these minor discrepancies did not prevent the films from being interpreted.

4.3 Vendors and Shop Fabricators Other than Those Previously Addressed

The team visually inspected 12 vendor-supplied tanks, filters, and heat exchangers. In addition, two floor-mounted instrument panels, two electrical inverters, two supply air fans, and four HVAC dampers were examined to assess compliance with the applicable engineering specifications. See Table 4-2 for a listing of the vendor supplied equipment the team inspected.

The team reviewed the radiographs and NDE documentation for equipment and hardware supplied by 30 vendors and contractors in addition to the welds inspected on equipment listed in Table 4-2. A total of 2450 films was reviewed including radiographs for valves, pumps, castings, pipe fittings, and other safety-related components. See Table 4-3 for a listing of the vendors and contractors for which the team reviewed NDE.

4.3.1 Welding Activities

In general, the team found that the welding quality for the vendor-supplied plant equipment complied with the requirements of the governing construction code and specifications. However, the team found undersized nozzle-to-shell welds on 8 of the 12 inspected tanks, filters, and heat exchangers. Of the eight affected items, two also had undersized welds on the support saddles. As a result of the NRC's findings, TVA issued CAQR WBP 890514 to track and resolve these deficiencies. This item remains open pending NRC review of TVA's corrective action (50-390/89-200-24).

The team also found that the reviewed vendor drawings for two electrical inverters and two supply air fans lacked adequate details to permit the team to determine the seismic adequacy of the welds. The electrical inverters were supplied by Solid State Control Incorporated, while the fans were supplied by Porter Corporation. As a result of the team's finding, TVA issued Quality Information Releases MTB-WBP89028 and MTB-WBP89029 to determine whether these items are suitable for seismic service.

In addition, the team found undersized (below fabrication drawing requirements) fillet welds on one of the five inspected dampers. The damper was fabricated by Techno, Incorporated. As a result, TVA issued CAQR WBP-890581 to trace and resolve this deficiency. See Table 4-2 for details of vendor equipment inspected and deficiencies found.

4.3.2 Nondestructive Examination Activities

In general, the reviewed vendor-related NDE activities complied with the governing construction codes and specifications. However, the team identified several problems, discussed below, during its review of radiographs. See Table 4-3 for details of vendor equipment inspected and NDE deficiencies found.

- The team identified rejectable defects such as linear indications and cracks, in radiographs supplied by Tube Line Corporation. As a result, TVA issued CAQR WBP890546 to track and resolve the deficiencies. However, the acceptability of these fittings will require careful scrutiny by TVA because of previous problems with Tube Line products experienced by the nuclear industry. Therefore, this item remains open pending NRC review of the licensee's corrective action (50-390/89-200-25).

- The team found that the radiographs supplied by Fisher Controls lacked adequate coverage in one area. As a result, TVA issued CAQR WBP890583 to track and resolve this deficiency.

- The team found rejectable aligned porosity during its review of radiographs for a surge tank supplied by Applied Engineering Company. As a result, TVA issued CAQR WBP89060 to track and resolve this condition.

4.4 Preservice Inspection (PSI)

The team selected for review a total of 16 welds requiring preservice inspection. The team reviewed radiographs for 5 of the 16 PSI welds to compare the PSI inspection results against the radiographic results. The team reexamined one weld using the applicable NDE methods to determine the validity of the recorded PSI data. In addition, the team reviewed six NDE procedures and eight NDE personnel qualification records for adequacy. The team observed eight NDE technicians performing inspections and evaluated the technicians for their ability to follow the applicable welding procedures. See Table 4-4 for a listing of the PSI welds inspected and NDE procedures and personnel qualification records reviewed by the team.

The team did not identify any problems in the inspected PSI activities. Activities were found to meet the governing code and program requirements.

4.5 Conclusions

In general, the team found that the inspected welding and nondestructive examination (NDE) activities complied with the requirements of the governing codes and specifications. However, during the inspection of tanks and heat exchangers, the team identified welds which did not meet the weld sizes required by fabrication drawings. Vendor drawings for electrical inverters and fan blowers also failed to provide adequate weld details to permit the licensee to determine the seismic adequacy of the welds. The team also identified several problems with vendor-provided radiographs.

TABLE 4-1

PIPE AND PIPE SUPPORT WELDS

Weld ID	System Description	Notes
SK-E-2879-5-E, Weld F	Feedwater	1
SK-E-2879-12, Weld H, Prep J	Feedwater	1
SK-E-2879-24, Weld B	Feedwater	1, 2
SK-E-2878-54, Weld G, Preps A, S, H	Main Steam	1
SK-E-2878-37, Weld G, Prep A	Main Steam	1, 2
SK-E-2878-19, Weld J, E, Preps A, H. N	Main Steam	1, 2
SK-E-2878-5, Weld E, Preps S, H	Main Steam	1
01A-MS-4	Main Steam	6
03A-FW-8H	Feedwater	6
03A-FW-20B	Feedwater	6
SK-E-2879-5F	Feedwater	2, 3
01A-MS-11	Main Steam	2
SK-E-2879-5A	Feedwater	2
01A-MS-5	Main Steam	2
03A-FW-1F	Feedwater	2
SK-E-2879-807D	Feedwater	2
SK-E-2878-4C,D,E	Main Steam	2
01A-MS-24B	Main Steam	2
01A-MS-53G	Main Steam	2
1-003B-D002-02	Feedwater	4
1-001A-D002-08	Main Steam	4
1-001A-D009-06	Main Steam	4
1-001A-D009-09	Main Steam	6
1-001A-D0001-09	Main Steam	4, 5
1-001A-D0001-08	Main Steam	4, 5
A-464-3-131	Pipe Support	6
74-1RHR-R46	Pipe Support	6
78-1FPC-R49	Pipe Support	6

Notes:

1. Welds and weld buildup subjected only to visual inspection and weld documentation review.

2. The radiographs for these shop welds, including buildup coverage, were reviewed.

3. Weld E2879-5F exhibited inadequate weld repair coverage. TVA reradiographed the repair area. The new radiograph revealed no unacceptable conditions.

4. The radiographs for these field welds were reviewed to verify weld buildup quality and coverage.

TABLE 4-1 (Continued)

5. These two welds were selected to perform UT thickness measurement and magnetic particle examination and were reradiographed with 7x17 inch film to determine the condition of weld buildup. During walkdown inspection, these two welds were the worst cases observed as having the most obvious buildup condition. The results of the reinspection and radiography revealed no problems.

6. No discrepancies noted.

TABLE 4-2

TANKS, HEAT EXCHANGERS, AND FILTERS

Item	Manufacturer	Notes
Spent Fuel Cooling Heat Exchanger	Joseph Oat Corporation	1, 2, 3
Auxiliary Boration Tank	Walters Engineering	7
Seal Water Injection Filter 1A	Pall Trinity Micro Corp.	1, 3
Seal Water Injection Filter 1B	Pall Trinity Micro Corp.	1, 2, 3
RHR Heat Exchanger	Engineers and Fabricators	1, 3
CVCS Volume Control Tank	Lampco Industries	1, 3
Spent Resin Storage Tank	Richmond Engineering Co.	7
CVCS Letdown Heat Exchanger	Atlas Manufacturing Co.	1, 3
CVCS Monitor Tank	Chicago Bridge and Iron	1, 3
Seal Water Heat Exchanger	Atlas Manufacturing Co.	1, 3
ERCW Heat Exchanger	Atlas Manufacturing Co.	7
Pressurizer Relief Tank	Westinghouse	7
20 KVA Electrical Inverters	Solid State Controls Inc.	4
Balancing Dampers	Techno Inc.	5
Containment Supply Air Fans	H. K. Porter Inc.	6

Notes:

1. Undersized nozzle-to-shell welds (Category D joints).
2. Undersized support or support saddle fillet welds.
3. CAQR WBP 890514 issued to trace and resolve weld deficiencies.
4. QIR MTB WBP 89028 issued to establish seismic suitability for service.
5. CAQR WBP 890581 issued to trace and resolve weld deficiencies.
6. QIR MTB WBP89029 issued to establish seismic suitability for service.
7. No discrepancies noted.

TABLE 4-3

VENDOR RADIOGRAPHS REVIEWED

Contractor	Product	No. of Films	Notes
Tube Line	Pipe Fittings	179	1
Rotterdam Drydock	Reactor Vessel	320	5
Applied Engineering	Surge Tank	125	2
Fisher Controls	Valve Body	52	3
Crane Midwest	Pipe Fittings	12	4
Westinghouse	Cooling Coils	40	5
Pacific Pump	Discharge Nozzle	16	5
Pro Fab	Pipe Welds	69	5
Capitol Pipe	Pipe Fittings	130	5
Atwood & Morrill	Valve Body	66	5
Metal Bellows	Bellow Welds	108	5
Taylor Forge	Pipe Fittings	43	5
Gray Tool Co.	Grayloc Clamp	22	5
Nuclear Energy Systems	Upper Gripper Plate	17	5
Bristol Steel	Lower Steam Generator Support Plug Welds	10	5
Tube Turns	Penetrations	126	5
Pall Trinity	Filters	18	5
Stainless Foundry	Upper Gripper Plate	10	5
CBI	Containment Vessel Welds	356	6
Target Rock	Valves	56	5
Stearns and Rogers	Transfer Tube	16	5
Atlas	Heat Exchangers	4	5
Joseph Oat	Heat Exchangers	60	5
Associated Tank	Tanks	23	5
Delta Southern	Tanks	56	5
Babcock and Wilcox	Pump Casings	50	5
Esco	Pipe Fittings	84	5
Swepco	Pipe Fittings	46	5
ITT Grinnell	Valves	25	5

Notes:

1. Several serial numbers (S/Ns) exhibited cracks and incomplete fusion due to oxidation. The worst cases identified by NRC were S/Ns ABMG 9, 10, 14, and 16. TVA issued CAQR WBP 890546 on this item after its Level III review which rejected 15 elbows (ABMG 1, 3, 5, 7, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, and 20).

2. There were problems in determining correct repair and reradiographing of required areas in the SH1-HD1 head seams. Other inconsistencies observed were yellowed film, evidence of back-scatter, and inadequate coverage of repaired areas on Seam 13.

TABLE 4-3 (Continued)

TVA subsequently reviewed the weld and established adequate coverage of repaired areas; however, its review detected that SH1-HD1 Sections 3-4, 5-6, 6-7, 7-8, 9-10, and 10-11 did not meet requirements for aligned porosity. CAQR WBP 89060 was issued to track and resolve this deficiency.

3. Contrary to the requirements of paragraphs NB-2573, NB-2573.1, and NB-2573.2 of the American Society of Mechanical Engineers (ASME) Code, the 1-inch valve body did not have complete coverage on the vendor film of record. CAQR WBP 890583 was issued to track and resolve this deficiency.

4. Incomplete fusion was observed to extend 1/2 inch into the end of the weld on S/N 3531X-1-S1. However, review of the weld documentation revealed that this area had been removed before the pipe fitting was installed and, therefore, the fitting was acceptable.

5. No problems or concerns were identified.

6. Some views exhibited a shim in the weld and some films were not dated; however, these conditions presented no problems with interpretation.

TABLE 4-4

PRESERVICE INSPECTION (PSI) ACTIVITIES

A. PSI Welds Reviewed

System	Weld	Drawing	Method	Notes
CVCS	PDPH00000001C	ISI0119	VT	1
CVCS	CUCS000000003	ISI0005	UT-0°	1
CVCS	CUCS000000003	ISI0005	UT-45°	1
FWS	FWF0003-00009	CHM2671	UT-0°	1
FWS	FWFD370-00016	CHM2671	UT-0°	1, 2, 3
CVCS	FWFD370-00016	CHM2671	UT-45°	1
CVCS	CVCFD036-0007D	ISI0005	PT	1, 2
CVCS	CVCFD036-0007D	ISI0005	UT-0°	1
CVCS	CVCFD036-0007D	ISI0005	UT-45°	1
CVCS	CVCFD036-0004A	ISI0005	UT-0°	1, 2
CVCS	CVCFD036-0004A	ISI0005	UT-45°	1
CVCS	CVCFD036-0004B	ISI0005	UT-0°	1
CVCS	CVCFD033-0009	ISI0005	UT-0°	1, 2
CVCS	CVCFD033-0009	ISI0005	UT-45°	1
CVCS	CVCFD034-0013	ISI0005	UT-0°	1, 2
CVCS	CVCFD034-0013	ISI0005	UT-45°	1

B. PSI Procedures Reviewed

Number	Revision	Full Title	Notes
N-PT-9	1	Liquid Penetrant Examination of ASME and ANSI Code Components and Welds	1
N-UT-18	7	Ultrasonic Examination of Piping Welds	1
N-MT-1	5	Magnetic Particle	1
N-UT-1	4	Ultrasonic Examination of Nuclear Coolant Water System Piping	1
N-VT-1	4	Pre-service and In-service Visual Examination Procedure	1
N-UT-6	2	0° Straight Beam Ultrasonic Examination of Nuclear Coolant System Piping	1

TABLE 4-4 (Continued)

C. PSI Activities Witnessed and Personnel Qualification Records Reviewed

Inspector	Method and Level of Certification	Area or Item Involved	Certification Package Reviewed	Notes
Inspector A	Level III UT	PSI calibration direction to Level IIs	Yes	1
Inspector B	Level II UT, PT	PSI-RCF-H3 to NUT-18 and FW-006-WC-09 cold leg LOOP-2 to NUT-18	Yes	1
Inspector C	Level II UT	PSI-RCF-H2-3 Procedure NDT-18	Yes	1
Inspector D	Level II MT	FWF-D002-05 feedwater piping dwg. CH-M-2671-C to N-MT-1	Yes	1
Inspector E	Level III RT	Interpretation of Dravo 1-01A-001-08 and 1-01A-001-09 for weld build-up	Yes	1
Inspector F	Level II UT	Thickness measurement of Dravo 1-01A-001-08 and 1-01A-001-09 for weld build-up	Yes	1
Inspector G	Level II VT	Inspection of Instrument Supports 47A051-13-A, B, and C, and Panels 0-L-350 and 0-L-30	Yes	1
Inspector H	Level II MT	FWF-D002-05 feedwater piping dwg. CH-M-2671-C	Yes	1

Notes:
1. Inspection results acceptable.
2. Original construction radiographs also reviewed.
3. Weld retested using PSI procedures.

5. CIVIL AND STRUCTURAL CONSTRUCTION

The NRC team evaluated the following specific areas of civil and structural construction: reinforced concrete, structural steel, surface-mounted baseplates and drilled-in anchors, embedded plates, masonry walls and partition walls, conduit supports, and cable tray supports.

5.1 Reinforced Concrete Construction

The team randomly selected five areas in Category I reinforced concrete structures for inspection in order to determine the adequacy of the concrete construction at WBNP, Unit 1. The team reviewed TVA documentation for concrete placements and cadweld splicing of reinforcing steel. In addition, the team inspected an opening in the wall of the fifth vital battery room, which was located in the control building.

The team reviewed 10 concrete pour packages relating to pour locations throughout the plant. The pour packages included pre-placement and placement records and test results of the sample concrete cylinders. In the absence of curing records, the team reviewed previous NRC inspection reports and interviewed present and past TVA employees to determine the adequacy of curing.

The team reviewed cadweld qualification records, splice data log sheets, and cadweld splice test reports of the "A", "D", and "T" crews that performed the cadwelding in various portions of the areas selected for review.

5.1.1 Concrete Placement

TVA had documented the pre-placement inspection on concrete pour cards. The pour cards for all pour packages reviewed by the team were found to conform to TVA requirements. During the review of the records, the team found that an adequate number of samples had been taken for strength and slump tests as required by TVA procedures. The team also reviewed the resolutions of two significant TVA audit findings, involving lack of test samples for one pour and several cases of excessive concrete slumps. The team considered the resolutions of the two audit findings to be acceptable.

The team requested documentation from TVA to show that the concrete was cured according to WBNP Quality Control Procedure (QCP) 2.2 and TVA General Construction Specification G-2. However, TVA indicated that such records were not available. In the absence of such records, the team interviewed the TVA project manager who was the supervisor for the Materials Engineering Unit from 1973 through 1979. This unit was responsible for quality assurance of the concrete activities. The project manager stated that concrete curing records were kept for each pour, but were discarded in the early 1980s. The project manager also stated that some nonconformance reports (NCRs) were written for concrete curing activities that were not in accordance with the TVA specification. However, TVA could not produce these NCRs.

The team reviewed 16 NRC inspection reports, from 1974 through 1977, to determine whether concrete was properly cured. Of these inspection reports, six showed that concrete curing activities were evaluated by NRC inspectors with no reported deficiencies. The team also reviewed TVA quality assurance audit reports WB-C-75-13, WB-C-82-03, and DEC-QCP-C2 (Quality Audit C.P.1), in which concrete curing activities were assessed. Audit WB-C-75-13 revealed that pours AB-E4 and RB1-C11a were not cured according to the requirements of TVA specification G-2. The other two audit reports did not reveal any concrete curing deficiencies.

TVA had performed an evaluation of the in-situ concrete because of employee concern IN-85-995-002. The results of this evaluation were submitted to the NRC on April 16, 1987. For this evaluation, TVA tested cores obtained from eight pours in WBNP, Unit 1. Although the average core strengths met the American Concrete Institute (ACI) requirements, several individual core strengths were below the design requirements. The lower strength cores were taken from the surfaces.

The team found the concrete curing activities to be acceptable based on the review of previous NRC inspection reports and TVA QA reports, the interviews held with previous and current TVA concrete inspectors, and visual inspections of concrete elements. However, with regard to the installation of surface-mounted plates and embedded plates, the team was concerned about TVA's use of projected concrete strengths in design calculations for anchor bolts and anchoring studs. Because TVA's earlier evaluation of in-situ concrete indicated that certain pours had actual strengths lower than the design requirements, the surface-mounted and embedded plates for all areas where the lower strength concrete was identified need evaluation. This item remains open pending additional action by the licensee and review by NRC (50-390/89-200-26).

The team also inspected the new opening in the wall of the fifth vital battery room and found that the reinforcing bar and concrete installed were acceptable.

5.1.2 Cadweld Splicing

The team reviewed cadweld data log sheets and the certification record for crews A, D, and T and found that the crews had been properly certified to perform the assigned tasks. The team also reviewed the laboratory test reports for the cadwelding at WBNP and found that the cadwelding met the design requirements.

5.2 Structural Steel

The team selected for inspection platforms and connections in four areas of the reactor, auxiliary, and control buildings to determine the adequacy of structural steel construction at WBNP Unit 1. The areas are identified in Table 5-1. The team performed walkdowns on portions of these areas in order to determine whether member sizes and configurations were in accordance with the design drawings, and also inspected connections to determine whether the bolt sizes, number and type of bolts, thread engagement, connection angle sizes, and weld configurations complied with the design drawings and procedures. Weld quality and size were outside the scope of this inspection.

The team also performed torque tests on 5/8-inch, 3/4-inch, and 7/8-inch diameter A325 high strength bolts to determine whether they were installed according to the American Institute of Steel Construction (AISC) requirements. The inspection torque values were established by the use of a Skidmore-Wilhelm tension device provided by TVA. A list of the number of bolts tested and the inspection torque values obtained are included in Table 5-1.

The team found that the structural steel member size and configurations met design requirements. However, the team identified various concerns as indicated in the following paragraphs.

- The team identified that A307 and A449 connection bolts had been used for a removable beam in the instrument room access platform, contrary to the design drawing requirements that these should be A325 bolts. TVA had not previously identified this condition and could not provide an explanation. The team was concerned that a similar problem could exist on other removable beams at WBNP, Unit 1. TVA needs to determine the extent of this deficiency. Pending NRC review of the licensee's evaluation, this is considered to be an open item (50-390/89-200-27).

- The team found, through its torquing of the connection bolts, that bolts were not installed to the AISC requirements. The summary of the bolt torquing tests is listed in Table V-1. The team found that bolts installed by the turn-of-nut method did not meet the AISC torque requirements. The tests also indicated that certain originally installed A325 bolts failed to meet the AISC requirements. Because of these NRC findings, TVA issued Condition Adverse to Quality Reports (CAQRs) WBP890559 and WBP890579 to determine the extent of the issue. Pending NRC review of the licensee's corrective actions, this is considered to be an open item (50-390/89-200-28).

- The team identified that the QC blue mark, indicating proper installation of the A325 bolts, was missing from one of the connections in the additional equipment room platform. TVA stated this omission was an oversight by the QC inspector and would be corrected under workplan E-6494-1. As the team did not identify any other missing QC marks, this one appeared to be an isolated case.

- The team found that the coping of certain beams of two platforms was not in accordance with the AISC requirements. However, this condition was already identified by TVA and documented under CAQR WBP870668.

- The team found that plate washers were missing for some oversized holes at bolted connections in the additional equipment room platform, and a bolt was missing in one of the connections in the instrument room access platform. These conditions had also been identified by TVA under NCR W-431-P and were to be corrected under workplan E-6494-1.

5.3 Surface-Mounted Baseplates and Drilled-in Anchors

The team performed direct tension pull tests on all types of drilled-in anchors used at WBNP, Unit 1. These included wedge bolt anchors, self-drilling expansion shell anchors, grouted anchors, and Maxibolt undercut anchors. The anchors tested and their locations are listed in Table 5-2. The anchor bolts were tested to tension loads as indicated in Table 5-3.

The team measured baseplate dimensions and anchor bolt locations to determine whether they were installed according to the design drawing requirements. A listing of the support numbers is included in Table 5-2. The team also randomly selected 18 surface-mounted plates for ultrasonic testing to verify that their various anchor bolt types and sizes were adequate.

5.3.1 Anchor Bolts

The team did not find any failures or deficiencies during the direct tension tests performed on the self-drilling, grouted-in, or Maxibolt undercut anchors. The team found that the plug depth and bolt length measurements of the self-drilling anchors also were within the TVA requirements. The test results are shown in Table 5-2.

The team's measurements indicated that the maximum slip during the wedge bolt tests was 3/16 inch, as shown in Table 5-2. Such a slip value was expected, since the wedge bolts at WBNP, Unit 1, were installed to a tension load of 150 percent of the maximum design allowable and the team tested these bolts to 200 percent of the same allowable. The team found that the wedge bolts attained the test load without failure. The team's measurements of the final projections were all within the TVA G-32 specification limits except for one bolt. The 5/8-inch wedge bolt tested for support 47A427-7-13 had a final projection of 1-3/8 inch, which was greater than the allowable of 1-1/4 inch. The team indicated that the initial projection of 1-9/32 inch, which was greater than the allowable projection, showed that the original installation of the bolt did not comply with TVA specification G-32. Due to the team's finding, TVA issued CAQR WBP890568 to document and correct this deficiency.

The team intended to perform tests on lead caulking anchors, which were specified for use in some drawings as stated in CAQRs WBP880391 and WBP880392. However, TVA's review of documentation for the fabrication and procurement of materials for these drawings showed that lead caulking anchors were never purchased for use at WBNP. Therefore, TVA invalidated these CAQRs, and no tests were performed on lead caulking anchors.

5.3.2 Baseplates

The team measured the plate dimensions and anchor bolt locations and found that all measurements were within the specified installation tolerances. The team did not find any deficiencies in this area. The team also performed ultrasonic testing of anchor bolts and found that all bolts tested had the minimum engagement length required by TVA Specification G-32.

During the walkdowns, the team noted that two baseplates were placed very close to free concrete edges, and therefore might have violated the minimum edge requirements of TVA specification G-32, Section 3.5.2. These baseplates were part of pipe support 70-1CC-R762 and conduit support CS-AB-10545. The team reviewed design calculation SWP 811008 028 provided by TVA to indicate that the free edge violation for pipe support 70-1CC-R762 had previously been investigated and found to be acceptable. TVA's conduit support walkdown team had documented the free edge violation of CS-AB-10545 in the walkdown package for correction if necessary.

5.4 Embedded Plates

The team inspected the embedded plates for the 26 supports identified in Table 5-2 to determine if the plate thickness and size and the locations and numbers of welded studs complied with the construction drawings. The team also randomly selected 18 plates for ultrasonic testing to measure the plate thickness and the length and location of studs. The plates selected were of different sizes and locations in different buildings and at various elevations. Some plates were on the ceilings of rooms and others were on concrete walls. Because of the attachments to the plates, not all studs could be reached and actually tested.

The team performed ultrasonic tests on the selected embedded plates and found them to be installed according to the construction drawings. The team also found that all welded studs were properly located in accordance with the drawings, and stud lengths were within design tolerance.

During the auxiliary building walkdown to select embedded plates for ultrasonic testing, the team noticed that, at floor elevation 713 feet near the reactor building, a concrete column had six embedded plates attached to it at the same elevation. Two of the six plates, 48B1221-2A-810 and 48B1221-2A-974, were located near a corner of the column and touching each other. The team requested the design calculation for this installation to ensure that the proper approach was used to document the interaction of the two plates sharing the same concrete for anchorage. TVA provided the team with calculations WCG-2-61-2 and WCG-2-61-2A, which qualified each plate individually. The team indicated to TVA that the interaction of the plates might invalidate the adequacy of the calculations. Based on the team's concern, TVA prepared a calculation entitled "Embedded Plates 48B1221-2A-810 and 48B1221-2A-974, Check of Pullout Capacity of Overlapping Cones." This calculation used the same loads that were used to qualify the two plates separately and, using a conservative approach, determined the factor of safety to be 3.7, which was greater than the TVA design requirement of 3.1. The team reviewed this calculation and found it and the baseplate installations to be acceptable.

5.5 Masonry Walls and Partition Walls

The team inspected the masonry wall construction attributes, including specifications, quality control procedures, and installed block walls. For the installed block walls, the team's inspection was limited to visual examination of the exterior. The team assessed masonry work that was located in the diesel generator building. The team also inspected several partition walls composed of poured, reinforced concrete. The installation requirements of partition walls were similar to those of reinforced concrete constructions.

The team examined the completed masonry work and found that the masonry wall installations conformed to design drawings and specifications. The team's review of completed quality control checklists indicated that materials used conformed to design and construction specifications. The team also found that mortar and concrete were tested to indicate that they, in general, exceeded the design strength. The team also reviewed portions of the design calculation to ensure that masonry walls were qualified for earthquake loads and loading combinations.

During the walkdown, the team noticed that many attachments were hung from the masonry and partition walls, although the walls were not designed for these attachment loads. The licensee indicated that this problem was discovered during a field survey on November 17, 1983, and documented in NCR WBNWBP8338. Subsequently, all walls were evaluated for these attachment loads and modifications were made to strengthen certain partition walls to ensure their adequacy. TVA also revised typical support drawings via Engineering Change Notice (ECN) 4507 and added a note to typical support drawings to prohibit adding attachments to these walls unless specific approval was given by a WBNP civil design engineer.

In 1987, TVA found that items were still being attached to masonry walls without proper controls and issued CAQR 870397 to document the problem. During the vertical slice review program, TVA again learned that conduit supports were attached to partition walls without engineering approval and issued CAQR 880766 to document it. These two CAQRs reflected the ineffectiveness of TVA's corrective action to prevent adding attachments to partition and masonry walls. In order to document the as-built condition of the partition and masonry walls, TVA proposed Technical Instruction (TI) 97.1 to perform a walkdown to identify all attachments on these walls and to initiate modification to qualify these walls if necessary.

The team was concerned that since the previous corrective action was not effective, a more effective method should be initiated to prevent additional attachments to the walls without proper controls. TVA responded to the team's concern by revising the CAQRs to indicate that engineering was to write a procedure indicating that no attachment should be made to these walls without proper engineering approval. This item remains open pending NRC review of TVA's corrective actions (50-390/89-200-29).

5.6 Conduit Supports

The team performed walkdowns of conduit supports to determine whether they were constructed according to the design requirements. The team measured conduit span lengths and diameters and inspected support configurations for various conduit runs.

The team inspected 46 conduit supports and 10 junction box supports that were located in the auxiliary building. The licensee had a previous program (WP-51) to walk down 100 percent of the conduits and conduit supports. The team selected supports which had been inspected by the licensee's walkdown team to assess the effectiveness of the licensee's walkdown program as well as the quality of the installations. The basic acceptance criteria for conduit support installation were included in the appropriate support drawings.

During the conduit support walkdown, the team found several instances in which double cantilever unistruts were used to support Category I conduits attached to ceilings. TVA indicated that the construction of these supports complied with TVA typical support drawing 47A056-66B. Although the construction met the TVA design drawing, the team believed that such a support configuration would not provide adequate resistance to torsional moments and requested that TVA evaluate the adequacy of this typical support. After the inspection, TVA provided the team with walkdown package AB-C19-058, which showed that the TVA walkdown team had identified this problem (support 40083 of conduit A4202) as a potential critical case and requested the Nuclear Engineering Department to evaluate it.

The team found during its walkdown that conduit 1T-3545 was not attached to support CS-AB-994. This made the unsupported length of the 1-inch diameter conduit 6 feet, which exceeded the maximum allowable span of 5 feet 6 inches. The team learned that TVA's workplan M-5695-5 contained a trouble sheet which stated that the Unistrut spring nut would not slide down into the Unistrut channel far enough to permit installation. TVA stated that this support would be attached to the conduit before the completion of the workplan.

The team found that an overspan existed between supports CS-AB-3078 and CS-AB-3088 for the 3-inch diameter conduit RM-505. The team measured this span to be 11 feet 2 inches compared to an allowable span of 10 feet 6 inches. This overspan was not noted in the TVA walkdown documentation, contrary to the requirements of TVA walkdown procedure WP-51, "Engineering Walkthrough Procedure For the Conduit and Conduit Support Critical Case Evaluation," which states that "measurements will be taken for installations whose dimensions approach the acceptance criteria limits ...".

TVA changed the requirements for tightening conduit clamps on June 1, 1985, as shown in TVA drawing 47A050-1J R4. The team questioned how these new requirements were applied to old installations. TVA stated that all clamps would be tightened to the new requirements as stated in Section 2.00 of workplan M-5695. The team found this explanation acceptable.

5.7 Cable Tray Supports

The licensee had a walkdown program (TI-2004) for the cable trays and cable tray supports. At the time of this NRC inspection, about five percent of the cable tray support walkdown had been completed. The team selected 12 supports that had been completed by the licensee's walkdown group to assess the effectiveness of that program. The team also selected another four supports which had not yet been inspected by the licensee to assess the adequacy of the installation. The acceptance criteria for cable tray supports were included in the appropriate construction drawings.

The team inspected the cable tray supports and found some minor discrepancies. For example, the team found several screws which did not have nuts connecting the tray and the clip angle, one screw which had two plate washers instead of a nut, and some screws which were cut off. TVA was able to resolve each of these discrepancies by providing additional installation information.

In the cable spreading room of the control building, the team found a discrepancy between an as-built cable tray support (1-CTSP-290-0887), which TVA's walkdown team had not inspected, and the corresponding TVA engineering drawing 48N1336-6, Revision 2, MK 14a. Section C-C of the drawing showed the distance between the lower end of the column (3 inch x 8 inch tube steel) and the top of bracket E to be 12 5/8 inches; the team found that the actual measurement was 19-1/2 inches. TVA indicated that some of the supports in this room were either newly installed or recently modified. Engineering drawings were in the process of being revised to match the as-built condition. However, the licensee indicated that the existing CAQR WBP 8700528 and TI-2004 should correct this discrepancy.

The team also noticed, on several occasions, that conduits were supported by cable tray supports. However, the cable tray support drawings did not depict these situations. TVA indicated that cable tray support drawings only displayed cable tray supports. Conduit supports would be shown on conduit support drawings. A note with a design change request (DCR) number would accompany the drawing to indicate which drawing would show the supports. The team inspected the DCR and found that it adequately described the situation.

5.8 Conclusions

In general, the team found that WBNP Unit 1 construction in the civil and structural area conformed with TVA construction procedures and specifications. However, the team identified concerns in three major areas as discussed in the subsequent paragraphs.

First, the team determined that the licensee had not accurately assessed the design adequacy of base plates located in areas with current concrete strength at or below the design strength. Of particular concern were installations for which TVA used projected concrete strengths in design calculations. The design adequacy of these baseplates using the actual concrete strength rather than the design strength or the anticipated strength was not known.

Second, the team found that certain bolts at structural steel construction joints were not tightened in conformance with AISC requirements. TVA subsequently issued CAQRs to determine the extent of the problem, but corrective actions were not identified at the time of the inspection.

And third, the team found that TVA's corrective actions were ineffective for controlling attachments to masonry walls. TVA revised existing CAQRs to provide for more positive controls based on the team's concerns.

TABLE 5-1

STRUCTURAL STEEL SAMPLE

A. Platforms and Connections

Building	Location	Drawing No.
Reactor Bldg	Inst Rm Access Pltfrs El 730.88	48W902 R21
Auxiliary Bldg	Addtl Eq Bldg El 740.5 & 752.0	48W1266 R12
Control Bldg	Floor Framing El 741.0	48N754-1 R10
Control Bldg	Steel Framing El 729.0	48N751 R12

B. A325 Bolt Torque Tests

Bolt Diameter (In)	Number Tested	Number Failed	Inspection Torque (Ft-Lb)
5/8	39	19	237
3/4 *	11	11	337
3/4	31	2	333
7/8 *	3	3	615
7/8	51	3	615

* New installations where turn-of-nut method was used to tighten the A325 bolts.

TABLE 5-2

ANCHOR BOLT TEST RESULTS

A. Wedge Bolts

Diameter (In)	Support No.	Bolt No.	Initial Projection (In)	Final Projection (In)	Slip (In)
5/8	47A427-7-13	1	1-9/32	1-12/32	3/32
	47A427-1-02	1	13/16	13/16	0
		2	25/32	25/32	0
3/4	1CTSP293-452	1	27/32	31/32	1/8
		2	28/32	1-2/32	3/16
	47A920-445	1	1-0/16	1-3/16	3/16
		2	1-6/32	1-12/32	3/16
1	1CTSP293-559	1	1-11/32	1-19/32	1/4
	47A450-3-86	1	3-5/16	3-6/16	1/16
		2	3-11/32	3-12/32	1/32
1-1/4	0CTSP292-2290	1	2-4/32	2-10/32	3/16
		2	1-23/32	1-25/32	1/16
	47A450-3-86	1	1-25/32	1-26/32	1/32
		2	1-23/32	1-25/32	1/16

B. Self Drilling Anchors

Diameter (In)	Support No.	Bolt No.	Plug Depth (In)	Bolt Length (In)	Test Result
1/4	1PM7096A	1	5/8	1-1/4	OK
	1PLC3315B	1	5/8	1-1/4	OK
3/8	47A400-7-46	1	7/8	1-1/4	OK
		2	7/8	1-1/4	OK
	47A427-1-5-S	1	3/4	1-1/2	OK
		2	7/8	1-1/2	OK
1/2	47A464-6-18	1	1-3/16	NA	OK
		2	1-1/16	NA	OK

TABLE 5-2 (Continued)

Diameter (In)	Support No.	Bolt No.	Plug Depth (In)	Bolt Length (In)	Test Result
	450-11-8-3	1	1-3/16	1-1/2	OK
		2	1-5/16	1-1/2	OK
5/8	70-1CC-R538	1	1-7/16	ROD	OK
	450-11-8-2	1	1-1/2	1-1/2	OK
		2	1-1/2	1-1/2	OK
3/4	70-1CC-R498	1	2-1/16	ROD	OK
		2	2-1/16	ROD	OK
	1ISL5998-0074	1	2-1/16	ROD	OK
		2	2	ROD	OK
7/8	67-1ERCW-R96	1	2-5/16	2-1/2	OK
		2	2-3/8	2-1/2	OK
	47A450-3-86	1	2-15/32	ROD	OK
		2	2-15/32	ROD	OK
		3	2-15/32	ROD	OK

NA: Bolts were not yet installed.

C. Grouted-in Anchors

Diameter (In)	Support No.	Bolt No.	Initial Projection (In)	Final Projection (In)	Slip (In)
3/4	47A491-51-33	1	1-20/32	1-20/32	0
		2	1-4/32	1-4/32	0
1	1-74-008	1	2-5/32	2-5/32	0
		2	2-5/32	2-5/32	0
1 1/8	1-74-008	1	2-3/32	2-3/32	0
		2	2-1/32	2-1/32	0
1 1/4	1-74-023	1	2-26/32	2-26/32	0
		2	2-28/32	2-28/32	0
1 3/8	1-74-023	1	2-12/32	2-12/32	0
		2	2-22/32	2-22/32	0

TABLE 5-2 (Continued)

D. Undercut (Maxibolt) Anchor Bolts

Diameter (In)	Support No.	Bolt No.	Initial Projection (In)	Final Projection (In)	Slip (In)
1	47A400-7-11	1	3 26/32	3 28/32	1/16

TABLE 5-3

TEST LOADS FOR ANCHOR BOLTS

A. Wedge Anchors

Bolt Diameter (In)	Test Load * (Lb)
1/4	1200
3/8	1800
1/2	4200
5/8	5500
3/4	8400
1	10400
1 1/4	16400

* These loads are 50 percent of ultimate capacity of the anchors.

B. Self-Drilling Anchors

Bolt Diameter (In)	Test Load * (Lb)
1/4	900
5/16	1700
3/8	2200
1/2	4000
5/8	5400
3/4	7600
7/8	8300

* These loads are taken from TVA Specification G-32, Table 4.3.4, and are approximately 50 percent of the ultimate capacity of the anchors.

C. Grouted-in Anchors

Bolt Diameter (In)	Test Load * (Lb)
3/4	10800
1	19600
1 1/8	24700
1 1/4	31400
1 3/8	37600

* These loads represent 90 percent of the minimum yield capacity of the A36 bolts specified by the American Society for Testing and Materials (ASTM).

TABLE 5-3 (Continued)

D. Undercut (Maxibolt) Anchors

Bolt Diameter (In)	Test Load * (Lb)
1	51000

* This load is taken from TVA General Construction Specification G-66, Table 6.

6. MATERIAL TRACEABILITY AND PROCUREMENT

The team reviewed the procurement and quality history of a sample of installed items selected during plant walkdowns and during review of 10 different lists of TVA-procured items. Each list represented a method by which parts or materials could be or had been installed in the plant; i.e., maintenance requests, engineering changes, and work plans. The sample selected by the team encompassed a wide range of both installed items and items in storage, including both initial construction items and replacement items.

The following discussion has been organized to follow the normal order of procurement activities, from item requisition through engineering issuance of technical requirements, contract placement, maintenance of approved suppliers, source and receiving inspection, item storage, release of materials, installation, and maintenance.

6.1 Equipment, Component, and Parts Requisition

Item requisition occurs when work plans or maintenance requests are prepared and sometimes with the issuance of design change notices (DCNs) or engineering change notices (ECNs). Frequently required items are maintained in stock and items are requisitioned when inventories drop to predetermined levels. Purchase requisitions are assigned identifying serial numbers which are transferred to the associated contract when it is prepared.

The team determined, for the samples reviewed, that technical requirements and item descriptions were accurately transferred from requisitions to purchase contracts. The team concluded that the procurement requisitioning was satisfactory and, at least in part, reflected good item traceability at WBNP.

6.2 Engineering Interaction with Procurement Activity

The team reviewed Nuclear Engineering (NE) Department input into procurement activities. Several procurement specifications for equipment were obtained (from TVA's Knoxville offices) and they were considered satisfactory. However, a full catalog of procurement specifications was not available to user groups at WBNP. TVA engineering personnel made a commitment to remedy this by making a full set of equipment procurement specifications readily available at Watts Bar. This item remains open pending NRC review of the licensee's corrective action (50-390/89-200-30).

In reviewing procurement data packages, the team noted that most of the engineering effort was provided by the Contract Engineering Group (CEG). The team interviewed management and engineering personnel from both NE and CEG, and considered the interface between their mechanical, electrical, and materials groups to be effective. However, the team found that interfaces between NE, CEG, and other groups involved in procurement activities were relatively weak and ineffective, as illustrated by the following specific examples.

- Engineering failed to provide instructions to QA to measure important dimensions on sleeves for expansion joints in the component cooling system (CCS) purchased under contract 75520A. Under Watts Bar Receiving Inspection Procedure U01-0001-003/2, dated August 24, 1989, important dimensions were to have been defined in the purchase requisition along with acceptance criteria. In the absence of this definition, the procedure states "Dimensions--random visual inspection to ensure ... conformance with drawings." Receiving Inspection Report (RIR) 891818 noted that the inspector took the initiative to check the sleeves with precision gauges and found all 12 sleeves rejectable.

- Engineering personnel requested a dimensional check of terminal lugs purchased under contract 42972B, as evidenced in RIRs 891519 and 891649, but did not provide acceptance criteria.

TVA agreed with the team's observation that the procurement process did not effectively identify receipt inspection requirements to the quality control inspectors. TVA committed on November 2, 1989, to take appropriate actions to resolve the deficiency. Pending NRC review of the licensee's corrective actions, this item remains open (50-390/89-200-31).

6.3 Contract Engineering Group (CEG) Procurement Package

TVA established the CEG under the WBNP replacement items corrective action program (CAP) to ensure that current and future purchases of replacement parts would not degrade the safety function of the equipment into which the parts are installed. The team reviewed packages prepared by CEG for procurement of commercial grade items to be used as basic components, and also reviewed post-procurement substantiation packages (PPSPs). The team considered the packages satisfactory, but found the system and practices for implementing dedication instructions to be generally ineffective.

As an example, TVA was not able to provide evidence that dedication instructions for the diesel generator water inlet tube assembly, contained in PPSP 03330, Revision 0, dated June 9, 1989, were ever carried out or that they would be carried out for future procurement of this part. The dedication instructions required a comparative dimensional inspection between the old part and the new part and a post-installation test for leakage. The pass-down mechanism for the CEG instructions, as described by TVA personnel, was that tags or the PPSP instruction were to be attached to the part or, alternately, to the bin in which the part was stored. The team visited WBNP Power Stores and found neither tags nor PPSP instructions at the storage bin.

PPSP 03330 instructions also required a post-installation test for leakage, referencing Maintenance Instruction (MI) 82.6, Revision 4, Section 6.25.15.1. However, MI 82.6, Revision 5, had been issued on May 18, 1989, 5 days before PPSP 03330 was prepared and 22 days before it was approved. MI 82.6, Revision 5, did not contain the referenced Section 6.25.15.1.

The diesel generator water inlet tube assembly had been released via 575 Form A075789 on June 9, 1989, the same day PPSP 03330 was approved. There was no evidence of follow-up by the CEG engineer or of contact on this job between maintenance, inspection, or Power Stores personnel to ensure that requirements were met. The end result was that the part was installed without the comparative dimensional inspection and without the post-installation leak test specified by the PPSP. The dedication instruction pass-down mechanisms did not work, and there was no effective system for implementing dedication instructions and for verifying their completion and acceptance.

The diesel generator water inlet tube assembly had been released from Power Stores on June 9, 1989, by the WBNP risk release method termed "Inventory Tracking Log." This method provides for post-release review to clear the acceptance status of risk-released items. In this case, whether the review action would result in removal of the water inlet tube assembly or in a documented engineering justification, the team concluded that WBNP construction would accrue no net gain in time savings or in hardware quality in return for the risk taken.

This finding illustrated two weaknesses: (1) inadequate practices for performing commercial grade item dedication, and (2) inattention to working interfaces between engineering groups and other procurement activity groups at WBNP. Each group -- engineering, Power Stores, and maintenance personnel -- placed emphasis on performing its own function and gave little effort to the integration of tasks to attain the end objective, the proper dedication of the commercially obtained water inlet tube assembly for safety-related use. This item remains open pending NRC review of licensee's corrective actions to its commercial grade dedication program (50-390/89-200-32).

6.4 Procurement Activity Relationship with Suppliers

WBNP procedures required that QA Level I items be purchased from approved suppliers. TVA corporate QA personnel at Knoxville maintain an approved suppliers list (ASL) on a "real-time" computer system. However, the team found that historical lists of approved suppliers were not available to facilitate procurement activity and release of items at WBNP, and supplier status at specific times could be determined only by a telephone call to Knoxville. TVA needed such status information for procured item releases (e.g., PPSP, item upgrade or transfer, NCR clearance, receipt inspection, or review of certificates of conformance for validity). The team's request to WBNP QA personnel for the status of one supplier was not answered for several days, indicating the cumbersome nature of the ASL system.

As another example of problems in this area, ampere meter PIN A-10354-B was ordered as a QA Level I item, with Westinghouse Nuclear Service Integration Division's (NSID) WCAP 9245 cited as the applicable QA program. NSID, the Westinghouse division structured to serve the replacement item needs of operational plants and to provide onsite residents and maintenance services, was not carried on the ASL as required for procurement of QA Level I items. The team also noted that a TVA report, dated December 1, 1988, of an audit of NSID cited TVA's failure to fully include technical and QA requirements in general orders to NSID. This indicates that attention to this supplier was necessary to ensure the quality of QA Level I items. This ASL omission indicated a failure of TVA corporate QA personnel at Knoxville to appreciate WBNP efforts to achieve the transition to on-line status.

A third example of problems in this area was the failure of QA personnel supporting procurement activities to solve a problem of bypassed source inspection. This was evident on contracts 54114-1 and 380341 for procurement of pressure transmitters (required by DCN-P-01121B) and a safety relief valve (required by DCN-P-02645A), respectively. Rather than promptly identifying and correcting the problem, the licensee kept the pressure transmitters on hold since February 1988, and cancelled the valve order after more than 20 memorandums were written during the 28 months the order was open.

The team concluded that lack of coordination between on-site QA and TVA corporate QA in handling replacement parts suppliers represented a weakness that adversely affects WBNP construction. Pending NRC review of the licensee's corrective actions, this is considered to be an open item (50-390/89-200-33).

6.5 Receiving Inspection, Procurement Item Storage, and Staging Areas

The team made numerous visits to the storage and inspection areas to trace items, inspect storage areas, and observe receiving inspections. The team interviewed TVA personnel at each activity.

Inspection of warehouses, staging areas, storage areas, and the procured item release system using Form 575 resulted in the team's conclusion that, overall, this was an area of strength. TVA devoted particular attention to item traceability, which was aided by consistent use of 575 forms. For example, bearing blocks BKH-190T and BKH-191D were stored with records traceable to the part number for the original equipment manufacturer (Trane) and the supplier (Ellis and Watt). The following paragraphs provide examples of strengths and concerns in this area.

o The team witnessed a receiving inspection of large fuses supplied as QA Level II items under contract 42792B. The documentation review aspects of the inspection were satisfactory, but the hardware aspects were not, since the receiving inspection facility had no tools or gauges for performing dimensional checks. TVA committed to keep tools readily available in the inspection area.

o RIR 890631 for control room handswitch 1-HS-67-84A, contract 74891A, did not adequately support release. Special Inspection and Other Requirements, TVA Criteria 15 and 17 respectively on the RIR, were shown as unsatisfactory on June 23, 1989, and remained uncorrected through July 21, 1989, the day of the handswitch release. TVA workmanship Criterion 14, for which there was no unsatisfactory rating, was shown as corrected.

- A diesel generator air starter motor was stored beyond the vendor-recommended five-year shelf life, and storage preservation precautions were not evident for other diesel generator provision repair parts. Also, as noted earlier, Power Stores personnel did not facilitate carry-over of CEG instructions for dedication of the diesel generator water inlet tube assembly.

- The team inspected the staging area, where parts and materials were collected in anticipation of a plant change. Even though the team observed congestion in the area, personnel had effective controls on item traceability and acceptance and had a positive interface with maintenance personnel. However, the team noted boxed items (identified by No. N6397.2) with a staging area entry date of August 22, 1986. TVA personnel stated that there was work underway to return such items to Power Stores. Such clear-out actions would alleviate the existing congestion in the staging area.

6.6 Traceability and Release of Procured Items

The team's inspection of installed and stored items revealed that WBNP systems and practices provided excellent item traceability. The team determined that early versions of Form 575 and ledgers of procured and transferred items had not provided all of the detail that is now available from the present procurement and release documents. However, the team did identify two items of concern.

- The team noted an inconsistency in WBNP equipment qualification procedures under 10 CFR 50.49 requirements. Procedure AI-1.13, Revision 2, Section 2.2.2, Item F, stated that "replacement piece parts and materials are reviewed and found acceptable before issue for work on 10 CFR 50.49 equipment." Contrary to that statement, since June 14, 1989, via procedure AI-5.4, Revision 21, ICF 89-257, 10 CFR 50.49 items have been released for installation before they have been determined to be acceptable. This has created a potential for confusion in later TVA efforts to clear risk-released items.

- The team noted that printed circuit boards for the auxiliary feedwater, essential raw cooling water, component cooling, and chemical and volume control systems were variously released as QA Level I and QA Level II, although procured on contract 46837 as QA Level II items. TVA issued Condition Adverse to Quality Report (CAQR) WBP 890576 to track this matter to resolution. The CAQR noted that the Materials Management System (MAMS) database, used improperly as the QA level source, provided misleading information. The proper record of QA level was stated as bin tags and ledger cards. The team also noted that the incorrect releases spanned the time period October 5, 1988 through July 12, 1989, and were made by the same individual, possibly indicating a generic problem affecting other released items.

6.7 Procurement Activities Associated with Initial Installation

The quality and traceability of procured materials, components, and equipment initially installed was reviewed and found to be satisfactory. For example, a snubber, baseplate, and angle support installed in the residual heat removal (RHR) system (procured under contract 83015) were selected for review. TVA personnel promptly provided drawings, procurement documentation, and quality release documentation to attest to the acceptability of the parts.

During a team walkdown, the inspectors noted bolts with a variety of head markings, usually indicative of bolts of different materials and physical characteristics. Different bolts were sometimes found intermixed on the same equipment supports. However, through review of controls on bolting materials, including incoming bolt inspection, sampling, and testing, the team verified that installed bolts, including those of different varieties, met specification requirements.

The team noted the following specific deficiencies related to installed equipment.

- Certified material test reports (CMTRs) were not available for two installed valves. The licensee issued CAQR WBP 890570 to track this problem through resolution.

- Documents and a sketch accompanying Maintenance Request A620462 (for repair of a safety relief valve for an HVAC system) provided inadequate description and confusing entries implying use of 1/2-inch diameter copper tubing. TVA was unable to confirm traceability of the small section of 5/8-inch diameter copper tubing that was actually used in the repair.

6.8 Maintenance Requests, Preventive Maintenance, and Lay-up

As a sample from a list of maintenance requests (MRs), the team selected an MR to replace components in Barton pressure transmitters 1-PT-3-49 and 1-PT-3-107. During the review, the team determined that no MRs had been issued against the transmitters since 1985. When questioned about the infrequent maintenance, TVA informed the team that maintenance could have been suspended on the transmitters because they were in the plant lay-up program for equipment and systems not needed for plant operational status. TVA later corrected this assertion and stated that the two transmitters were on hold for Work Plan (WP) E 5974-1, which would relocate the instruments and rework sensing lines. That is, the two Barton transmitters were not in the lay-up program, but could have been. In response to team questions about the lay-up program, TVA provided the program's controlling procedures and instructions.

- AI-9.20, "Preservation and Maintenance of Plant Equipment," Revision 2, instruction change form (ICF) number 89-288, dated July 19, 1989.

- TI-77.000, Part I, "Electrical Preservation Criteria," Revision 1, ICF number 89-202, dated May 26, 1989.

- o TI-77.000, Part II, "Chemical Preservation Criteria," Revision 1, ICF number 89-270, dated June 27, 1989.
- o TI-77.000, Part III, "Instrument Preservation Criteria," Revision 1, dated June 8, 1988.
- o TI-77.000, Part IV, "Mechanical Preservation Criteria," Revision 2, dated June 23, 1989.

6.8.1 Lay-Up Procedures

During the procedure review, the team observed that the cover sheets of four out of the five procedures were marked as "safety-related", "PORC-Reviewed", and "Non-Quality Related" (TI-77.000 Part IV was the exception). The team questioned how the procedures could be safety-related and not also quality-related. TVA was unable to provide an adequate response to the team's question during the inspection. This item remains open pending further review by the licensee (50-390/89-200-34).

6.8.2 Lay-Up Environment

The team determined that CAQR WBP 880609, initiated on September 29, 1988, had identified problems in maintaining plant lay-up environments (in particular, humidity control). The team reviewed an internal TVA memorandum from H.C. Johnson, Site Quality Manager, to D.E. Douthit, Program Manager, WBNP, dated September 26, 1989, reporting on the QA monthly trend report for July 1989. This memorandum included information showing a sharp increase in PM deficiencies because of excessive humidity levels in layed-up Unit 2 piping. The memorandum further stated that corrective actions in response to CAQR WBP 88069 may not have been adequate. The team was concerned that the same problem could exist in Unit 1. This item remains open pending further review by TVA and NRC (50-390/89-200-35).

6.8.3 Maintenance and Lay-Up Concerns

In the general area of maintenance requests, preventive maintenance, and lay-up, the team's specific concerns are summarized as follows.

- o Periodic surveillance and preventive maintenance of safety-related equipment, including instrumentation, had been deferred through the lay-up program and in anticipation of plant changes. The team was concerned that TVA had not given sufficient detailed consideration to the requirements for returning the equipment to an operational state, including required periodic surveillance and preventive maintenance.
- o The team was also concerned that TVA had not adequately defined the scope of effort and requirements for new material with regard to refurbishment before starting up the plant.

Following the inspection, TVA provided additional information to the team on November 2, 1989, which indicated that some material requirements for removal from lay-up had been considered and acted upon. The team concluded that further information was required with regard to the three concerns noted above. Pending NRC review of TVA's corrective actions in this area, these concerns are considered to be an open item (50-390/89-200-36).

6.9 Procurement Activity in Support of Unit 1 Completion

The procedures for implementing the replacement item program (RIP) of the WBNP Nuclear Performance Plan have not been completed. Items have been released for installation subject to later engineering review, dedication, and post-installation testing. WBNP expects that two to three years will be required in a transition stage before the RIP program is completed and the quality release mode is reinstated.

6.10 Conclusions

The team found inadequacies in WBN's commercial grade dedication process and receipt inspection process. These inadequacies were the result of ineffective interfaces among various organizations involved in procurement and ineffective coordination of the separate work activities.

With regard to the WBN system lay-up program, the team had significant concerns that TVA had not given sufficient consideration to the requirements for returning the installed equipment to an operational state, that TVA had not adequately defined the requirements for new materials and equipment before plant startup, and that many of the existing lay-up procedures were either inadequate or were not being followed.

7. DESIGN CHANGE CONTROLS

The team evaluated the control of design changes, including changes to design documents. The team interviewed TVA personnel responsible for the control of design change activities; reviewed procedures, audits, and surveillance reports; and reviewed a sample of controlled documents. In addition, the team verified a sample of design changes which had been inspected and accepted by the onsite construction Quality Control Department.

7.1 Control of Design Change Documents

The design programs that TVA incorporated at WBNP have changed several times since 1985, when the plant was originally scheduled for full power operation. The team reviewed these programs from that period in 1985 to the present. TVA used an Engineering Change Notice (ECN) Program from before the 1985 pre-operating license period to December 1987, and a Design Change Notice (DCN) Program from December 1987 to the present. Specific aspects inspected with regard to the control of design documents were the availability to the users of the latest approved design and design change documents, and the methods of ensuring that approved changes were provided to the users before work was performed. The team also reviewed and evaluated a licensee contractor report that addressed the quality of site design document records related to a Sargent and Lundy vertical slice review.

The licensee had recently contracted with Sargent and Lundy to review the quality of the Watts Bar QA records, including design control records, in association with a vertical slice review (VSR). The preliminary report was supplied to the licensee the week immediately before this assessment. The contractor examined a sample of approximately 14,800 records including different types of documents and quality aspects. The contractor's findings indicated that quality concerns were identified with approximately 20 percent of the QA records for WBNP. The contractor also concluded that very few (less that 1/10 of one percent) constituted real safety questions. TVA had also documented QA record problems in Condition Adverse to Quality Report (CAQR) WBP 870036 and had developed corrective actions that appeared adequate.

The documents reviewed by the team, and discussed here and in Section 8 of this report, contained minor QA record deficiencies similar to those identified by Sargent and Lundy. The team considered that these minor recordkeeping deficiencies did not constitute a significant programmatic problem and should be remedied by TVA's current programs.

7.2 Control of Design Changes

The team reviewed the following specific design change controls: design change notices (DCNs), engineering change notices (ECNs), field change requests (FCRs), modification packages (MPs), temporary changes (TACFs), and maintenance requests (MRs). In addition, the inspectors reviewed the findings, trends, and corrective actions in nine QA audit and surveillance reports concerning design changes.

7.2.1 Support for Technical Determinations

The team found that some design change packages had unsupported technical determinations. The unsupported technical determinations included breaker trip time delays and trip setpoints, FSAR impact determinations, as-constructed drawing differences, and post modification test determinations. Examples of the types of technical determinations that were not supported by the design change documents are discussed in the subsequent paragraphs.

- TVA modified several fire doors through ECN E-5582. The NRC inspectors noted that fire door A-36 appeared to have an excessive gap at the bottom of the door. In this case, the design QA documentation did not support the as-found condition of the door gap. As a result, the licensee surveyed 33 doors for proper gap and determined that 30 of the 33 did not meet the required installation requirement. The licensee determined further that 26 of the 30 doors rejected were fire doors. CAQR WPB 890561 was written by the licensee to document the deficient conditions.

- Through ECN E-5684, TVA changed the control level of the Unit 1 steam generators when maintained by the auxiliary feedwater (AFW) pumps. The level change was not technically justified in the design change package. TVA determined that the FSAR was not affected by the change; however, that determination could not be verified through the documentation in the package. No review was performed by the licensee to determine whether the design change affected the assumptions in the FSAR or introduced an unreviewed condition into the plant. A review for these factors was important because the NRC had issued two Safety Evaluation Reports (SERs) against the current revision of the FSAR. In addition, a large number of FSAR changes resulting from licensee corrective action activities were still outstanding. TVA determined that no post-modification test was required for this design change and that "instrument calibrations and loop checks sufficiently test changes." However, a subtier document, MR A-834034, stated that a "functional test was performed" and did not indicate that a calibration or loop check was accomplished.

- With ECN E-5638, TVA changed the overcurrent trip setpoints on the diesel generator room battery exhaust fan circuit breakers. There was no technical justification in the design package for this change. The design change neither required a post-modification test nor justified why a post-modification test was unneeded. Finally, the licensee did not review the change to determine if it affected the assumptions in the FSAR or introduced an unreviewed safety question into the plant.

- Through ECN E-6684, TVA eliminated the automatic isolation functions for the AFW system to specific steam generators. The design package contained no technical justification for the change or for the licensee's decision that the FSAR was not affected. Secondly, the licensee did not perform a review to determine whether the design change affected the assumptions in the FSAR or introduced an unreviewed safety question into the plant.

- Through ECN E-5619, TVA changed the time delay settings of several circuit breakers in 480 Vac safety-related shutdown boards. TVA identified the need for the setting changes from its review of breaker coordination curves which were in the calculation reverification process. These curves had unsupported assumptions, and TVA had determined that an improper breaker coordination existed, which could potentially result in an overload condition on the 480 V shutdown boards. The link between the setpoint changes and the breaker coordination curves was not supported in the design change package. Secondly, TVA did not review the changes to determine whether the design change affected the assumptions in the FSAR or introduced an unreviewed safety question into the plant. Finally, TVA determined that no post-modification test was needed and that a periodic routine maintenance activity was acceptable. This particular maintenance activity (MI-57.2) was delinquent but the design change was closed.

The team reviewed the results from the Sargent and Lundy VSR, dated March 1989, and a nonconformance report (NCR) use-as-is review dated September 14, 1988. In each case, the licensee determined that there were problems associated with documentation of design changes performed in the plant. Specifically, these reviews identified issues with design document availability and accuracy and the specific detail contained within the design documents (including engineering calculations). The team's findings confirm the results of those two licensee reviews.

Both licensee reviews concluded that TVA's programmatic corrective actions should result in the documentation of a conservatively designed and adequately constructed plant. Because the licensee's corrective actions in some cases had not been established or implemented, the inspectors were not able to confirm the conclusions reached by the two reviews. Pending NRC review of TVA's corrective actions with regard to the inadequate reviews of design changes, including unsupported technical determinations and, in some cases, a lack of technical justification, this is considered to be an open item (50-390/89-200-37).

7.2.2 Temporary Design Change (TACF) Program

TVA had previously determined that the current TACF control program was weak, and documented planned corrective actions in CAQR WBQ 89-0247. The most significant TVA-identified issue with TACFs was that some temporary modifications were not adequately controlled by the TACF procedure.

Aside from the issues identified by TVA, the team identified that the current TVA TACF program does not perform a safety evaluation or associated system impact evaluation before a TACF is implemented. TVA identified a set of corrective actions designed to resolve outstanding TACFs at the time of licensing, including an appropriate safety evaluation. The team noted that the TACF corrective actions did not appear to include a review or walkdown of closed TACFs to ensure that TACF tracking and closure was adequate.

7.2.3 Maintenance Request Program

In CAQR WBP890343, TVA identified that maintenance requests written before December 1987 did not control system configurations during the work process. The licensee's corrective action was to perform several types of system walkdowns sometime in the future. However, TVA had not yet determined the specifics for the walkdowns. The team was concerned that if the walkdowns do not include a detailed review of the maintenance work performed on a systemic basis, important safety system issues might be missed.

The team reviewed MRs for maintenance activities the licensee had performed on the containment spray and residual heat removal systems from 1985 to the present. It appeared to the team that some maintenance activities were being used to control temporary modifications to the plant, and that some temporary modifications performed under maintenance requests are being made permanent by a DCN process intended only for drawing changes. The team considered that this use of the MR and DCN processes was acceptable if the maintenance activities were in-process, rather than longer-term plant activities, and if the DCNs were reviewed to determine whether the work practices employed in the MR meet the requirements of a permanent design change. The team identified three MRs with temporary modifications.

7.2.4 QA Audits and Surveillances

The team's review of QA audits and surveillances determined that these activities appeared to correctly monitor the design change processes and were adequate. The team identified one deficiency in the identification, tracking, and trending of conditions adverse to quality. TVA documented the NRC finding on CAQR WBQ 880605P to track this deficiency through resolution.

7.3 Conclusions

The team found the programmatic control of design documents to be adequate for the sample of documents the team reviewed, contingent upon an adequate response by TVA to the administrative weaknesses identified by the Sargent and Lundy vertical slice review.

The team found that, for the sample of documents it inspected, the control of design documents was generally adequate. In addition, the licensee had implemented several upgrade processes. However, the team also found that, design change documentation did not always technically justify the design change, post-modification acceptance, or impact on the FSAR. The design basis or FSAR revision against which the design change was made was not clear in all cases. The documentation did not determine whether an unanalyzed condition existed as a result of the design change.

8. CORRECTIVE ACTIONS SYSTEM

Several programs for corrective action have existed at the WBNP site since 1985, when the plant was initially thought ready for operation. The team assessed the licensee's current program, described in the TVA Nuclear Quality Assurance Manual (NQAM), for identification and control of corrective actions. The team did not review the special purpose corrective action programs (CAPs) and special programs described in Watts Bar Nuclear Performance Plan, Volume 4. The assessment included a review of procedures and documents, as well as followup verifications that identified those corrective actions accomplished in the plant. The following areas formed the basis for the review.

- Procedures and organizational interfaces
- Audit and surveillance reports
- Condition adverse to quality reports (CAQR)
- Corrective action reports (CAR)
- Drawing deviations (DD)
- Maintenance requests (MR)
- Problem reporting documents (PRD)
- Selected reports for the Nuclear Safety Review Staff (NSRS), Nuclear Manager's Review Group (NMRG), Independent Safety Engineering Group (ISEG), and Authorized Nuclear Insurer (ANI)
- Nonconformance reports (NCR), significant condition reports (SCR), and inspection rejection notices (IRN)
- Correct on the spot (COTS)
- Preoperation test deficiencies
- Plant information requests (PIR)
- Construction deficiencies - 10 CFR 50.55(e) reports
- Management Review Committee (MRC) activities
- Preventive maintenance deficiency reports (PMDR)

8.1 Management Review Committee (MRC) Activities

The team reviewed and observed MRC activities to determine the amount of middle management control of the CAQR process. The MRC was comprised of a cross-section of site work disciplines. The team considered that the MRC performed the function of reviewing and approving the corrective actions for CAQRs and PRDs in an adequate manner, and that the participants of the MRC aggressively pursued the resolutions of problems consistent with the MRC's charter. The team concluded that, in general, the

MRC's activities have improved the quality of CAQR identification and resolution activities.

8.2 Conditions Adverse to Quality Reports

The team reviewed a sample of 87 CAQRs to determine whether safety concerns were adequately resolved. The team identified several concerns within the sample. The concerns included weak documentation of root cause evaluation, extent of condition or generic applicability, and corrective action. The team was able to determine that, in some cases, the indication of weak licensee corrective action was the result of poor thought process documentation, lack of administrative completeness, or lack of adequate technical justification. Specific examples of these concerns are discussed below to illustrate the types of corrective action issues identified by the team.

- In CAQR WBP-890026, TVA addressed the surveillance testing of the ERCW pumps in accordance with an established standard. TVA was using an uncustomized manufacturer pump curve for the ERCW pumps, ERCW screen wash pumps, and high-pressure fire pumps. With the pump curve standard and surveillance testing, the CAQR addressed problems with river level measurement, level indication instrument calibration, and pump curve applicability. In the CAQR, TVA determined that each of these issues was an isolated case, but the CAQR did not contain supporting technical or programmatic justification. The team found that the CAQR corrective action did not ensure that the restart test program would verify the necessary pump curves. The team also found that the CAQR corrective actions and extent of condition were weak. Specifically, the CAQR failed to address other safety-related pumps and determine whether the standards for their performance (flow and differential pressure) were appropriately established, including the use of properly calibrated instrumentation. The CAQR also did not determine this condition to be generic to other TVA plants, some of which have similar pumps and instrumentation.

- In CAQR WBA 89093911, TVA addressed the failure to perform annual maintenance on the 6.9 kV shutdown boards. The CAQR did not address other maintenance activities to be performed on these particular shutdown boards, or maintenance activities on other safety-related boards. The extent of condition was kept narrow without technical justification. Without documented support, the CAQR determined the instance to be isolated without generic applicability. The CAQR did not determine whether this adverse condition impacted the affected system's ability to perform its long-term safety function.

- In CAQR WBP 880801, TVA addressed inconsistencies between the TVA design and the manufacturer specifications for the refueling hoist and the upenders. The specific corrective actions for the hoist referenced NCR WBNNEB 8402. However, TVA determined that the CAQR did not relate generically to other TVA plants, did not determine a root cause, and did not consider the appropriateness of other crane and hoist torque values. Finally, the CAQR did not determine whether this adverse condition impacted the affected system's performance of its long-term fuel transfer support function.

- In CAQR WBP 870302, TVA addressed the fact that the power supply to the hydrogen analyzers and hydrogen recombiners would trip on a loss of offsite power. Manual action was necessary in order to restore power to the electric power supply boards. Finally, loss of power might result in temperature changes within the equipment which could affect its ability to perform within 30 minutes of an accident. TVA determined that the root cause of this CAQR was an isolated instance of design input error, even though another related CAQR (WBP 870443) stated that a programmatic problem existed in that "all design inputs may not be well documented." The CAQR did not establish, in its corrective actions, whether the power supply issue was limited to the hydrogen analyzers and recombiners.

  The hydrogen analyzer issue was initiated by a Sequoyah CAQR. Based on interviews with the WBNP Management Review Committee, the team learned that consideration for generic review is not given if an issue came from another site. This limited the flow of information on corrective action and root cause determination which may affect another site. Finally, the CAQR did not determine whether this adverse condition impacted the affected system's ability to perform its long-term safety function.

- In CAQR WBA 870933730, TVA addressed an Employee Concern Program (ECP) issue that was a potential condition adverse to quality and was not processed under a CAQR. TVA determined the concern to be an isolated instance without justifying that determination. Without support, the root cause was determined to be personnel error. The corrective action neither established the extent of the condition nor supported the determination that a generic or programmatic problem did not exist. Finally, the CAQR did not determine whether the adverse condition impacted the ability of the affected system to perform its long-term safety function.

- In CAQR WBP 880747, TVA addressed a closed maintenance activity that left an intermediate configuration without the required controls (TACF or open maintenance document). The CAQR stated that, before December 15, 1987, there was no requirement in the maintenance request procedure (AI 9.2) for in-process configuration changes to be identified. The root cause and corrective actions dealt only with the particular component in the CAQR. The extent of condition was not established and a look-back program was not identified. Finally, the CAQR did not determine whether this adverse condition impacted the ability of the affected systems to perform their long-term safety function.

- In CAQR WBQ 890247, TVA addressed programmatic controls on the TACF program. The programmatic controls were judged to be weak by TVA, and the corrective action was to walk down the open TACFs at the time of licensing and to write a safety evaluation to support their existence during plant operation. No explanation was given in the CAQR with regard to how the extent of condition was established or that the impact of closed TACFs on operating plant condition was addressed.

- o In CAQR WBQ 880443, TVA addressed a number of seals and gaskets that were removed from equipment on MR 620962 and stored in the maintenance storage facility. The CAQR only addressed this specific instance and did not address root cause or generic applicability, or establish controls to prevent recurrence. These omissions were important because other MR activities allowed disassembly and temporary storage of components.

As illustrated by the examples above, the team identified weaknesses in the documentation of root cause determination, extent of condition, generic reviews, and corrective actions. In addition, TVA did not determine whether issues identified in CAQRs had impacted or would impact the ability of a system or component to perform its intended long-term or short-term safety function. Finally, the team considered that three PRDs met the program definition of a CAQR, since they constituted deviations from the QA program and procedures.

8.3 Other Licensee Corrective Actions

The team reviewed selected samples of the licensee's corrective action activities. With the exception of the preventive maintenance deficiency report activities, the individual activities appeared to be implemented adequately. The team identified weaknesses in each of the implemented licensee corrective action activities. These weak areas corresponded to similar licensee findings, and the licensee appeared to have adequate corrective actions either in place or planned. However, the team was not able to identify a management position at WBNP with the task to ensure adequate communication and interface among all of the licensee's corrective action activities, the WBNP CAPs, and the SPs. Representative weaknesses noted by the team are as follows:

- o The team reviewed approximately 105 preventive maintenance deficiency request reports (PMDRs), of which 90 percent were documented lay-up deficiencies. The deficiencies involved recurring failures to meet program requirements, as documented in 1988 by CAQR WB88069 and in the July 1989 trend report.

- o The licensee did not document, track, or trend certain issues, including drawing deviations, in the QA Administrative Program before issuing and implementing Change Notice 2 to the NQAM. In addition, the licensee was not able to generate a drawing deviation list and description without excessive manipulation of hard copy ECN and DCN files.

- o The licensee recently reorganized the Division of Nuclear Engineering and eliminated Engineering Assurance. The Engineering Assurance function was transferred, in part, to site QA. However, the licensee failed to update site procedures and the NQAM to implement the transfer of responsibility. The licensee also modified the QA program by memo, dated November 21, 1988, to increase the time allowed for documentation of corrective actions. In addition, the advance DCN process corrective action time frame was increased from 45 to 90 days by memo. Although the licensee's administrative practices generally prohibit program management through the use of memos, TVA indicated that special conditions and interpretations applied for each of these cases.

- The licensee terminated the use of an Independent Safety Engineering Group (ISEG) onsite and planned to reestablish it before obtaining an operating license. One open ISEG item was identified, which was tracked on the licensee's Tracking Open Item (TROI) list and had a status of "to close prior to obtaining an operating license." Similarly, Nuclear Safety Review Staff (NSRS) items were included into the WBNP Special Employee Concern Program, with one exception. One Draft 1985 NSRS report (no number or RIMS number assigned) was reviewed and addressed in a Nuclear Manager's Review Group (NMRG) report dated April 30, 1987.

8.4 Conclusions

The NRC assessment team concluded that the licensee's current CAQR program was founded on an adequate philosophy with an appropriate threshold for initiating action. The implementing procedures appeared to be effective and to be understood by site personnel. The sample reviewed by the team disclosed that, primarily because of the efforts of the MRC, the current program was adequately implemented. However, the team found that CAQRs processed before the MRC was initiated did not always document adequate corrective actions, extent of condition, generic review, or root cause.

The team also found that the resolutions of CAQRs, TACFs, MRs, PMDRs, and other deficiency documents did not determine whether the implemented corrective actions would impact the long-term ability of the affected components and systems to perform their intended safety functions, or determine whether the deficiencies had generic applicability to other areas. Pending NRC review of the licensee's corrective actions in these areas, this is considered to be an open item (50-390/89-200-38).

In general, the team found that integration and coordination of the various licensee corrective action programs, special programs, and related activities were not effective, and did not ensure that all required work activities and corrective actions would be accomplished in a timely manner. The licensee acknowledged that more effective coordination of the interfaces among the various programs and activities is needed. Pending NRC review of the licensee's actions in this regard, this is considered to be an open item (50-390/89-200-39).

9. PLANT CONSTRUCTION STATUS AND SCHEDULE

The objective of this part of the inspection was to assess plant work progress and status relative to the projected TVA schedule. The assessment team attempted to determine the current status of plant construction activities and to identify the amounts and types of work remaining prior to fuel load. The team reviewed documents and schedules relating to current construction status and the scope of remaining work, performed walkdown inspections of the plant to observe ongoing activities, and held meetings and discussions with members of TVA Watts Bar site management.

This part of the assessment encompassed the following areas.

- The status of civil, structural, mechanical, electrical, and instrumentation work activities.
- The status of TVA corrective action programs (CAPs) and special programs (SPs) relative to the projected work schedule.
- The work remaining for completion of the specific plant systems required before fuel load and, in particular, the "punch list" work items for the first scheduled group (Group 1) of three systems.
- The preoperational test program, including the projected schedules for both procedure development and test performance.
- Other bases for the current projected TVA fuel load schedule, including the overall status of plant open items, the design and engineering work yet to be done, and the current levels and projected availabilities of specific work force craft personnel.

9.1 General Work Estimates

The team found that the licensee had insufficient knowledge of the remaining scope of work to support its projected fuel load schedule. The licensee had not established a firm baseline for the remaining work activities and it was therefore not possible to determine the rate of completion of required work. The team found that the estimated amount of work remaining changed substantially from day to day as additional discovery items were added to the work scope. The licensee's estimates for some specific major remaining work activities as of October 13, 1989, included:

o Instruments	1,935	
o Instrument tubing	30,610	linear feet
o Tubing supports	15,692	
o Power and control cable	795,880	linear feet
o Cable terminations	45,380	
o Metal conduit	49,144	linear feet
o Conduit supports	6,277	
o Large pipe hangers	3,249	

The licensee also was unable to provide information requested by the team regarding the remaining scope of work in some areas. For example, the licensee could not provide the total number of open items and the work-off rate or the add-on rate for open items. In addition, it took the licensee more than two weeks to provide information regarding the remaining work associated with the control room design review modification, and then it was stamped "Preliminary" with comments that the schedule for the control room was currently under review. At the time of this inspection, the control room work was scheduled to be completed in December 1989.

9.2 Control Room Work Estimates

The team inspected the control room and reviewed the remaining scope of work for that area. The control room modifications were scheduled by the licensee to be completed in mid December 1989. The inspection and review of remaining work by the team revealed that the control room was not close to a December completion or to the condition required for support of a full scale preoperational test program. Major items on the licensee's preliminary estimate for remaining control room work included:

o	Power and control cable	53,210 linear feet
o	Cable terminations	17,130
o	Power and control cable removal	4,000 linear feet
o	Cable termination removal	5,003
o	Modification of existing panel openings	124
o	Metal conduit	2,230 linear feet
o	Conduit supports	304
o	Electrical instruments	912
o	Electrical instrument removal	1,890
o	Tagging	7,954
o	Testing	2,219

The team concluded that the licensee's estimate of staff hours for the testing of controls was not supported by adequate data. In addition, material problems (such as shortage of nuts and bolts) were evident. The team was informed that the control room completion schedule was currently under review.

9.3 System Groups Work Estimates

The team reviewed in detail the licensee's estimated remaining scope of work for Systems Groups 1, 2, 3, 4, 5, and 6, which constitute approximately 61 systems. The majority of these systems were safety-related. At the time of this inspection, most of the licensee's effort was directed toward completion of the Group 1 systems. These Group 1 systems were officially scheduled for completion in early October 1989, but (according to the licensee's estimate) were approximately 2-1/2 months behind schedule. These Group 1 systems were the control air system, the essential raw cooling water system, and the component cooling system and had been walked down by the licensee. The walkdowns had resulted in more than 1000 punch list items, as well as approximately 300 discovery items which could result in another 1000 or more punch list items. The major current estimated remaining work on these three systems was as follows:

o	Cable	125,647 linear feet
o	Cable terminations	8,634
o	Metal conduit	5,577 linear feet
o	Large-bore pipe hangers	310

9.4 <u>CAPs and SPs Work Estimates</u>

The team's review of the CAPs and SPs revealed that there were a large number of discovery items (items for which the scope of required work had not yet been determined) within the Nuclear Engineering Department, for which only conceptual estimates had been made for the scope of work. Based on discussions with the licensee, the team concluded that the magnitude of the unknown work could be significant. There were currently 28 ongoing walkdowns and another 17 proposed for input to engineering associated with the discovery phase of the programs, and some work for the discovery phase had not yet started. The most critical CAPs, with potential for greatest impact from the discovery phase, were cable issues, electrical issues, the design baseline and verification program, and the hanger analysis and update program. The team also found that the Construction Engineering Department was not transmitting work packages to the Nuclear Construction Department in a timely manner.

9.5 <u>Prestart Test Program</u>

The team reviewed the WBNP prestart test program in detail. The program covered 61 systems and 108 tests and required reperformance of the entire preoperational test program, including cold hydrostatic testing, hot functional testing, and integrated leak rate testing. The licensee's schedule showed the start date for the preoperational test program as January 1990, with a completion date of February 1991, a duration of 13 months. The industry average for a preoperational test program is approximately 18 to 24 months. These 61 systems had previously been through a preoperational test program during the period from 1983 to 1985, and have been in lay-up, in continuous service, or in intermittent service since that time. The team was concerned that some plant equipment may have been modified without adequate testing and that the performance of some plant equipment may have degraded.

With regard to the status of the prestart test program, the team found that 32 of a total of 57 functional analysis reports were in preparation, 4 were in Joint Test Group (JTG) review, and 4 were approved. Of a total of 108 test instructions, 5 were in preparation, none had been submitted for JTG review, and none had been conducted.

9.6 Craft Work Force and Work Plans

The total craft work force for the period of September 22, 1989, through September 28, 1989, was 974. The two major craft areas were electricians, with 431 craftsmen; and steamfitters and welders, with 243 craftsmen. The team's discussions with knowledgeable plant personnel indicated that there was a shortage of qualified electricians and steamfitters at the union halls, and that these crafts were the ones most needed for the WBNP project. The team was later informed by licensee management that there was no major anticipated increase in craft work force for FY 1990.

Discussions by the team with Nuclear Construction Department personnel elicited the information that there were approximately 2200 construction work plans yet to be written. In addition, the team found that the remaining scope of known work was selective in nature and could not be done in a bulk mode, which indicated that work-off rates could be much slower than normal. During the several plant walkdowns conducted by the team, the inspectors observed that little work appeared to be underway in any area. However, during the last week of the inspection, work activities appeared to be increasing in the control room modification area.

During the last week of the inspection, the team was informed by licensee management that the overall schedule was under review and that the estimated date for fuel load was being reevaluated. The licensee also indicated that additional steps were being taken to ensure timely completion of required work items.

9.7 Conclusions

The licensee was not able to supply sufficient information to support its estimated December 1990 fuel load date, or to allow the team to independently develop a realistic schedule. The team concluded that the specific work associated with the large number of "discovery" items will need to be quantified before a firm schedule can be determined. As a result of responding to this inspection, the licensee appeared to develop a better understanding of the magnitude of work remaining to be accomplished.

10. EXIT MEETING

The team conducted an exit meeting with WBNP and NRC management on Friday October 27, 1989. The individuals who attended the meeting are identified in Appendix A to the report. The team presented a summary of the inspection findings and the preliminary conclusions reached by the team. The licensee was given the opportunity to have issues or findings clarified.

During the inspection, several team members provided written copies of inspection questions to licensee personnel during the inspection. Copies of these question sheets have been placed in the public document room (PDR).

APPENDIX A

PERSONS CONTACTED

A. Exit Meeting Attendees

The following Tennessee Valley Authority (TVA) and Nuclear Regulatory Commission (NRC) personnel attended the assessment team's exit meeting on October 27, 1989.

1. TVA Personnel

K.F. Wilson	D. Koehl	R. Olson
D.E. Douthit	G. Jestrab	H. Benninghoff
H. Johnson	J. Thompson	F. Laurent
G. Ashley	C.R. Hitson	S. Woods
L.E. Martin	W. Crabtree	S. Casteel
T. Ippolito	J. Mize	J.E. Gibbs
J.R. Lyons	R. Manley	J. Lund
K. Jones	E. Fuller	J. Oravitz
W.J. Hastie	R. Lewis	J. Lewis
D.E. McCloud	A. Gwal	K. Westervelt
D.R. Hawkinson	D. Stewart	F. Denny
D. McConnell	C.R. Seay	R.W. Alley
J. Yarborough	K. Hasting	R. Blevins
J.M. Boykin II	L.R. Willis	R. Kokesh
P.R. Mandana	R. Hoesly	R. Painter
S.A. Bokhari	R. Alexander	R. Raheja
J. Cruise	T. Dean	R. Norton
A. Lewis	S. Spencer	C. Touchstone
J. Dawkins	P. Candage	C. Nelson
H. Hemmati-Aram	L.J. Peterson	

2. NRC and Contractor Personnel

B. Grimes	J. Konklin	S. Stein
R. Pierson	R. Auluck	H. Wang
T. Conlon	R. Anand	R. Correia
K. Barr	B. Wilson	G. Hubbard
G. Humphrey	S. Burris	J. Watt
M. Branch	G. Walton	W. Lovelace
A. Gautam	G. Georgiev	E. Meils
L. Ramsett	M. Hunt	R. Compton
D. Ford	M. Good	A. Unsal
K. Jenison	M. Schuster	B. Scanga

B. Discipline Coordinators and Key Points of Contact

The following TVA personnel acted as the assessment team's coordinators for each discipline and were the key individuals contacted by the team. In addition to these people, the assessment team also contacted numerous licensee inspectors, engineers, and supervisors.

Team Leader and Overall Coordination

G. Ashley
J. McDonald
P. Candage
J.R. Lyons
L.J. Peterson
J. Blevins
M. Tuell
D. McConnell

Electrical and Instrumentation

R. Swallows
J.M. Boykin II
G. Jestrab
G. Crawley
S. Hughes

Mechanical

C. Touchstone
H. Benninghoff
M. Terry
C. Nelson
L. Willis
J. Lund
W. Bessom
J. Mize
C. Manning
J. Platfoot
J. Dawkins
R. Bradley
J. Chin

Civil and Structural

S. Spencer
W. Bessom
J. Adair
V. Storch
C. Floyd
D. McNabb

Welding and Nondestructive Examination

T. Dean
J. Yarborough
W. Joest
K. Hasting

Material Traceability and Procurement

A. Lewis
J. Lewis
G. Gibson
A. Smith

Design Change and Corrective Actions

J. Cruise
A. Robertson
H. Johnson
K. Jones
R. Painter
R. Norton
E. Condon
J. Thompson
S. Gibson
J.R. Lyons

Plant Schedule and Status

J. Stone
T.E. Simpson
J.R. Lyons
R.W. Alley
J. Coan
D.E. Douthit
M. Richardson
M.C. Brickey
R.M. Johnson
T. Horning
C.R. Seay
P.R. Nandaua
F.A. Koontz
J.E. Hinman

APPENDIX B

DOCUMENTS REVIEWED

The assessment team reviewed the document types listed below to the extent necessary to satisfy the objectives stated in Section 1 of this report. The report contains references to specific procedures, instructions, specifications, drawings, and other documents that the team reviewed.

Administrative procedures
Mechanical equipment installation procedures
Procedures for processing nonconformances
Procedures for controlling site documents
Final Safety Analysis Report
General construction specifications
Quality control procedures and instructions
Electrical installation procedures
Concrete installation specifications
Piping and pipe support installation procedures
Quality assurance procedures and instructions
Nuclear Quality Assurance Manual
Schedules for work activities
Welding and NDE procedures
Procedures for processing design changes
As-built drawings
Instrumentation installation procedures
Lists of remaining work activities

APPENDIX C

GLOSSARY OF ABBREVIATIONS

ACI	American Concrete Institute
AFW	auxiliary feedwater
AI	administrative instruction
AISC	American Institute of Steel Construction
ANI	authorized Nuclear Inspector (Insurer)
ANSI	American National Standards Institute
ASCO	Automatic Switch Company
ASL	approved suppliers list
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BBCA	broad-based construction assessment
CAP	corrective action program
CAQ	condition adverse to quality
CAQR	condition adverse to quality report
CAR	corrective action report
CBI	Chicago Bridge and Iron Company
CCS	component cooling system
CEG	contract engineering group
CFR	Code of Federal Regulations
CMTR	certified material test report
COTS	correct on the spot
CPI	construction project instruction
CVC	chemical and volume control
CVCS	chemical and volume control system
DCN	design change notice
DCR	design change request
DD	drawing deviation
EA	Engineering Assurance
ECN	engineering change notice
ECP	Employee Concern Program
EGTS	emergency gas treatment system
EQ	environmental qualification
ERCW	essential (or emergency) raw cooling water
ESQ	equipment seismic qualification
FCR	field change request
FI	flow indicator
FSAR	Final Safety Analysis Report
GDC	General Design Criterion
HAAUP	hanger analysis and update program
HVAC	heating, ventilation, and air conditioning
ICF	instruction change form
IEEE	Institute of Electrical and Electronics Engineers
IN	information notice (NRC Office of Inspection and Enforcement)
INPO	Institute of Nuclear Power Operations
IRN	inspection-rejection notice
ISEG	independent safety engineering group
ISV	instrumentation stop valve
JTG	Joint Test Group

LCV	level control valve
LER	licensee event report
LOCA	loss-of-coolant accident
MAMS	materials management system
MCC	motor control center
MI	maintenance instruction
MOV	motor-operated valve
MP	modification package
MR	maintenance request
MRC	Management Review Committee
MS	moisture sensor
MT	magnetic particle testing
NC	nuclear construction
NCR	nonconformance report
NDE	nondestructive examination
NE	nuclear engineering
NEP	nuclear engineering procedure
NMRG	Nuclear Manager's Review group
NQAM	Nuclear Quality Assurance Manual (TVA)
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation (NRC)
NSID	Nuclear Service Integration Division (Westinghouse)
NSRS	Nuclear Safety Review Staff (TVA)
NSSS	nuclear steam supply system
P&ID	piping and instrumentation drawing
PCV	pressure control valve
PI	pressure indicator
PIR	plant information request
PM	preventive maintenance
PMDR	preventive maintenance deficiency report
PORC	plant operations review committee
PORV	power-operated relief valve
PPSP	post-procurement substantiation package
PRD	problem reporting document
PSI	preservice inspection
QA	quality assurance
QC	quality control
QCP	quality control procedure
RG	regulatory guide (NRC)
RHR	residual heat removal
RIP	replacement items program
RIR	receiving inspection report
RT	radiographic testing
RTD	resistance temperature detector
SCR	significant condition report
SER	safety evaluation report
SI	surveillance instruction
SIS	safety injection system
S/N	serial number
SRN	specification revision notice
TI	technical instruction
TROI	Tracking Open Item
TS	temperature switch
TVA	Tennessee Valley Authority

VSR	vertical slice review
WBEP	Watts Bar engineering procedure
WBNP	Watts Bar Nuclear Plant
WP	work plan