EMPLOYEE CONCERNS

SPECIAL PROGRAM

VOLUME 1

CONSTRUCTION CATEGORY

SUMMARY AND CONCLUSIONS

TVA

NUCLEAR POWER

TVA NUCLEAR

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EXECUTIVE SUMMARY

This category report summarizes the findings and actions that resulted from evaluation of 575 employee concerns assigned to the Construction Category. The concerns raised issues about plant construction and related areas such as design, installation, inspection, surveillance, and maintenance of plant facilities and equipment.

Nuclear construction activities, in most of the areas evaluated, were adequately performed. Some technical problems and some programmatic weaknesses were identified. However, these have been or are being evaluated and corrected.

The Construction Category Evaluation Group initiated 242 recommendations for corrective action plans to address technical and programmatic issues. Most of the corrective action plans were to improve existing programs, correct documentation discrepancies, improve procedures, or to track corrective actions previously initiated by line organizations.

Approximately half of the concerns did not identify problems requiring corrective action. The employees who expressed those concerns may have misperceived what they saw or simply disagreed with some policies or procedures.

Of the problems that were identified by concerns, many had already been detected through other means and actions were underway or had already been completed at the time of the evaluations. At the same time, some concerns helped to identify previously unrecognized problems and brought about actions that will significantly enhance overall performance.

Some technical discrepancies that potentially could have affected plant safety were identified in the areas of electrical cable and flexible conduit installations, instrumentation design and installation, and design calculations for anchorages and hanger installations. Each of these areas is being evaluated through walkdowns, analyses, and testing, and corrected by modifications where required.

Three general types of shortcomings were identified, through analysis of the cumulative findings, as having caused or contributed to the identified deficiencies: design documentation and site implementation, work control, and corrective action programs.

Design output documents provided to the sites did not always contain timely, accurate, and complete requirements. Changes in upper-tier criteria and vendor information were not consistently incorporated into design output documents and, subsequently, into site implementing procedures. Some procedures, therefore, did not fully specify the appropriate storage, handling, and installation requirements of some materials and components. The

organizational structure existing at the time was not conducive to good communication and cooperation among organizations; therefore, the deficiencies were not expeditiously resolved. The new organizational structure and other major management improvements outlined in the Nuclear Performance Plan and the additional actions identified in the ECSP Engineering Category Report 20000 should significantly enhance overall performance in these areas. Identified negative findings that meet the restart criteria for Sequoyah and/or Browns Ferry Nuclear Plants have already been or will be corrected prior to the restart of the respective units. Those required for fuel load of Watts Bar and/or Bellefonte Nuclear Plants will be corrected prior to fuel load for those respective units.

Work control systems at Watts Bar exhibited weaknesses in the areas of planning and coordination, the content of work instructions, and the work review function. Work activities often were not well planned or coordinated and some work packages were not complete. Also, there was no performance monitoring system in place to aid in management review of work results and detection of adverse trends. Watts Bar management had previously recognized the weaknesses in work control systems and initiated a comprehensive overhaul of the program. In response to the employee concerns evaluation, Watts Bar also committed to develop a procedure for monitoring and trending the work control program. The new program, when fully implemented, should substantially improve work control performance at Watts Bar.

Although several programs for resolving "conditions adverse to quality" were in existence, they were not fully effective in achieving their goals. The primary weaknesses were untimely problem identification and recurrence prevention. Once recognized, the immediate problem was usually corrected. However, follow-up for recurrence prevention, through root cause analysis and generic implications review, was not always completed. As a consequence, the same or similar problems sometimes recurred at the same or other sites. A new Condition Adverse to Quality Report procedure was published in November 1986 in the Nuclear Quality Assurance Manual and subsequently revised to fully address the above findings. The new procedure consolidates the previous multiple programs into a single program and clearly delineates the responsibilities and requirements for identifying and resolving conditions adverse to quality. This new program effectively addresses the weaknesses found in the previous programs.

The programmatic weaknesses discussed above were judged to have resulted from a set of underlying conditions that existed during the timeframe represented by the concerns. It is significant that these conditions had been previously recognized by the Manager of Nuclear Power as detrimental to the nuclear program and major improvements had been planned and were underway before the Employee Concerns Special Program was implemented.

TVA's massive nuclear construction program, and the attendant rapid expansion of the work force, created the need for a greater number of experienced managers and supervisors than was available within TVA. The available qualified personnel were spread thinly throughout the nuclear organization and hundreds of new managers were appointed. Many

of these new managers had neither the managerial nor the nuclear power plant experience to fulfill their new responsibilities effectively, and TVA programs did not develop the needed managerial capability.

Furthermore, the decision to decentralize the nuclear organization in the early 1980's came at a time when cohesion, not fragmentation, was most needed. Unprepared managers, without benefit of adequate training or development programs, were placed in an atmosphere of ambiguous lines of authority, ill-defined responsibility, and very little individual accountability. Functional organizations operated autonomously, often in competition with each other, with no unified sense of purpose. Corporate management was slow in recognizing these weaknesses, thereby delaying the initiation of corrective action.

TVA has restructured the nuclear organization to centralize responsibility and define lines of authority under the Manager of Nuclear Power. Newly created departments have been assigned discrete functional responsibilities, and line managers within the departments are accountable for the technical adequacy of activities within their assigned areas. The overall level of nuclear management expertise has been improved, and continues to improve, through a combination of hiring, development, and retention of experienced nuclear managers. These and many other major program improvements are being implemented in accordance with the Nuclear Performance Plan. The corrective actions initiated to resolve specific discrepancies in the Construction, Engineering, Operations, and Quality Assurance categories, along with the sweeping program improvements outlined in the Nuclear Performance Plan, should significantly enhance performance, not only in construction activities, but throughout the nuclear organization.

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CONSTRUCTION CATEGORY SUMMARY AND CONCLUSION

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PREFACE

This report is one of a series prepared under the Employee Concerns Special Program (ECSP) of the Tennessee Valley Authority (TVA). The ECSP and the organization which carried out the program, the Employee Concerns Task Group (ECTG), were established by TVA's Manager of Nuclear Power to evaluate and respond to those Office of Nuclear Power (ONP) employee concerns filed before February 1, 1986 that related to TVA's nuclear power program. Concerns filed after that date are handled by the ongoing ONP Employee Concerns Program (ECP).

The ECSP addressed more than 5,800 employee concerns. Each of the concerns was a formal, written description of a circumstance or circumstances that an employee cited as inappropriate, inefficient, unjust, or unsafe. The scope of the ECSP was to thoroughly evaluate all alleged problems (issues) presented in the concerns and to report the results of those evaluations in a form accessible to ONP employees, the Nuclear Regulatory Commission (NRC), and the general public.

This preface contains background information on how the ECSP was initiated, descriptions of the categories to which concerns were assigned for evaluation, profiles of the Senior Review Panel members who provided independent oversight of the program, and information on feedback of program results to employees.

A HISTORY OF THE EMPLOYEE CONCERNS SPECIAL PROGRAM

In early 1985, a gap in communications between management and non-management employees at Watts Bar Nuclear Plant was recognized. After consultation with the NRC about this situation, the TVA Board of Directors directed that a far-reaching employee concerns program be implemented at Watts Bar. The Employee Concerns Special Program was established to thoroughly review employee concerns. To ensure that employees felt free to express their concerns without fear of retaliation, an independent contractor was selected to interview employees then assigned to Watts Bar.

Precautions were taken throughout the program to protect the identities of those who expressed concerns. The original records of the interviews remain in the custody of the interviewing contractor; the only other copies of these records are held by the NRC. Only the contractor and the NRC have had access to these files. The information provided to TVA was screened to maintain employee confidentiality.

Upon completion of the interview phase on February 1, 1986, 5,876 employees had been interviewed. Approximately one third of the employees (1,850) had expressed one or more concerns, resulting in approximately 5,000 individual employee concerns. Although TVA extended the program to employees at all Office of Nuclear Power sites through the use of mailers and a toll free telephone number, most of the concerns were from Watts Bar employees.

An Employee Concerns Task Group was established to carry out the program. The Task Group's concentration of qualified personnel and its comprehensive approach to problem resolution also made it the logical organization to resolve concerns and items gathered from several other sources. Therefore, the Task Group's responsibilities included the following:

- Concerns expressed during the contractor interviews.
- Concerns generated by earlier employee concern programs.
- Additional concerns identified from the interview files by the contractor and the NRC.
- Additional items identified by Task Group evaluators.
- Concerns received by the NRC before February 1, 1986, and referred to TVA.
- Concerns identified by TVA's former Nuclear Safety Review Staff.
- Open items identified from reviews of TVA incoming correspondence.

CATEGORIZATION OF CONCERNS

The concerns were grouped into nine categories to provide for consistent evaluation of related concerns. This also aided in identifying and developing corrective actions that addressed identified deficiencies specifically and programmatically to prevent recurrence. The responsibility for each category was assigned to a designated Category Evaluation Group. This responsibility included identification of the issues raised by the concerns, thorough investigation, determination of generic applicability and root causes of deficiencies, evaluation of Corrective Action Plans (CAPs) developed by the line organizations, and preparation of the program reports. In addition, the line organizations evaluated identified deficiencies for potential reportability to the NRC under Title 10 to the Code of Federal Regulations, Parts 50.55(e), 50.72, 50.73 and 21.

The concerns were grouped into the following categories:

- **Construction** - Concerns about the adequacy of construction practices, the quality of as-constructed facilities (excluding welding and as-designed features), in-storage and installed maintenance prior to turnover to operations, measuring and test equipment and handling of equipment used during construction, and construction testing activities. TVA personnel evaluated the concerns in this category.

- **Engineering** - Concerns about the adequacy of the design process and the as-designed plant features. The design process consists of the technical and management processes that commence with the identification of design inputs and lead to and include the issuance of design output documents. These concerns were evaluated by Bechtel Western Power Corporation.

- **Operations** - Concerns about operational activities, including operator qualifications, maintenance or equipment needs, security, health physics, and ALARA (as low as reasonably achievable) implementation, and concerns about preoperational and surveillance testing. Personnel from TVA and from Impell Corporation performed the evaluations in this category.

- **Material Control** - Concerns about the adequacy of material, including its procurement, receipt, handling, storage, and installation, and the adequacy of procedures governing material control. TVA personnel evaluated the concerns in this category.

- **Welding** - Concerns about any aspect of welding, including welder or weld procedure qualification, weld inspection/nondestructive examination, heat treatment, weld quality, filler material quality, and weld documentation. The welding concerns were evaluated by personnel from TVA and the EG&G Idaho Corporation.

- **Intimidation, Harassment, Wrongdoing, or Misconduct** - Concerns about personnel conduct that interferes with the ability of employees to fulfill their assigned responsibilities, unauthorized actions taken against employees for fulfilling their assigned responsibilities, and illegal activities or violations of TVA policies and regulations. Concerns in this category were transmitted by the Task Group to the Office of the Inspector General for evaluation.

- **Management and Personnel** - Concerns about the adequacy of policies, management attitude and effectiveness, organization structures, personnel management, and personnel training and qualification, except training and qualification covered by the Quality Assurance/Quality Control Category. These concerns were evaluated by TVA personnel and contracted consultants.

- **Quality Assurance/Quality Control** - Concerns about the adequacy of Quality Assurance/Quality Control programs and procedures (e.g., auditing; document control; records; deficiency reporting and corrective action; and inspection, except nondestructive examination and welding inspection) and the training, qualification, and certification of Quality Assurance/Quality Control personnel. The concerns in this category were evaluated by Stone & Webster Engineering Corporation.

- **Industrial Safety** - Concerns about the working environment and controls which protect the health and safety of employees in the workplace (excluding health physics and ALARA). TVA personnel and the DuPont Company - Safety Management Services evaluated these concerns.

Concerns that affected more than one category were assigned to multiple categories. In such cases, each category evaluated the concern from its specific point of view.

Each Category Evaluation Group sorted its assigned concerns into subcategories, according to the subject matter of the concerns, then into elements. An element is a group of related concerns that raise the same or similar issues. An issue is an alleged problem cited or implied, as interpreted by an evaluator, in one or more concerns. Concerns were evaluated according to the issues they raised. A comprehensive explanation of the evaluation and reporting process is contained in the introduction section of each category report and in the program summary report.

PROGRAM OVERSIGHT

The ECSP has been reviewed, audited, and inspected by the NRC, the TVA Office of the Inspector General, and the TVA Nuclear Quality Assurance Division. To provide additional independent and objective oversight, the TVA Manager of Nuclear Power established a Senior Review Panel of recognized experts within the nuclear power industry. Those selected had extensive backgrounds with experience in the design, construction, operation, quality assurance and safety evaluation of nuclear power plants.

The Senior Review Panel provided oversight to ensure that (1) the scope and depth of the evaluation effort was adequate, (2) the evaluation findings and conclusions were logically derived from the evidence, (3) the proposed CAPs adequately addressed identified deficiencies, and (4) the reports adequately described the evaluation effort, the evaluation findings and conclusions, and the measures taken to resolve the identified deficiencies.

Profiles of the Senior Review Panelists

Myer Bender

Querytech Associates Inc., Knoxville, Tennessee. Consultant on engineering practices for nuclear and advanced technology programs. More than 40 years of experience with complex technological activities including the Manhattan Project, and advanced nuclear fuel processing and waste management installations. Former Director of Engineering at the Oak Ridge National Laboratory and, for ten years, a Member of the NRC Advisory Committee on Reactor Safeguards (Chairman in 1977). Known for his work in standards, quality assurance, and system failure assessment.

James M. Dunford

Former startup readiness consultant for Three Mile Island. Former manager in the Naval Reactor Program. Former Vice President for Naval Reactor Plant Construction for New York Shipbuilding Corporation. Former Professor of Mechanical Engineering at the University of Pennsylvania. Nearly 50 years of experience in engineering management, material procurement, quality control, radiological control, construction, and training related to nuclear facilities.

Richard E. Kosiba*

Former Vice President for Quality and Technology, Babcock and Wilcox Company. Former manager in the Naval Reactor Program. Former Assistant Director (Plant Engineering) for the Atomic Energy Commission. Forty years of experience in the design, manufacturing, research and development, testing, operation, and maintenance of nuclear plants.

Joseph C. LaVallee, Jr.

Former Nuclear Project Manager for Sargent and Lundy. Twenty-five years experience in project management, licensing, construction, design, and operation of nuclear power facilities.

Daniel L. Garland*

Former Manager, Nuclear Quality Assurance Program Office for Westinghouse Hanford Company. While at Westinghouse, assisted Department of Energy in developing Quality Assurance standards and programs. Thirty years of experience in the quality assurance of nuclear plants, including preparation of plans, procedures, and manuals; indoctrination and training of personnel; and participation in more than 400 quality assurance audits, frequently as audit team leader.

James R. McGuffy* (Deceased)

Over 40 years experience in ASME Code fabrication work, specialty welding practices, materials technology, and quality assurance methodology. Former Director of Quality Assurance and Inspection for the Oak Ridge National Laboratory.

*These members served on the panel for part of the duration of the program.

QUESTIONS ABOUT CONCERNS

How to Find a Concern

These category reports and their appendices are intended to inform the concerned individual as to how his or her concerns were addressed. These reports summarize the Employee Concerns Task Group's investigations, findings, and line management identified corrective actions. In most cases the concerned individual should be able to identify the resolution of the issue associated with his/her concern using the following steps:

1. Determine which category would contain the concern. A list of the categories begins on page ii of this preface.

2. Review the category report identified in step 1, above. In particular, review the "Category Assessment" and "Conclusions" sections and the appendix titled "Subcategory Report Overviews."

A process has been developed which will permit employees to obtain additional information concerning their specific concern. As has been the case throughout this program, this will be done in a manner that ensures the confidentiality of the individual. Details of this process will be made available coincident with the release of these category reports.

What to Do If You Believe Your Concern Has Not Been Adequately Addressed

The Employee Concerns Task Group has made an intensive effort to thoroughly evaluate and report on all the issues raised by the concerns. In some cases, adequate information may not have been available to properly evaluate your concern or the concern may have been misinterpreted by the Task Group. Any employee who believes that his/her concern has not been adequately addressed by the ECSP is requested to bring this to TVA's attention by taking the question to the Employee Concerns Program site representative.

1.0 INTRODUCTION

Employee concerns and other items included in the Employee Concerns Special Program were collected or otherwise identified before February 1, 1986. Generally, the concerns reflect problems identified during an approximate timeframe of 1980 to 1985. Some refer to earlier time periods.

The Construction Category Evaluation Group evaluated 575 employee concerns that raised 119 issues about plant construction and related areas such as design, installation, inspection, surveillance, and maintenance of plant facilities and equipment and the adequacy of construction programs and procedures. The evaluations were conducted during the period of February through October of 1986.

Readers are cautioned not to construe this category report to be a comprehensive evaluation of all aspects of the TVA nuclear construction program. The findings and analyses presented in this and the 19 Construction subcategory reports are based solely on the evaluations of the issues raised by the employee concerns and 28 peripheral issues that were identified in the course of the evaluations. The subject matter represents a small, negatively biased set of items identified in the concerns.

It is also important, for a proper understanding of the context of this report, that readers be aware of the basic objective of Employee Concerns Task Group evaluations. The primary objective was to provide for evaluation and timely disposition, correction, and closeout of safety-related employee concerns in order to provide assurance that plant safety was not affected by identified issues.

To this end, major emphasis was placed on analysis of negative findings. The process was designed to be self-critical, to seek out and resolve any remaining weaknesses, and to promote enhanced performance throughout the Office of Nuclear Power as a result of corrective actions initiated for findings identified by the Employee Concerns Task Group.

The results of issue evaluations have been published in a series of 19 subcategory reports and 32 Sequoyah element reports. This category report summarizes the information contained in the subcategory and element reports and assesses the cumulative findings. A list of the 52 reports that comprise the total Construction Category report product is included as Appendix A, Construction Category Table of Reports.

1.1 Evaluator Qualifications

Evaluations and subsequent analyses of findings in the construction category were performed by a team of trained evaluators under the direction of the Category Evaluation Group Head. The Group Head is a TVA manager with 17 years of experience in the construction phase and related areas that comprise this category.

Evaluations were performed by a team of 35 TVA employees and managers along with two consulting engineers with nuclear industry experience. The TVA team members had been associated with the nuclear construction organization or with other Office of Nuclear Power organizations.

Total work experience of all the team members exceeds 475 years for an average of 12 plus years per member. The TVA work experience of the TVA team members exceeds 345 years for an average of approximately 10 years per member.

A list of members of the Construction Category Evaluation Group, with a brief description of the work experience of each, is included as Appendix B, Evaluator Profiles.

1.2 Evaluation Process

1.2.1 General Methodology

The starting point of evaluations in the Construction category was with the 575 employee concerns assigned to the category. Before any evaluation began, the concerns were sorted into 19 subcategories, according to the subject matter of the concerns (e.g., concrete, mechanical, and cable).

Within each subcategory, concerns were further divided into elements. An element is a group of related concerns, i.e., concerns that raise the same or similar issues. An element, then, consists of one or more closely related issues. Issues are alleged problems cited in one or more concerns.

Evaluations of individual concerns were conducted at the element/issue level. The results of element evaluations were reported and analyzed in a series of 19 subcategory reports; subcategory findings were then combined and evaluated to produce the overall evaluation of the Construction category, as presented in this report. Each step of the evaluation process is explained below.

1.2.2 Element Evaluation Process

Evaluations were performed and documented in accordance with an approved Construction Category Evaluation Plan by personnel who had successfully completed the approved Evaluator Training Program.

The evaluators reviewed applicable baseline requirements documents (e.g., regulations, technical specifications), implementing procedures and instructions, relevant documents of the Nuclear Regulatory Commission, and investigation reports on concerns that had been previously

investigated by other organizations. They interviewed personnel who had knowledge of or responsibility for items being evaluated, visually inspected plant systems and components, and researched relevant historical data such as maintenance records and surveillance documentation.

Issues that were determined to be generically applicable to additional plants were evaluated at those plants. Similarly, issues with implied applicability to other structures, components, or processes within a plant were evaluated accordingly.

Findings requiring action were reviewed with responsible line managers who developed corrective action plans to resolve the identified problems. Corrective action plans were then submitted to the Group Head and evaluators for concurrence.

Element reports were published to document the results of evaluations of those issues directly affecting Sequoyah Nuclear Plant. All element evaluations are included in subcategory reports.

1.2.3 Subcategory Evaluation Process

Subcategory reports contain the results of the element evaluations (including corrective actions, causes, and significance for substantiated issues). Every concern assigned to the Construction category was addressed, either individually or as part of an issue evaluation, in one of the 19 Construction subcategory reports.

Problems identified through the element evaluations were systematically analyzed to determine the immediate causes and to detect symptoms of underlying root causes. Problems identified through this root cause analysis were referred to the responsible managers for preparation of corrective action plans.

1.2.4 Category Evaluation Process

At the category level, the negative findings, or weaknesses, identified at the subcategory level were analyzed for important patterns that might not have been apparent when the subcategories were examined individually. This analysis identified programmatic weaknesses and strengths and determined the perceived root causes of the weaknesses. Findings requiring action were referred to the responsible organizations for preparation of corrective action plans where applicable.

2.0 SUBCATEGORY DESCRIPTIONS

This section contains a brief description of each of the 19 subcategories that comprise the Construction category. Summaries of the subcategory reports are contained in Appendix C, Subcategory Report Overviews.

Subcategory 10100 - Soils

The Soils subcategory addresses issues concerning the materials and methods used in backfill operations during the construction phase. At Watts Bar, questions were raised in regard to the ability of the barrier trenches to perform their designed function, which is to protect the soil supporting the Essential Raw Cooling Water intake pipeline from outflow during a seismic event. Other Watts Bar issues concerned the adequacy of the Essential Raw Cooling Water pipeline backfill, the north valve room backfill, the cooling tower blowdown pipeline backfill, the filling of a sinkhole, and low volume waste holding pond dike construction. The lone Sequoyah issue concerned the planned construction of the Dry Active Waste Building on a site that had been filled with random materials left over from various excavation and backfill operations. The concern was that the soil might not be adequate and could cause uneven settling of the building.

Subcategory 10200 - Concrete

The Concrete subcategory addresses issues pertaining to concrete mixes, concrete placement, types of concrete placed, and post-placement conditions. Fourteen issues were addressed with ten applying to Watts Bar, three to Bellefonte, and one to the now canceled Hartsville site. The ten Watts Bar issues concerned water content and lift thicknesses being exceeded, substandard concrete, cracks in concrete, foreign objects/debris embedded in concrete, improper surface preparation, broken concrete edges, the validity of a Nonconformance Report and associated corrective actions related to concrete mortar patches, inappropriately used epoxy mortar, concrete compressive strength test commitments not being met, and poor concrete pour practices. The three Bellefonte issues concerned allegations that welding machines were embedded in concrete, improper concrete curing, and substandard concrete. The lone Hartsville issue alleged that lime (used to control algae on concrete) was not removed before placement of concrete walls on existing slabs.

Subcategory 10300 - Protective Coatings

The Protective Coatings subcategory addresses seven issues about the coatings and paints used on some floors, walls, and welds to reduce corrosion or to aid in decontamination of surfaces that could be subject to radioactive contamination. In general, the issues concerned the quality of applications, maintenance and repair of deteriorating coatings, use of proper materials, and failure to coat some welds.

Subcategory 10400 - Embeds

The Embeds subcategory addresses the design of embedded and surface mounted plates used to attach platforms, supports, and such to the walls, floors, and ceilings in concrete structures at all four TVA nuclear plants. The concerns raised issues related to errors, omissions, or incorrect assumptions discovered in previously approved design calculations during 1984 that were not corrected; noncompliance with NRC IE Bulletin 79-02 with respect to baseplate flexibility design considerations; undocumented loads on embedded plates; changes in design philosophy that allowed greater bolt loads for Unit 1 than for Unit 2 at Watts Bar; a procedure that permits engineering to approve attachment of "minor loads" to embedded plates based only on visual inspection; failure to reevaluate existing installations following a change in criteria for minimum spacing of anchor bolts from concrete edges; engineering approval of violations of minimum spacing criteria; the adequacy of "hollow" sounding embedded plates; and whether only one or two welded studs are supporting excessive loads on embedded plates that were originally designed to be spanned by surface mounted plates supported by cast-in-place anchors.

Subcategory 10500 - Deterioration of Permanent Facilities

The Deterioration of Permanent Facilities subcategory addresses issues associated with architectural features and installed components subject to deterioration during the construction phase. These items are managed under the preventive maintenance programs for plant equipment and facilities. Eight issues were addressed concerning dust in vital electrical control cabinets, rusty conduit, indeterminate instrumentation maintenance requirements, rusty instrument air lines, deteriorated caulking at the Additional Diesel Generator Building at Sequoyah and Watts Bar, water in cable trays, debris in cable trays, and equipment components installed in an underground water source at Bellefonte.

Subcategory 10600 - Bolting

The Bolting subcategory addresses the adequacy of bolting material and bolted installations. Three issues were evaluated: the use of carbon steel bolts in stainless steel components such as pipe flanges, valve bodies, and pump casings; the adequacy of a borated water tank holddown bolt assembly; and installation of a piping spool piece with only two bolts to hold it in place.

Subcategory 10700 - Instrument Tubing

The Instrument Tubing subcategory addresses five issues associated with tube bending equipment, configuration of Radiation Monitoring System tubing bends, and tubing materials; cleanliness of stainless tubing assemblies; venting of tubing assemblies before or during hydrostatic testing; routing of panel drain tubing; and instrumentation line installation practices.

Subcategory 10800 - Structural

The Structural subcategory addresses eight issues involving miscellaneous civil applications such as concrete/masonry wall installations, expansion joint seals, and door installations.

Six Watts Bar issues were raised by allegations that a concrete block wall had cavities in the mortar joints; a hole was improperly made in the floor above the contaminated-laundry room; construction changes to the gatehouse were made on the basis of verbal approval and were not documented; expansion joint seals between the Reactor Building and Auxiliary Building (both units) are leaky and could permit a radioactive spill to leak into the groundwater system; five doors not shown on design drawings were installed and not inspected; and the Auxiliary Building Secondary Containment Envelope test (vacuum test on internal doors) was not valid because personnel sealed the doors with rags until acceptance criteria could be met. Two issues at Bellefonte were based on allegations that rebar and/or insulation may have been omitted during concrete placement for the Essential Raw Cooling Water pipe tunnels and that inadequate methods were used to establish survey control points.

Subcategory 10900 - Cable

The Cable subcategory addresses a wide range of employee concerns questioning the adequacy of electrical cable installation practices. Issues were raised about improper pulling, splicing, terminations, inspections, fireproofing, maintenance, and damage to cable insulation.

Subcategory 11100 - Hangers/Supports

The Hangers/Supports subcategory addresses issues pertaining to the installation and documentation of supports for cable trays, conduit, ducts, instrumentation, and pipe during the construction phase. Issues were raised about stainless steel pipe contacting carbon steel supports; the adequacy of some designs and design output documents; methods of installing hangers and supports; the condition of installed supports; the availability of craft training concerning specifications; and the adequacy of hanger inspection documentation.

Subcategory 11200 - Workplan/Work Control

The Workplan/Work Control subcategory addresses the broad areas of administrative controls, work practices, and procedures governing construction work. Work Control issues were raised by allegations of improper work authorizations and undocumented work; craftsmen doing engineering work; poor work planning and coordination; inadequate verification of completed work; inaccurate and incomplete work packages; and questionable engineering practices.

Subcategory 11300 - Anchorages

The Anchorages subcategory addresses many topics dealing with concrete bolt anchors used to attach many different items to hardened concrete walls, floors, and ceilings in the buildings at all four nuclear sites.

The issues were based on contentions that concrete expansion type anchors were inadequate for use at TVA nuclear plants, concrete and/or rebar had been damaged during the anchor installation process, and anchors had been altered in various ways to give the appearance of an acceptable installation. Also, concrete expansion type anchors allegedly had been incorrectly installed and tested and were allowed to rust and/or corrode after installation.

Subcategory 15100 - Damage/Construction Control

The Damage/Construction Control subcategory addresses ten issues concerning component damage during the construction phase. Issues were raised about floor drains plugged by debris; sheet metal electrical penetration covers being walked on; electrical cabinets and open conduits watersoaked during pipeflushing activities; conduits exposed to heat from nearby welding, possibly resulting in cable insulation damage; lack of protection of flex hose connections; potential damage to soft insulation that is frequently walked on; possible damage to electrical cables due to abuse of cable trays; possible damage to installed piping; possible damage to instruments and instrument line tubing; and possible damage to valves.

Subcategory 15200 - Housekeeping

The Housekeeping subcategory addresses the day-to-day general cleanliness and maintenance of permanent and temporary facilities. Issues were raised about the adequacy of housekeeping practices in permanent plant facilities, the possibility of dust from plant roads adversely affecting parts stored in warehouses, and general deterioration of the temporary construction medical complex.

Subcategory 15300 - Construction Equipment

The Construction Equipment subcategory evaluates construction equipment and tools and their use by construction personnel. Four issues were evaluated in this subcategory with all four being applicable to Watts Bar only. These four issues pertained to unsigned construction scaffold inspection tags, adequacy of a computer system, availability and condition of construction hand tools, and allegedly poor maintenance and condition of construction heavy equipment.

Subcategory 17100 - Mechanical

The Mechanical subcategory addresses issues concerning the mechanical aspects of construction involving valves; heating, ventilation, and air conditioning; mechanical equipment; insulation; and piping. Issues were raised pertaining to a Class B valve that was installed in a Class A line, orientation and maintenance of Limitorque valve operators, hydrostatic testing of containment penetration vendor welds allegedly not properly performed, a perception that the Essential Raw Cooling Water system was designed to be stainless steel but was not constructed of stainless steel, and valves that were "rusty on the outside but okay on the inside."

Subcategory 17300 - Instrument Line Installation

The Instrument Line Installation subcategory addresses four issues about installation of the lines between termination points. The issues pertained to slope, compression fittings, clamps, and bending of the lines. No evaluations of the termination points (i.e. instruments and origination connection point) or instrument line hydrostatic or pneumatic tests, except for drain and vent lines at Watts Bar, were performed in the subcategory. Employee concerns related to slope, compression fittings, and clamps were evaluated at all four nuclear sites. However, bending was evaluated at Watts Bar only, since the bending issues within this subcategory were characterized as not generically applicable to the other three sites. Subcategory 10700 addresses other instrument tube bending issues at all four sites.

Subcategory 19100 - Electrical Equipment

The Electrical Equipment subcategory addresses three issues on only three types of electrical equipment - control panels, junction boxes, and hand switches. Issues concerning control panels and handswitches were applicable to Watts Bar only, while the junction box issue was evaluated at all four nuclear sites.

Subcategory 19200 - Conduit and Cable Tray

The Conduit and Cable Tray subcategory addresses concerns pertaining to conduit, conduit fittings and cable tray hardware. Issues were raised about conduit installation methods and materials and possible damage to conduits and cables during installation, installation and identification markings of cable tray wall penetrations, and use of solid rather than coated reactive metal conduit fittings in the Reactor Building.

3.0 CATEGORY ASSESSMENT

3.1 Program Weaknesses and Corrective Actions

The cumulative findings of the 19 subcategories were assessed for programmatic weaknesses that caused or contributed to identified deficiencies. Judgments were then made as to the current status of these programs, i.e., the extent to which the weaknesses had been or were being addressed by the Nuclear Performance Plan and other performance enhancement programs and whether additional corrective action was needed.

3.1.1 Design Documentation and Site Implementation

Design output documents provided to the sites did not always contain timely, accurate, and complete requirements. Changes in upper-tier criteria and vendor information were not consistently incorporated into design output documents and, subsequently, into site implementing procedures. Some procedures therefore did not fully specify the appropriate storage, handling, and installation requirements of some material and components. Also, procedure compliance and enforcement at the branch and site levels were not always satisfactory. The organizational structure existing at the time was not conducive to good communication and cooperation among organizations; therefore, the deficiencies were not expeditiously resolved.

A review of the Nuclear Performance Plan, specifically section IV.B, "Consolidation of TVA's Nuclear Organization," and section VI.E.4, "Improvements in the Control of Design Changes and Plant Modifications," provides assurance that TVA has identified the actions necessary to correct many of the factors that contributed to deficiencies in design documentation and site implementation. The construction category has identified the need and the line has provided corrective actions for the specific deficiencies resulting from individual issues. In addition, the ECSP Engineering category has also identified corrective actions on a much broader and detailed scope to address the design documentation and site implementation problems as outlined in Category Report 20000, section 3.1 - Summary, section 3.2 - Root Causes and Resolutions, and section 3.3 - Category Level Corrective Actions. The present controlled pace of design and construction activity should allow time to improve overall performance in these areas.

Specific procedure deficiencies found during issue evaluations have been corrected through the Corrective Action Tracking Document process at the subcategory level. Programmatic weaknesses in the procedure system can be corrected by actions described in the Nuclear Performance Plan's

section VI.C.1, "Improvements in Programs and Procedures." The more difficult problem to correct is that of adherence to procedures. However, procedure improvements and enhanced training programs should help improve procedure compliance.

3.1.2 Work Control

Work control systems at Watts Bar exhibited weaknesses in the areas of planning and coordination, the content of work instructions, and the work review function. Work activities often were not well planned or coordinated and some work packages were not complete. Also, there was no performance monitoring system to aid in management review of work results and detection of adverse trends.

Isolated instances of work control problems were observed at Browns Ferry, Bellefonte, and Sequoyah Nuclear Plants. These problems involved planning and coordination and the use of some outdated procedures. The weaknesses were not in the basic programs but rather in implementation and control of the programs.

The Nuclear Performance Plan, in section VI.C., "Improving Management Systems and Controls," proposes some broad actions to improve performance in this area. Section III.B.2, "Management Development," and section IV.E.3, "Nuclear Training," describe actions to improve overall training, some of which have already been completed, including elevation of the training organization to a division level corporate function.

Additional improvements in work control systems are expected to result from current work on the Nuclear Procedures System, which will control organizational interfaces through Office of Nuclear Power standards. As soon as the standards are completed, they will be implemented through the Nuclear Construction Program Manual. Division level procedures will be written to provide standardization and improvement of the construction and modification work control programs. Some differences may exist between the sites, but only those that are due to site specific requirements.

Watts Bar had previously initiated a comprehensive overhaul of the work control system but had not included a performance monitoring system. As a result of the evaluations, Watts Bar has committed to develop and implement a procedure for monitoring and trending the work control program. The new program, when fully implemented, should substantially improve work control performance at Watts Bar.

3.1.3 Conditions Adverse to Quality Programs

Although several programs for resolving "conditions adverse to quality" were established, they were not fully effective in achieving their goals. The primary weaknesses were untimely problem identification and recurrence prevention. Once recognized, the immediate problem was usually corrected. However, follow-up for recurrence prevention, through root cause analysis and generic implications review, was not always completed. As a consequence, the same or similar problems sometimes recurred at the same or other sites.

Volume I of the Nuclear Performance Plan, section VI.D, identifies "Improving TVA's Nuclear Corrective Action Program" as a performance improvement objective. Thus, the findings and assessments made by the Construction category validate the performance improvement decision made by TVA management.

A new Condition Adverse to Quality Report procedure was published in November 1986, in the Nuclear Quality Assurance Manual, part I, section 2.16. The new procedure consolidates the previous multiple programs into a single program and clearly specifies the responsibilities and requirements for documenting and resolving conditions adverse to quality. However, a detailed review of the new procedure revealed some areas that needed improvement. They were as follows:

- The sequence of report processing steps did not place root cause analysis before the generic implications review and determination of recurrence prevention action.

- The procedure did not require a root cause analysis, generic implications review, or recurrence prevention analysis for a condition classed as non-significant.

- There was no provision for automatic review of "not-applicable" generic implications determinations.

- There was no provision that would ensure coordination of recurrence prevention actions among affected organizations.

- There was no provision that would ensure assignment of generic implications review responsibility to the appropriate level as determined by the scope of the condition.

The Construction Category Evaluation Group initiated Corrective Action Tracking Documents to address these points. Management responses indicated that appropriate changes would be included in revision 3 of the procedure, which was subsequently published on June 1, 1987. A subsequent review of the revised procedure confirmed that the cited areas have been improved.

However, the new program will not correct all weaknesses by itself. The program, together with full implementation of Nuclear Performance Plan commitments as well as those actions already underway, give assurances that the new program can be implemented effectively. This issue is also addressed in the ECSP Quality Assurance Category Report 80000.

3.2 Root Causes

An important objective throughout the Construction category evaluation process has been to identify causes of weaknesses so that action could be taken to eliminate the weaknesses and improve overall performance. At the element level, the proximate, or nearest causes of specific problems were identified and actions were initiated to correct and prevent recurrence of the specific problems.

Root cause analysis at the subcategory level searched for underlying causes that brought about or helped bring about undesirable results. Causative conditions identified through subcategory root cause analysis were referred to responsible line managers for recurrence prevention action.

At the category level, the perceived root causes derived from subcategory evaluations were collectively assessed for higher level root causes. The root causes identified through category level analysis are those underlying conditions, events, or circumstances that ultimately caused programmatic weaknesses to occur or permitted them to remain uncorrected.

The conditions discussed in the following paragraphs were judged to have been responsible for the programmatic and technical deficiencies identified in the Construction category. It is significant that these conditions had been recognized by the Manager of Nuclear Power as detrimental to the nuclear program and major improvements had been planned and were underway before the Employee Concerns Special Program was implemented.

TVA's massive nuclear construction program, and the attendant rapid expansion of the work force, created the need for a greater number of experienced managers and supervisors than was available within TVA. The available qualified personnel were spread thinly throughout the nuclear organization and hundreds of new managers were appointed. Many of these new managers had neither the

managerial nor the nuclear power plant experience to effectively fulfill their new responsibilities, and TVA programs did not develop the needed managerial capability.

Furthermore, the decision to decentralize the nuclear organization in the early 1980's came at a time when cohesion, not fragmentation, was most needed. Unprepared managers, without benefit of adequate training or development programs, were placed in an atmosphere of ambiguous lines of authority, ill-defined responsibility, and virtually no individual accountability. Functional organizations operated autonomously, often in competition with each other, with no unified sense of purpose. Corporate management was slow in recognizing the weaknesses in the nuclear program, thereby delaying the initiation of corrective action.

TVA is providing effective management of its nuclear activities through the combination of hiring, development, and retention of experienced nuclear managers, and the use of loaned managers. Section III of the Nuclear Performance Plan, "Hiring, Development, and Retention of Experienced Nuclear Managers," describes TVA's short-term and long-term efforts to provide experienced managers for its nuclear activities.

TVA has restructured its nuclear organization to centralize responsibility and authority under the Manager of Nuclear Power. Within the Office of Nuclear Power, a new organizational structure has been implemented and position descriptions have been developed to provide centralized direction and control of nuclear activities. A description of this restructuring and the new organization is provided in the Nuclear Performance Plan's Section IV, "Restructuring of TVA's Organization."

In Section IV.C. of the Nuclear Performance Plan, TVA recognized the need for instituting accountability for work performed within discrete functional areas. Each of the nuclear headquarters departments created by organizational restructuring has been assigned responsibility for discrete functions. Each department's responsibility includes developing programs and standards, providing technical direction, and providing technical support for activities within its functional area. The director or manager of each department and the line managers within each department are accountable for the technical adequacy of activities within their respective functional areas.

Actions described in the Nuclear Performance Plan, as previously discussed, are the actions necessary to promote cooperation among groups. The new organizational structure, and the resulting emphasis on responsibility and accountability, will create an environment that demands interaction throughout the nuclear organization. However, fully effective communication, cooperation,

and coordination can be achieved only through teamwork. Management has the opportunity to ensure a spirit of teamwork by fulfilling the commitments made in the Nuclear Performance Plan.

4.0 CONCLUSION

The Construction Category Evaluation Group evaluated 119 issues raised by 575 employee concerns and 28 peripheral issues identified by evaluators. These issues addressed a variety of functional areas throughout the entire spectrum of nuclear plant construction and related activities.

Nuclear construction activities, in most of the areas evaluated, were adequately performed. Some technical problems were found and some programmatic weaknesses were identified. However, these have been or are being evaluated and corrected.

Approximately half of the issue evaluations did not identify problems requiring corrective action. The employees who raised those issues may have misperceived what they saw or simply disagreed with some policies or procedures.

Of the problems that were identified by concerns, many had already been detected through other means and corrective actions were underway or completed. Conversely, some concerns helped to identify previously unrecognized problems and brought about actions that will enhance several programs.

Some technical discrepancies that potentially could have affected plant safety were identified in the areas of electrical cable and flexible conduit installations, instrumentation design and installation, and design calculations for anchorages and hanger installations. Each of these areas is being evaluated through walkdowns, analyses, and testing, and corrected by modifications where required.

The Construction Category Evaluation Group issued 242 Corrective Action Tracking Documents addressing technical and programmatic issues. A large majority of the actions were to improve already existing programs, correct documentation discrepancies, improve procedures, or track previously initiated actions. These specific actions and the actions outlined in the ECSP Engineering Category Report 20000 and Quality Assurance Category Report 80000, along with the sweeping program improvements outlined in the Nuclear Performance Plan, should significantly enhance performance, not only in construction activities, but throughout the nuclear organization. Identified negative findings that meet the restart criteria for Sequoyah and/or Browns Ferry Nuclear Plants have already been or will be corrected prior to the restart of the respective units. Those required for fuel load of Watts Bar and/or Bellefonte Nuclear Plants will be corrected prior to fuel load for those respective units.

Management can help ensure the success of the nuclear program by following through on the corrective action plans that resulted from the Employee Concerns Special Program and the commitments made in the Nuclear Performance Plan. Employees will then be convinced, through visible results, that the plans are being translated into

action and the promises are being kept. The TVA nuclear team spirit will be strengthened and real progress can be made toward the common goal: safe, efficient - and operating - nuclear plants.

APPENDIX A
CONSTRUCTION CATEGORY TABLE OF REPORTS

Reports in the Construction Category comprise Volume 1 of the Employee Concerns Special Program Report of Findings and Conclusions. Each of the 52 reports within Volume 1 is identified with a Part number corresponding to its Employee Concerns Special Program report number.*

PART	REPORT TYPE AND NUMBER	TITLE
10000	**Category Report 10000**	**Category Summary and Conclusions**
10100	**Subcategory Report 10100**	**Soils**
10107	Element Report 10107-SQN	Dry Active Waste Building Foundation
10200	**Subcategory Report 10200**	**Concrete**
10300	**Subcategory Report 10300**	**Coating and Paint**
10307	Element Report 10307-SQN	Uncoated Welds
10400	**Subcategory Report 10400**	**Embeds**
10401	*Element Report 11301-SQN	*Design of Plates

*Element 11301-SQN, Design of Plates, was originally included in Subcategory 11300, Anchorages. It was subsequently moved to Subcategory 10400, Embeds, as the Embeds Subcategory was expanded to include surface-mounted plates. Because Element Report 11301-SQN and several related documents had already been issued, the element number was not changed. However, the evaluation results for Element 11301-SQN are contained in Subcategory Report 10400.

10500	**Subcategory Report 10500**	**Deterioration of Permanent Facilities**
10501	Element Report 10501-SQN	Caulking
10504	Element Report 10504-SQN	Conduit
10505	Element Report 10505-SQN	Electrical Control Cabinets
10600	**Subcategory Report 10600**	**Bolting**
10603	Element Report 10603-SQN	Bolting Material Compatibility
10700	**Subcategory Report 10700**	**Instrument Tubing**
10703	Element Report 10703-SQN	Pending Equipment/Material
10800	**Subcategory Report 10800**	**Structural**

10900	**Subcategory Report 10900**	**Cable**
10901	Element Report 10900-SQN	Cable
11100	**Subcategory Report 11100**	**Hangers/Supports**
11101	Element Report 11101-SQN	Contact Between Dissimilar Metals
11102	Element Report 11102-SQN	Design Output
11103	Element Report 11103-SQN	Methods Used During Installation
11106	Element Report 11106-SQN	Hanger Inspection Documentation
11200	**Subcategory Report 11200**	**Workplan/Work Control**
11202	Element Report 11202-SQN	Craft Designed Hangers
11203	Element Report 11203-SQN	Poor Planning and Coordination
11206	Element Report 11206-SQN	Unauthorized Work/Undocumented Work
11207	Element Report 11207-SQN	Improper Installation
11300	**Subcategory Report 11300**	**Anchorages**
11302	Element Report 11302-SQN	Design of Anchors
11305	Element Report 11305-SQN	Anchors Cut Off
11306	Element Report 11306-SQN	Testing of Anchors
15100	**Subcategory Report 15100**	**Damage/Construction Control**
15101	Element Report 15101-SQN	Floor Drains
15102	Element Report 15102-SQN	Electrical Penetrations
15105	Element Report 15105-SQN	Flex Hose Connections
15109	Element Report 15109-SQN	Instrumentation Tubing
15200	**Subcategory Report 15200**	**Housekeeping**
15300	**Subcategory Report 15300**	**Construction Equipment**
17100	**Subcategory Report 17100**	**Mechanical**
17101	Element Report 17101-SQN	Valves
17105	Element Report 17105-SQN	Pipe Fittings
17300	**Subcategory Report 17300**	**Instrument Line Installation**
17301	Element Report 17301-SQN	Line Slope
17303	Element Report 17303-SQN	Clamps
17304	Element Report 17304-SQN	Compression Fittings
19100	**Subcategory Report 19100**	**Electrical Equipment**
19101	Element Report 19101-SQN	Junction Boxes

19200	**Subcategory Report 19200**	**Conduit and Cable Tray**
19201	Element Report 19201-SQN	Conduit
19203	Element Report 19203-SQN	Conduit Fittings

APPENDIX B
EVALUATOR PROFILES

The following are brief descriptions of the professional qualifications of the evaluators and other key personnel who assisted in the evaluation of the employee concerns within the Construction Category.

Jack L. Howard, Category Group Head, Evaluator

B. S. in Civil Engineering, University of Kentucky. Over 17 years experience as a Civil construction engineer and manager, including 10 years as an engineer or manager in TVA's nuclear construction organization.

Martin B. Bailey, Evaluator

B. A. in Mathematics, University of the South, and B. S. in Civil Engineering, Columbia University. Over eight years experience in design and scheduling activities with four years in TVA's nuclear design organization as a pipe support designer.

Gerald L. Baker, Evaluator, Report Writer

B. S. in Mechanical Engineering, Tennessee Technological University. Over 18 years experience in the design and operations of power generating facilities. Has served in several capacities in TVA's nuclear program during the past 13 years.

Hugh F. Bates, Jr., Report Writer, Peer Reviewer

B. S. in Civil Engineering, Georgia Institute of Technology. Over 29 years experience with TVA's overall construction program as an engineer and manager.

James E. Blackburn, Report Writer, Peer Reviewer

B. S. in Civil Engineering, University of Tennessee, eight-plus years experience in TVA's nuclear construction and quality assurance program as an engineer and manager. Has served as a Quality Manager at Bellefonte for the past three years.

Douglas R. Brown, Report Writer, Peer Reviewer

B. S. in Civil Engineering, University of Tennessee. Over 13 years of experience in the design and construction programs of TVA's nuclear program as an engineer. Has served as a technical supervisor in various aspects of the construction program for the past nine years.

Robert M. Brown, Evaluator, Report Writer, Peer Reviewer

B. S. in Electrical Engineering, University of Tennessee. Over six years experience in TVA's nuclear design and operations organizations as an engineer. Served as a contract administrator/equipment qualification specialist in TVA's Electrical Engineering Branch for four years.

Jack K. Bryant, Evaluator, Report Writer, Peer Reviewer

B. S. in Mechanical Engineering, Tennessee Technological University. Over seven years experience in TVA's nuclear operations program as an engineer or engineering aide. Served as a preoperational test director at Watts Bar for past three years.

John E. Campbell, Evaluator

Over 16 years of experience in TVA's design and construction organizations. Served as a group leader/manager over electrical and maintenance/receiving inspection units for the past nine years in TVA's nuclear construction organization.

James A. Chesney, Evaluator, Report Writer, Peer Reviewer

Associate of Science in Mechanical Engineering Technology, Roane State Community College. Over five years experience in TVA's Nuclear Construction Organization. Served as an engineering aide and as an engineering associate.

U. M. Clemmer, III, Evaluator, Report Writer

B. S. in Mechanical Engineering, University of Tennessee. Over three years experience in TVA's nuclear design organization as a support design engineer.

John S. Craig, Evaluator, Report Writer

B. S. in Electrical Engineering, University of Tennessee. Over 14 years experience in TVA's nuclear design organization as an instrumentation and controls engineer/technical group leader.

Julie Cromer, Evaluator, Report Writer

B. S. in Civil Engineering, Clemson University. Over six years experience in TVA's nuclear construction organization as a project controls engineer/manager. Served as liaison between design and construction organizations for scheduling of construction activities and on nuclear licensing commitments.

Chris A. Haerr, Evaluator, Report Writer, Peer Reviewer

B. S. in Mechanical Engineering, University of Missouri, B. S. in Aeronautical Engineering, Tri-State University. Over 12 years experience in fabrication and construction activities as an engineer. Served as a preoperational test coordinator in TVA's Watts Bar operations organization for the past nine years.

Jimmy M. Henard, Evaluator

Over 15 years experience in TVA's nuclear construction organization. Served as a craft manager and as a Labor General Foreman/Superintendent for past 11 years at several TVA nuclear sites.

Guy R. Huff, Evaluator, Report Writer

Over 19 years experience in industrial engineering applications in manufacturing/ construction activities. Served as a Construction Management Assistant in TVA's nuclear construction organization as an industrial engineer for the past six years.

Jack L. Johnson, Evaluator, Report Writer

Over nine years experience in TVA's nuclear operations and construction organizations as a construction engineering associate.

Robert M. Johnson, Evaluator, Report Writer

Over 16 years experience in power generating facilities. Served in various positions in the engineering, construction, and quality assurance areas at three nuclear and two fossil power generation plants. Served as a consultant to TVA from Stone and Webster Corporation.

Jimmie W. Joyce, Evaluator

Over 11 years experience in TVA's nuclear construction organization as an engineering associate. Served as a surveyor and in other capacities in the Civil Engineering Units at several TVA nuclear sites.

Henry W. Loftis, Evaluator, Report Writer, Peer Reviewer

B. S. in Aerospace Engineering, University of Tennessee. Over 11 years of experience in TVA's nuclear construction organization as an engineer and manager. Served as a technical group leader or unit supervisor in the Mechanical Engineering or Inspection Units at three TVA nuclear sites.

Gary L. Lyles, Evaluator

B. S. in Mechanical Engineering, Memphis State University. Over 12 years experience in TVA's nuclear construction organization as an engineer and manager. Served as a technical group leader or unit supervisor in the Mechanical Engineering Unit at two TVA nuclear sites.

Charles A. Manning, Evaluator, Report Writer, Peer Reviewer

Associate Degree in Mechanical Engineering, Chattanooga State Technical Community College. Over 12 years experience in TVA's nuclear construction organization as a construction engineering associate. Served as a system engineer for NSSS piping systems and equipment. Served as group leader responsible for developing piping support isometrics for all safety-related small bore piping systems at two TVA nuclear sites.

Martha S. Martin, Category Group Head (May 1986 to August 1986)

B. S. in Electrical Engineering, University of Tennessee. Over seven years experience in various TVA nuclear organizations as an engineer and manager. Served in nuclear quality, nuclear safety, and nuclear licensing activities during the majority of the seven years.

Ernest C. McDonald, Evaluator, Report Writer

A. B. in Chemistry, Pittsburg State University. Over 48 years experience in the manufacture, technical development, application, and inspection of paint and protective coatings. Served as a technical group leader in architectural coatings in TVA's nuclear design organization for the past 10 years.

Donald E. Nixon, Evaluator, Report Writer, Peer Reviewer

Associate Degree in Business Administration, Northeast Alabama State Junior College. Over 15 years of experience in TVA's nuclear construction organization in concrete and soils quality control activities. Served as a unit supervisor for five quality control units at Bellefonte Nuclear Plant for the past six years.

William R. Norris, Evaluator

B. S. in Civil Engineering, Auburn University. Over 14 years experience in construction related activities as an engineer and manager. Served in various positions including the Civil Engineering Unit supervisor at Bellefonte Nuclear Plant during the past 11 years.

Donald R. Owen, Evaluator, Report Writer, Peer Reviewer

Over 17 years experience in fabrication and construction activities as a sheetmetal craftsman and engineering associate. Served as an engineering associate in a hanger engineering unit at two TVA nuclear sites during the past nine years.

Gary L. Portwood, Evaluator, Report Writer, Peer Reviewer

Associate in Science, Northeast Alabama State Junior College. Over 12 years in TVA's nuclear construction organization as an associate engineer. Served as a staff documentation coordinator in the Hanger Engineering Unit during the past seven years.

Michael U. Rudolphi, Category Group Head (February 1986 through May 1986)

B. S. and M. S. in Civil Engineering, University of Tennessee. Over 16 years experience in the design and construction programs of several nuclear utilities as an engineer and manager. Served as a project/construction manager for more than seven years at two TVA nuclear sites.

James R. Russell, Evaluator, Report Reviewer

B. S. in Industrial Engineering, University of Tennessee. Over 14 years experience as an industrial engineer in manufacturing and construction applications. Served as an industrial engineer in TVA's nuclear construction organization during the past seven years.

Margaret E. Selewski, Evaluator, Peer Reviewer, Report Writer

B. S. in Chemical Engineering, Tennessee Technological University. Over six years in TVA's nuclear operations organization as a chemical engineer and in preoperational testing activities.

David E. Shelton, Evaluator

B. S. in Business Administration, University of Montevallo. Over 17 years experience as a boilermaker craftsman and craft manager in TVA's nuclear construction organization. Served as a craft manager at Bellefonte for the past nine years.

Michael B. Shirey, Evaluator, Report Writer

B. S. in Civil Engineering, Auburn University. Over four years experience in TVA's nuclear construction organization as an engineer in the Bellefonte Hanger Engineering Unit.

Barry S. Snider, Evaluator, Report Writer

B. S. in Civil Engineering, West Virginia Institute of Technology. Over six years experience as an engineer in TVA's nuclear construction organization in the Watts Bar Hanger and Instrumentation Engineering Units.

William M. Stone, III, Evaluator, Report Writer

B. S. in Engineering, University of Tennessee at Chattanooga. Over six years experience in TVA's nuclear operations organization as an engineer in preoperational testing and instrument maintenance groups.

Wallace L. Sykora, Report Writer, Peer Reviewer

B. S. in Electrical Engineering, University of North Dakota. Over 22 years experience in the nuclear construction industry as an electrical engineer and manager. Served as a consultant to TVA from Daniel Construction Company.

James E. Worthy, Evaluator, Report Writer

Associate in Mechanical Engineering Technology, State Technical Institute in Knoxville. Over five years experience in TVA's nuclear design organization as a Nuclear Licensing engineering associate.

APPENDIX C
SUBCATEGORY REPORT OVERVIEWS

Subcategory 10100 - Soils

The Soils subcategory addresses issues concerning the materials and methods used in backfill operations during the construction phase. At Watts Bar, questions were raised in regard to the ability of the barrier trenches to perform their designed function, which is to protect the soil supporting the Essential Raw Cooling Water intake pipeline from outflow during a seismic event. Other Watts Bar issues concerned the adequacy of the Essential Raw Cooling Water pipelines backfill, the north valve room backfill, the cooling tower blowdown pipeline backfill, the filling of a sinkhole, and low volume waste holding pond dike construction. The lone Sequoyah issue concerned the planned construction of the Dry Active Waste Building on a site that had been filled with random materials left over from various excavation and backfill operations. The concern was that the soil might not be adequate and could cause uneven settling of the building. The issues were all found to be either not factual, factual but not a problem, or factual but previously corrected.

Evaluation of the barrier trenches found that proper materials were used, construction methods were correct, and the trenches are functionally and structurally sound. This finding was corroborated by an outside consultant, Robert L. Cloud Associates, Inc., who conducted an independent engineering review.

Evaluation of the other Watts Bar issues found that backfill materials were correctly used, placed, inspected, and documented in accordance with drawings, specifications, and procedures. The sinkhole in question had already been identified and evaluated by site civil engineering. The cause had been determined and eliminated and the hole had been excavated and refilled with crushed stone prior to the employee concern evaluation.

As a result of a previous evaluation of the employee concern at Sequoyah, the soil structure in the foundation area had been evaluated before construction of the Dry Active Waste Building began. The foundation area had been excavated, backfilled with crushed stone material, and compacted as a result of that evaluation.

Subcategory 10200 - Concrete

The Concrete subcategory addresses issues pertaining to concrete mixes, concrete placement, types of concrete placed, and post-placement condition of concrete. Fourteen issues were addressed with ten applying to Watts Bar, three to Bellefonte, and one to the now canceled Hartsville site. The ten Watts Bar issues concerned water content and lift thicknesses being exceeded, substandard concrete, cracks in concrete, foreign objects/debris embedded in concrete, improper surface preparation, broken concrete edges, the validity of a Nonconformance Report and associated corrective actions related to concrete mortar

patches, inappropriately used epoxy mortar, concrete compressive strength test commitments not being met, and poor concrete pour practices. The three Bellefonte issues concerned allegations of welding machines embedded in concrete, improper concrete curing, and substandard concrete. The lone Hartsville issue alleged that lime (used to control algae on concrete) was not removed before placement of concrete walls on existing slabs. Of the 14 issues evaluated in this subcategory, four were found to be factual. None of these represented conditions adverse to quality, however. Needed corrective actions had already been taken or the condition did not pose a problem.

The issues pertinent to Watts Bar and Bellefonte were all safety-related but were found to be either not factual, factual but not a problem, or factual but previously corrected.

The evaluation found that concrete compressive strength test results were below standards more frequently than was allowed by the specification at Watts Bar and Sequoyah and the sampling frequencies were not always in compliance with the specifications at Watts Bar. Also, bedding mortar was sometimes improperly used and lacked procedural control at Watts Bar.

The Division of Nuclear Construction initiated Nonconformance Reports on the above conditions. The conditions were determined to be significant, resulting in subsequent initiation of Significant Condition Reports. However, comprehensive in-place testing and design evaluations have proven the in-place concrete to be acceptable. Independent consultants (Wiss, Janney, Elstner Associates, Inc.) corroborated these findings.

One side issue surfaced that required a review of the use of epoxy mortar in areas where temperatures may exceed 120°F. A review of Watts Bar pour cards and interviews with knowledgeable personnel identified instances of such use. Corrective actions had been assigned to correct these problems.

Subcategory 10300 - Coating and Paint

The Protective Coatings subcategory addresses seven issues concerning the coatings and paints used on some floors, walls, and welds to reduce corrosion or to aid in decontamination of surfaces that could be subject to radioactive contamination. In general, the issues concerned the quality of applications, maintenance and repair of deteriorating coatings, use of proper materials, and failure to coat some welds. Five of the seven issues were determined to be valid, with four issues requiring corrective action.

Evaluators found some areas where coatings were in need of repair due to cracking or loss of adhesion. Final coats were often too thick, which caused cracking. In some cases, surfaces were inadequately prepared, especially between coats, resulting in loss of adhesion. Corrosion of some uncoated welds was also observed.

Excessive thicknesses were caused primarily by misinterpretation of a thickness chart in the general specification and lack of attention to detail on the part of painters and foremen. Loss of adhesion resulted from failure to follow preparation and application instructions. The failure to coat some welds was caused by misinterpretation of a drawing note at WBN.

Some damaged coatings had been identified and repairs had been initiated or planned before this evaluation. Additionally, applicators and supervisors were being trained on the requirements and procedures governing application of protective coatings.

Line management responses to evaluator recommendations indicated that work in progress and newly revised policies and procedures will provide adequate corrective action for the identified deficiencies. Steps are being taken to protect coatings from ongoing construction damage. Current procedures provide for adequate inspection of coatings and expeditious repair as necessary.

Subcategory 10400 - Embeds

The Embeds subcategory addresses the design of embedded and surface mounted plates used to attach platforms, supports, and such to the walls, floors, and ceilings in concrete structures at all four TVA nuclear plants. The concerns raised issues related to errors, omissions, or incorrect assumptions discovered in previously approved design calculations during 1984 that were not corrected; noncompliance with NRC IE Bulletin 79-02 with respect to baseplate flexibility design considerations; undocumented loads on embedded plates; changes in design philosophy that allowed greater bolt loads for Unit 1 than for Unit 2 at Watts Bar; procedure that permits engineering to approve attachment of "minor loads" to embedded plates based only on visual inspection; failure to reevaluate existing installations following a change in criteria for minimum spacing of anchor bolts from concrete edges; engineering approval of violations of minimum spacing criteria; the adequacy of "hollow" sounding embedded plates; and whether only one or two welded studs are supporting excessive loads on embedded plates that were originally designed to be spanned by surface mounted plates supported by cast-in-place anchors. Three of the seven issues were determined to be factual and required corrective action and the remaining four issues were factual but not a problem.

The evaluation found that the issues involving bolt load allowables, minimum spacing criteria change, engineering approval for exceptions to minimum spacing of attachments to embeds, and "hollow" sounding embedded plates were factually accurate but did not represent a problem or compromise the safe operation of the plant. The generic issue on allowable bolt loads and factors of safety concerning non-compliance with NRC Bulletin 79-02 was identified as factual but TVA had identified and initiated corrective action to resolve these items before this evaluation, with the exception of a specific deficiency on the qualification and use of Rawl (brand name) self-drilling anchors at Sequoyah. A Condition Adverse to Quality Report has been initiated for this item.

Errors in design calculations for plate loading were found at Watts Bar only and corrective actions were initiated as a result of the evaluation. Undocumented loads on embedded plates were found at all plants. Condition Adverse to Quality Reports have been initiated to address these problems. The issue of visual approval of minor loads was not a problem at Sequoyah but required corrective action at Watts Bar. The change in bolt load allowables was proven to be factual for Watts Bar only; however, what was described did not represent a problem.

The issue concerning embedded plates supported only by welded studs was factually accurate at Bellefonte. The original design of this feature included a surface mounted plate spanning the embedded plate and supported by cast-in-place threaded anchors. A Field Change Request to delete the surface mounted plates was approved on condition that outer nuts on the cast-in-place anchors be torqued to snug tight. Torquing the nuts would place the loading on the cast-in-place anchors rather than on the welded studs. However, most of the nuts had not been installed, and those that were installed were not torqued.

Corrective action had been initiated before this evaluation to address the embedded plate designs for pipe supports. Actions already taken included sampling programs for all sites, which provided a 95 percent confidence level that less than five percent of the pipe supports may not meet the intent of Bulletin 79-02. Also, design procedures had been revised to incorporate the Bulletin requirements. Designers had been retrained and drawing notes and procedures had been revised to account for field fabrication and installation tolerances. Watts Bar had reviewed instrument, process pipe, and civil features attached to embedded items to ensure proper documentation existed.

For Sequoyah, the qualification and use of the Rawl self-drilling anchors has resulted in a Condition Adverse to Quality Report being initiated. The issues involving minimum spacing criteria changes, exemptions to minimum plate attachment spacing requirements, and "hollow" sounding embedded plates did not require corrective action. Regeneration of the 5600 (approximate) lost or destroyed calculation packages prior to unit 2 restart will serve to verify that baseplate flexibility has been considered in calculations for surface mounted baseplates using self-drilling anchors.

For Bellefonte, a Nonconformance Report was initiated to document and correct the deficiency of missing or improperly installed nuts on threaded anchors and to evaluate plate integrity where a single welded stud is suspected of accepting the entire load on the plate.

Condition Adverse to Quality Reports were initiated to address baseplate flexibility for cable tray supports and errors in design calculations for Watts Bar.

Collectively, it was determined that NRC OIE Bulletin 79-02 has been open for eight years and remains open at Bellefonte, Browns Ferry, and Watts Bar. In addition, the regeneration of design calculation packages and the Rawl anchor issue are related items being addressed

by Sequoyah. The fact that Bulletin 79-02 remains open after so many years is at least partly attributable to the poor communication that has existed between TVA and the NRC with regard to the bulletin issues.

Subcategory 10500 - Deterioration of Permanent Facilities

The Deterioration of Permanent Facilities subcategory addresses issues associated with architectural features and installed components subject to deterioration during the construction phase. These items are managed under the preventive maintenance programs for plant equipment and facilities. Eight issues were addressed concerning dust in vital electrical control cabinets, rusty conduit, indeterminate instrumentation maintenance requirements, rusty instrument air lines, deteriorated caulking at the Additional Diesel Generator Building at Sequoyah and Watts Bar, water in cable trays, debris in cable trays, and equipment components installed in an underground water source at Bellefonte. Four of eight issues were factual and required corrective action, one issue was factual but not a problem, and three issues were not factual.

Modifications to eliminate dust in the Diesel Generator Building control cabinets at Watts Bar had been planned before the concern evaluation. Rusty conduit was determined to be a minor cosmetic problem at three of the four sites and required no corrective action. The instruments evaluated at Watts Bar were determined to have no apparent physical damage and were being maintained according to the controlling procedures developed through the preventive maintenance program. The issue concerning the rusty instrument air line proved to be factual, but the instrument air line in question had already been identified and replaced before the evaluation. Deteriorated caulking was found at Watts Bar but posed no safety-related problem.

Water and debris were found in cable trays in manholes at Bellefonte but not in cable trays in the powerhouse. Water and debris in manholes had also been previously identified at the other three sites. Housekeeping and preventive maintenance procedures had been scheduled for revision to incorporate inspection requirements for manholes and cable trays. The Operations Category evaluated the cable trays in manholes issue at all four sites also. Their evaluation results were used to develop more detailed corrective action plans. These plans included:

- Evaluate all class IE/CSSC cables and splices for fitness of duty.
- Determine root cause of manhole flooding.
- Determine corrective action to prevent recurrence at all four nuclear plants. This information is addressed in more detail in Operations Category Report 30000.

Subcategory 10600 - Bolting

The Bolting subcategory addresses the adequacy of bolting material and bolted installations. Three issues were evaluated: the use of carbon steel bolts in stainless steel components such as pipe flanges, valve bodies, and pump casings; the adequacy of a borated water tank holddown bolt assembly; and installation of a piping spool piece with only two bolts to hold it in place. One issue was factual requiring corrective action, one issue was factual but not a problem, and one issue was not factual.

At Bellefonte, the piping spool piece in question was being installed and temporarily supported at the time the concern was filed. A further investigation by the Bellefonte safety engineer several weeks later found that the spool piece was adequately bolted in place as a result of normal on-going construction activities.

Investigation of the borated water tank holddown bolt assemblies did not confirm the explicit concerns expressed. Appropriate materials were used and installation tolerances were met. However, a related issue involving the lack of Quality Control documentation on the holddown assembly installation process was identified. These holddown assemblies will be evaluated to ensure they are adequate.

The use of carbon steel bolts in stainless steel bolted connections is a standard, acceptable practice in accordance with applicable codes and standards and is not a problem. Carbon steel and stainless steel are fully compatible. However, industry experience has been that, when joint leakage occurs in a borated water system, carbon steel bolts are susceptible to corrosion by boric acid. Through involvement with an Electric Power Research Institute project concerning bolted joint integrity, TVA had become aware of the corrosion potential in borated water systems. TVA will comprehensively review all bolted connections on the pressure boundary of borated water systems at Watts Bar, Sequoyah, and Bellefonte, determine those connections that require replacement of carbon steel bolts and replace them, and ensure that the design integrity of modified connections is not compromised. Carbon steel bolting will remain installed in those applications where it is either unnecessary or impractical to effect a bolting change-out.

Subcategory 10700 - Instrument Tubing

The Instrument Tubing subcategory addresses five issues associated with tube bending equipment, configuration of Radiation Monitoring System tubing bends, and tubing materials; cleanliness of stainless tubing assemblies; venting of tubing assemblies before or during hydrostatic testing; routing of panel drain tubing, and instrumentation line installation practices. Two of the five issues were factual requiring corrective action, one issue was factual, but not a problem, and two issues were not factual.

The bending issues were associated with the qualification, periodic inspection, and segregation of tube benders and the perception that defective copper tubing materials were being used at Watts Bar. The cleanliness issue was based on two employees' perceptions

that stainless steel tubing was being contaminated by bending machines that were coated with rust, dirt, or grease as a result of being stored in an environment with no cleanliness control. One concern was voiced as a suggestion to use Teflon tape as an alternative thread sealant on tubing connections. The venting issue involved an employee's perception that venting practices at Watts Bar possibly adversely affected system hydrostatic test results. The routing issue pertained to the routing scheme chosen for panel drains in the Unit One Reactor Building raceway at Watts Bar. The installation issue concerned the amount of rework caused by the installation of tubing systems in areas with pre-existing interferences and the installation of incorrect tubing sizes.

Review of each site's tube bending and installation controlling procedures identified weaknesses in the storage and segregation controls in effect before the issue evaluations. Weaknesses were apparent in each site's bending equipment qualification and maintenance methods. Watts Bar completed a sampling program for existing tubing installations, which verified their adequacy. The decision was made to accept all of the unit two tubing bends installed before the current controlling procedures became effective based on the unit one sampling program assessment. The TVA-fabricated benders used to bend 1" and 1 1/2" outside diameter Radiation Monitoring System tubing had been repaired and requalified to make acceptable bends. Evaluation of the "defective" copper tubing issue revealed that hard copper tubing (non-bending quality) was being supplied by vendors. Review of the bills of materials for each site showed that the procurement specifications were worded in such a way that this non-bending quality copper tubing could be supplied by vendors and still be in compliance with contract specifications. Corporate management committed to revise the copper tubing specifications on applicable drawings and bills of material and to train craft personnel at each site in the use of each type of copper tubing. The specification and bills of materials have been revised and training has been completed at all sites. Since hard-copper tubing has been shown to break or crack during operations, and no reports of copper tubing ruptures during construction hydrostatic testing or system operations have been documented, it is concluded that defective hard-copper tubing material is not installed. Copper tubing is only installed in non-QA (nonsafety-related) and non-essential control air systems, therefore, providing no safety functions.

Evaluation of the cleanliness issue revealed that bending equipment storage facilities were deficient at Watts Bar. As a result of the evaluation, the controlling procedure was revised to include control and storage requirements for bending equipment. Cleanliness requirements for bending equipment were also addressed in the procedure revision to prevent stainless steel tubing contamination. Stainless steel tubing for critical systems is cleaned in its installed configuration before system transfer to operations.

A review of the hydrostatic test documentation found that venting requirements for tubing assemblies were included in each test package. Field observations revealed that high point vents were properly installed or that venting could be performed through the process piping associated with the tubing assemblies.

The routing issue evaluation found that panel drains were incorrectly field routed into a floor drain system that was designed to be a closed loop system for retaining water inside the unit one cranewall. The closed loop breach was documented by a Nonconformance Report. The drain lines were subsequently rerouted to open floor drains, as originally designed.

Review of the installation criteria for instrument tubing proved the issue concerning separation violations existing in Watts Bar's Unit Two South Valve Room to be factual. The installation specification required a field evaluation by Engineering to determine final acceptability of tubing installations. It was concluded that the pre-existing interferences were known during installation and the installation program required evaluation at a later date. As stated in the foreword of the applicable engineering specification, "failure to meet these requirements did not necessarily mean that pipe rupture requirements were violated." The issue was determined to be factual but no corrective action was required.

Subcategory 10800 - Structural

The Structural subcategory addresses eight issues involving miscellaneous civil applications such as concrete/masonry wall installations, expansion joint seals, and door installations.

Six Watts Bar issues were raised by allegations that a concrete block wall had cavities in the mortar joints; a hole was improperly made in the floor above the contaminated-laundry room; construction changes to the gatehouse were made on the basis of verbal approval and were not documented; expansion joint seals between the Reactor Building and Auxiliary Building (both units) are leaky and could permit a radioactive spill to leak into the groundwater system; five doors not shown on design drawings were installed and not inspected; and the Auxiliary Building Secondary Containment Envelope test (vacuum test on internal doors) was not valid because personnel sealed the doors with rags until acceptance criteria could be met. Two issues raised at Bellefonte were that rebar and/or insulation may have been omitted during concrete placement for the Essential Raw Cooling Water pipe tunnels and that inadequate methods were used to establish survey control points.

Two of the eight issues were factual and have been or are being corrected. The remaining six issues were not factual.

Evaluation of the Watts Bar issues revealed that the concrete block wall, the hole in the contaminated-laundry room ceiling, the gatehouse, and the five doors were properly installed, documented (where required) and designed for their intended purposes. The leaky expansion joints had been identified and repaired before the employee concern evaluation. In regard to the vacuum testing of doors, rags and such were used only to pinpoint leaks. Appropriate repairs were made and subsequent tests were valid.

At Bellefonte, the section of Essential Raw Cooling Water pipeline in question was not encased in concrete. It was properly insulated, buried in limestone sand or type A backfill up to a foot above the pipe, and covered with a concrete slab, in accordance with the design drawings.

Inaccurate survey control points had been previously identified and corrective actions had been initiated. As inaccurate control points were identified, other engineering units were notified to investigate installed features in the affected areas and take necessary corrective actions. Any future discrepancies identified will be corrected by issuing Nonconformance Reports.

Subcategory 10900 - Cable

The Cable subcategory addresses a wide range of employee concerns about the adequacy of cable installation practices. Issues were raised about improper pulling, splicing, terminations, inspections, fireproofing, maintenance, and damage to cable insulation.

Evaluation of the cable issues revealed significant discrepancies with the potential to impact plant safety. The discrepancies were in the areas of cable pulling, splicing, terminations, inspection, fireproofing, and maintenance.

A significant indeterminate situation was identified with respect to the adequacy of installed cable. Engineering did not establish adequate criteria to control and/or calculate sidewall pressure, maximum pull tension, and minimum bend radius. Sites did not adhere to procedures governing pulling, terminations, and maintenance of cable. Appropriate discrepancy reports have been issued which require engineering evaluation and verification of the adequacy of installed cable and replacement of deficient cable. Completion of this action is required at each site before startup.

Cable splicing was deficient in that incorrect connectors were referenced in the general specification. Also, splices in harsh environments using Raychem heat shrinkable material were not correctly installed. Splices and terminations using Raychem products and completed before December 2, 1985 did not meet requirements as listed in drawings, the general specification, and the manufacturers's application guide. Deficient splices were corrected through field walkdowns and replacement where necessary. The general specification was revised to reference the correct connectors.

Deficient cable terminations were found where lugs designed for use with stranded wire were incorrectly used with solid conductor wire. These terminations were corrected by installing replacement lugs or soldering, as appropriate.

Inadequate inspection of cable occurred when only one inspector was assigned to more than one cable pulling activity at the same time. Site procedures have been revised to prohibit inspection of more than one cable pull at a time.

Evaluation of the fireproofing issue found that some cable coatings were applied thicker than recommended by the manufacturer, sharp instruments were sometimes used to remove cable coatings, procedures for breaching fire barriers had discrepancies, and ampacity losses due to cable coatings had not been determined and considered in the design process. Actions to correct procedural discrepancies in controlling breaching of fire barriers were being taken at WBN and SQN, and corrective measures had been completed prior to ECSP evaluations at BFN and BLN. The effects of cable coating on ampacity were being evaluated and documented.

A discrepancy in cable maintenance was found where debris was able to enter conduits when covers were temporarily removed during construction and modification activities. Site procedures were revised to provide protection of cable when conduit covers are removed.

Subcategory 11100 - Hangers/Supports

The Hangers/Supports subcategory addresses issues pertaining to the installation and documentation of cable trays, conduit, ducts, instrumentation, and pipe supports during the construction phase. Issues were raised about stainless steel pipe contacting carbon steel supports; the adequacy of some designs and design output documents; methods of installing hangers and supports; the condition of installed supports; the availability of craft training on specifications; and the adequacy of hanger inspection documentation. Two of the six issues were factual but not a problem, and the remaining four issues were factual and required corrective action.

The evaluation found several specific deficiencies that appeared to be isolated occurrences. However, three significant programmatic deficiencies were identified.

Design output for hangers/supports displayed a number of deficiencies, including drawings that specified inconsistent support locations, procedures with incorrect bolt tightening requirements, poorly designed typical conduit supports, and lack of design control over field fabricated replacements for vendor supplied parts. These deficiencies indicate weaknesses in the design review program for hangers and supports.

Vertical tube steel sections without cap plates were installed as components of hangers/supports in outdoor areas. These installations could trap water and other debris and could become damaged during freeze/thaw cycles. The requirement for these cap plates should have been included in installation specifications, but no requirements existed. Bellefonte identified the problem and corrected deficient installations. Watts Bar identified the problem and generated a Field Change Request for future installations. Past installations will be corrected in accordance with a nonconforming condition report for unit 1. A walkdown of nontransferred areas in unit 2 was conducted and no problems were identified. Sequoyah did not identify the problem and no installations had been corrected. Once the problem was found at one site, design feedback should have resulted in complete corrective actions at all nuclear sites.

Control of shock arrestors (snubbers) required on design drawings was found to have overall programmatic deficiencies. Snubber installation and protection criteria should have been provided by design. The site organizations attempted to correct the deficiencies by revising site procedures to include snubber installation and protection criteria and requirements. However, the site organizations had not been provided with all the vendor recommendations and could not include them in the site procedures. There should have been a cooperative effort between site organizations and design to provide an appropriate set of installation and use requirements.

Open-ended vertical tube steel sections located in outdoor areas at Sequoyah and Watts Bar that do not have cap plates are being identified and corrected. Engineering is evaluating the field fabricated replacements for vendor parts and performing the necessary calculations. Engineering will identify to Construction those cases that require rework or replacement. Engineering review and resolution of snubber criteria deficiencies is being performed. A review of upper-tier documents, TVA General Construction Specifications, and Pacific Scientific Document Number 141 (Instruction Manual, Installation and Maintenance of Mechanical Shock Arrestors) is being included. Appropriate criteria to govern snubbers will be issued to site organizations upon completion of this process. All four sites are reviewing site procedures for specific deficiencies identified in this subcategory.

Subcategory 11200 - Workplan/Work Control

The Workplan/Work Control subcategory addresses the broad areas of administrative controls, work practices, and procedures governing construction work. Work Control issues were raised by allegations of improper work authorizations and undocumented work; craftsmen doing engineering work; poor work planning and coordination; inadequate verification of completed work; inaccurate and incomplete work packages; and questionable engineering practices. Four of the seven issues evaluated were factual requiring corrective action, one issue was factual and not a problem, and two issues were not factual.

At Sequoyah, discrepancies between fuse specifications on design drawings and fuses actually installed under a specific workplan were verified. However, corrective action had already been initiated as the result of a previous evaluation of the concern.

At Bellefonte, it was found that most work packages were adequately planned. The controlling procedure was in need of revision and it was apparent that engineers responsible for preparing work packages needed to be better trained for the task. Bellefonte construction management committed to revise the procedure and develop a training module on work control and work implementation documents.

Watts Bar work control systems were found to be deficient in several areas. Unauthorized and undocumented work occurred frequently and poor planning and coordination was a major deficiency in the Work Control Program. Work Control procedures were deficient because they did not contain specific guidelines on work package size or content. Large work packages were split between different crews, which caused work control difficulties.

Some work packages were incomplete or inaccurate when issued. Identified areas of unauthorized and undocumented work have been documented on CAQRs that have already been or are being evaluated for any necessary corrective actions.

Watts Bar construction management had recognized significant deficiencies in work control systems and had initiated a major overhaul of the governing site procedure. The revised procedure corrected the deficiencies in work authorization and documentation, planning and coordination, and work package content and control. However, a significant programmatic weakness remained. Management had not identified critical performance indicators for monitoring the effectiveness of the work control program. In response to this finding, Watts Bar construction management committed to develop and implement a procedure titled "Surveillance of Critical Parameters in Work Control." This new procedure will provide for an initial representative sample of the work control program, using recognized statistical sampling methods. Following completion of the sample and resolution of any identified deficiencies, the procedure will be applied as needed to identify and evaluate adverse trends in the work control program.

Subcategory 11300 - Anchorages

The Anchorages subcategory addresses many topics dealing with concrete bolt anchors used to attach many different items to hardened concrete walls, floors, and ceilings in the buildings at all four nuclear sites. The issues were based on contentions that expansion type concrete anchors were inadequate for use at TVA nuclear plants, concrete and/or rebar had been damaged during the anchor installation process, and anchors had been physically altered in various ways to give the appearance of an acceptable installation. Also, concrete expansion type anchors allegedly had been incorrectly installed and tested and were allowed to rust and/or corrode after installation. Five of the six issues evaluated were factual requiring corrective action, and one issue was not factual.

The evaluation revealed deficiencies in upper-tier design criteria and site procedures regarding the tightening of bolts installed in self-drilling expansion shell anchors. Concrete anchor bolt installation and inspection methodology frequently allowed bolt overtightening to occur and remain undetected. Sufficient training was not always given, especially at the craft level, on the applicable bolt tightening criteria.

Upper-tier design criteria did not contain specific requirements to ensure anchor shells did not contact the base plate during proof load testing. However, the necessary methodology to verify lack of contact between the anchor shell and the base plate was a standard recognized practice at each nuclear plant.

TVA's compliance with NRC OIE Bulletin 79-02 requirements was questioned with regard to the acceptability of anchors that had been incorrectly installed and cut off so they would appear acceptable. At Browns Ferry, major programs were in progress to address the requirements of Bulletin 79-02. Concrete anchor inspections were still being performed and deficient anchors were being replaced, repaired and/or qualified. At Watts Bar, the

NRC was satisfied that TVA's design verification work had provided reasonable assurance that there were no Bulletin 79-02 related safety concerns which would preclude issuance of an operating license. However, the NRC required that a 100 percent review of all affected support calculations be performed to provide complete assurance that the requirements of Bulletin 79-02 are met for Watts Bar. At Bellefonte, field inspections have been completed for Bulletin 79-02 requirements. These inspection results have been transmitted to Engineering for evaluation. Due to schedule considerations and manpower assignments, this evaluation has not been completed.

Collectively, it was determined that Bulletin 79-02 remains open at Watts Bar, Browns Ferry and Bellefonte eight years after initial issue. Poor communication between TVA and the NRC contributed to this occurrence as well as TVA's attitude of justifying existing methodology/installations instead of making the changes necessary to satisfy bulletin requirements.

At Sequoyah, it was found that the cumulative effects of cut and/or damaged rebar had not been evaluated. Also, documentation for cut/damaged rebar in specific areas was found to be inadequate. However, this issue was being evaluated from a generic standpoint by the Engineering Category Evaluation Group. Therefore, no further evaluation was performed on this issue by the Construction category.

Corrective actions had already been completed for the majority of the deficiencies and corrective actions were in progress on other identified deficiencies. For the deficiency on concrete anchor bolt tightening, the applicable upper-tier criteria was being revised to clarify and improve bolt installation and inspection criteria. Laboratory tests were to be performed to evaluate the effects of bolt overtightening on the anchor installations. Also, more comprehensive employee training programs were to be implemented. For the deficiency identified on anchor shells potentially contacting the base plate during proof load testing, the applicable upper-tier criteria was to be revised to specifically require pull tests before base plate installation whenever possible and to require shimming of the base plate when through-the-plate proof tests were performed. Also, the Division of Nuclear Quality Assurance will perform a review of documentation for existing installations to evaluate the condition identified by this potential deficiency.

Subcategory 15100 - Damage/Construction Control

The Damage/Construction Control subcategory addresses ten issues concerning component damage during the construction phase. Issues were raised concerning floor drains plugged by debris; sheet metal electrical penetration covers damaged from being walked on; electrical cabinets and open conduits watersoaked during pipe flushing activities; conduits exposed to extreme heat from nearby welding, possibly resulting in cable insulation damage; lack of protection of flex hose connections; potential damage to soft insulation that is frequently walked on; possible damage to electrical cables caused by personnel walking and/or placing tools and building material in cable trays; possible damage to installed

piping; possible damage to instruments and instrument line tubing; and possible damage to valves. Seven of the ten issues evaluated were factual requiring corrective action, one issue was factual but not a problem, and two issues were not factual.

All blocked floor drains had been corrected as a result of preoperational testing. One floor drain had backed up due to a defective level alarm and transmitter in the sump. The sump level transmitters were scheduled to be replaced with a different type.

Some damaged electrical penetration covers were found in the Watts Bar Unit 2 Reactor Building. The damage was documented and scheduled for repair.

Two discolored spots found on conduit at Watts Bar could have been caused by nearby flame cutting. Tests of the cable inside one conduit did not indicate any insulation damage. Cable inside the other conduit was to be pulled back and inspected for insulation damage. A flexible conduit was found to have been damaged from what appeared to be improper grounding of a welding lead. The conduit was repaired by Mechanical Maintenance, and correct grounding of welding leads was re-emphasized at safety meetings.

Electrical cables and cable trays being left uncovered, being used as walkways, and being subjected to potential damage caused by welding operations were factual at WBN and BLN. Poor cable-tray housekeeping had been noted by NRC and was being addressed prior to ECTG evaluation. No damaged cables were found during the evaluation that was the result of the poor housekeeping practices. The potential to damage cable by these abuses were corrected by retraining personnel on pertinent quality control procedures and on the proper protection of cables and cable trays during construction activities.

Bellefonte pipe system flush status control was deficient due to inadequate procedures. The appropriate procedures have been revised.

Instrument line damage has been a problem area requiring constant attention at Watts Bar and, to a lesser degree, at Bellefonte. Watts Bar has initiated several programs to minimize the amount of damage. These programs include caution signs, a new surveillance program, additional protection for vulnerable lines, and communication with employees through safety bulletins, newsletters, and the Employee Involvement Program. At Bellefonte, the problem is minimal but has been given steady attention to further reduce instrument line damage. Construction management has communicated with employees through awareness bulletins, caution signs, and training sessions. Protective devices are used and periodic preventive maintenance walkdowns are being performed.

Two valves at Watts Bar had been damaged by a pry bar used to operate them. The valves had been repaired and subsequent inspection found no indication of a nonconforming condition.

Subcategory 15200 - Housekeeping

The Housekeeping subcategory addresses the day-to-day general cleanliness and maintenance of permanent and temporary facilities. Issues were raised concerning the adequacy of housekeeping practices in permanent plant facilities, the possibility of dust from plant roads adversely affecting parts stored in warehouses, and general deterioration of the temporary construction medical complex. One of the three issues evaluated was factual but not a problem, and two issues were not factual.

Housekeeping in permanent plant facilities was found to be generally adequate and typical for a plant under construction. Dust suppression on plant roads has been adequate. No evidence was found of dust having any adverse effect on equipment in warehouse storage. A leaky roof and deteriorated floor area in the Watts Bar Medical Office had been repaired before the employee concern evaluation.

Subcategory 15300 - Construction Equipment

The Construction Equipment subcategory evaluates construction equipment and tools and their use by construction personnel. Four issues were evaluated in this subcategory with all four being applicable to Watts Bar only. These four issues pertained to unsigned construction scaffold inspection tags, adequacy of a computer system, availability and condition of construction hand tools, and allegedly poor maintenance and condition of construction heavy equipment. Two of the four issues evaluated were factual requiring corrective action, and two issues were not factual.

Although at times there were equipment shortages and some procedural breakdowns, they were matters to be expected during the construction phase. Problems were corrected, when found, by more emphasis being placed on the problems by site management. However, recommended corrective actions to strengthen the scaffold tagging program were provided to Watts Bar site management. The use of a scaffold "hold" tag was implemented into the scaffolding erection and inspection requirements so that a scaffold would not be removed prematurely.

Subcategory 17100 - Mechanical

The Mechanical subcategory addresses issues concerning the mechanical aspects of construction involving valves; heating, ventilation, and air conditioning; mechanical equipment; insulation; and piping.

Issues were raised pertaining to a Class B valve that was installed in a Class A line, orientation and maintenance of Limitorque valve operators, hydrostatic testing of containment penetration vendor welds allegedly not properly performed, a perception that the Essential Raw Cooling Water system was designed to be stainless steel but was not

constructed of stainless steel, and valves that were "rusty on the outside but okay on the inside". Two of the six issues were factual requiring corrective action, three issues were factual but not a problem, and one issue was not factual.

A Significant Condition Report had documented (as a result of the employee concern) the issue of a Class B valve in a Class A line at Watts Bar. The valve was upgraded under an Engineering Change Notice by Kerotest, the vendor. A Class 1 ASME tag was placed on the valve.

The issue regarding Limitorque (brand name) valve operators was found to be factual at Watts Bar and Bellefonte. Programs and procedures did not ensure that all preventive maintenance and storage requirements were met. A number of corrective actions were identified to address specific deficiencies. Generally, the sites will research applicable requirements documents and revise preventive maintenance programs as necessary to ensure that all applicable vendor and TVA requirements are identified and performed.

The issue regarding improper hydrostatic testing of containment penetration vendor welds was factual and a problem at Watts Bar and also was potentially generic to all sites. This condition had been properly documented on a Nonconformance Report at Watts Bar. This evaluation found that neither Sequoyah nor Browns Ferry had addressed this potential condition adverse to quality. A Nonconformance Report had been issued to document and resolve the issue of improper hydrostatic testing of containment penetration welds. This Nonconformance Report had been closed on a use-as-is basis. An additional Nonconformance Report had been issued to further document the cited problem at Watts Bar (both Nonconformance Reports had been generated before the employee concern). At the time of evaluation, the second Nonconformance Report was still open pending hydrostatic testing and proper documentation and agreement between TVA and the Nuclear Regulatory Commission relative to the acceptability of the initial use-as-is disposition. Sequoyah, Browns Ferry, and Bellefonte had been notified of this potential condition adverse to quality; however, only Bellefonte had responded to the Potential Generic Condition Evaluation memorandums at the time of the evaluation.

The issue that the Essential Raw Cooling Water system was designed as stainless steel but not constructed as such was found partially factual and a problem at Sequoyah. Sequoyah had implemented an Engineering Change Notice to change portions of the system piping inside the plant from carbon steel (as originally designed) to stainless steel because of corrosion problems. The change-out was performed on a piece-meal basis as outages and manpower permitted. The actual up-to-date status of the pipe change-out was not reflected on the design as-constructed drawings at the time of the ECTG evaluation. Division of Nuclear Engineering and Sequoyah Modifications were in the process of evaluating the as-constructed piping configuration of both units by walkdowns and analysis. Evaluation of the portion of pipe required for restart has been completed.

The last issue was that Bellefonte construction employees did not have a means, such as the Maintenance Request, for initiating and tracking corrective maintenance of plant equipment. This side issue was developed as the result of a concern stating that some valves at Bellefonte were, "rusty on the outside but okay on the inside." The exterior rust itself was found not to constitute a problem. Bellefonte had taken action to address the inconsistencies in their preventive maintenance programs by assigning the equipment preventive maintenance assessment responsibilities to the appropriate system engineer. Although this was a step in the right direction, it had not been completely implemented at the time of the evaluation, as documented by the deficiencies identified in the subcategory report.

Subcategory 17300 - Instrument Line Installation

The Instrument Line Installation subcategory addresses four issues concerning installation of the lines between termination points. The issues pertained to slope, compression fittings, clamps, and bending of the lines. No evaluations of the termination points (i.e. instruments and origination connection point) or instrument line hydrostatic or pneumatic tests, except for drain and vent lines at Watts Bar, were performed within this subcategory. Employee concerns related to slope, compression fittings, and clamps were evaluated at all four nuclear sites. However, bending was evaluated at Watts Bar only, since the bending issues within this subcategory were characterized as not generally applicable to the other three sites. Subcategory 10700 addresses instrument tube bending issues at all four sites. All four issues evaluated were factual and required corrective action.

Watts Bar, Sequoyah, and Browns Ferry had instrument sensing lines installed which deviated from the minimum slope criteria as specified by the design output documents. Inconsistent requirements were identified during a review of the upper-tier procedures controlling slope parameters. There was inconsistent application of the minimum slope requirements during the installation and inspection processes by construction and quality assurance personnel. Programs in place and scheduled at the three sites for resolving the slope issue failed to consider the effects of Design Basis Accident (DBA) conditions on a sensing line's ability to function throughout all operational modes.

Watts Bar, Sequoyah, and Browns Ferry had installation and inspection procedures which did not adequately implement manufacturer's installation instructions for instrument line compression fittings. The evaluation concluded that installation procedures did not incorporate or reference manufacturers' installation instructions for compression fittings, craft training did not include manufacturers' instructions, and the Quality Assurance organizations did not inspect the installed compression fittings to verify the integrity of the installed configurations.

Watts Bar and Sequoyah had instrument sensing line support clamps inadequately installed. The Browns Ferry project was in the process of implementing a sampling verification program to determine if the clamp issue was applicable to that site. The clamp issue was not factual at Bellefonte.

Corrective action varied between sites due to their differing statuses. Basically, Engineering was to evaluate and correct deficiencies in the design criteria; Construction was to evaluate, identify, and correct the installation of instrument sensing lines according to the revised criteria established by Engineering; craft personnel were to be trained to perform their duties in accordance with revised documents; Quality Control was to inspect to these specified instructions; and Quality Assurance was to monitor and audit the processes to ensure the quality of the program.

Subcategory 19100 - Electrical Equipment

The Electrical Equipment subcategory addresses three issues pertaining to only three types of electrical equipment - control panels, junction boxes, and hand switches. Issues concerning control panels and handswitches were applicable to Watts Bar only while the junction box issue was evaluated at all four nuclear sites. One issue was factual but not a problem, and two issues were not factual.

Discrepancies were found in the "as-constructed" configuration drawings of the 480V shutdown board panels. The configuration discrepancies documented by Watts Bar Nonconformance Report W-205-P showed that terminal block strip labeling and wire labeling did not conform to the existing "as-constructed" configuration vendor drawings available at that point in time. Prior to initiating the Nonconformance Report, there were no site implemented inspection criteria in place to require or control labeling on vendor-supplied equipment wiring. The drawing discrepancies existed, but functional tests had been completed on the control panels. No additional conditions adverse to quality had been identified and the equipment operated as designed. Site procedures for Watts Bar were being revised to incorporate inspection requirements for interface terminal labeling and updating of vendor drawings.

The junction box material substitution issue was found not to be factual. Construction General Specification G-40 identifies galvanized steel as an acceptable junction box material. The issue was evaluated at all four nuclear sites. Procedural clarification was undertaken at Watts Bar, but no corrective action was required at any of the other sites.

The perceived obsolete hand switches questioned at Watts Bar were of the Westinghouse Type W-2 configuration. In 1980, the Nuclear Regulatory Commission issued Bulletin No. IE 80-20. This bulletin identified a shortcoming in the design of the switches that left some uncertainty as to the position of the switch during operation of its controlled equipment. The Nuclear Regulatory Commission gave each utility utilizing the switches an option to either replace or modify the switches.

TVA implemented the modification option at Watts Bar by issuing Engineering Change Notices and adding a position indication circuit to 69 unit one and 33 unit two switches, which met the requirements of the bulletin. The design of the position indication circuit introduced the potential for a false indication problem which was documented by Post

Modification Test Deficiency No. PT-301. The problem had also been identified by the NRC in Bulletin IE 82-01. Engineering Change Notices were issued to modify the circuit for the 28 (total for Unit 1 & 2) switches that were identified to be potentially susceptible to the false indication problem. Sequoyah took the same option and modified their Type W-2 handswitches.

Subcategory 19200 - Conduit and Cable Tray

The Conduit and Cable Tray subcategory addresses concerns pertaining to conduit, conduit fittings and cable tray hardware. Issues were raised about conduit installation methods and materials and possible damage to conduits and cables during installation, installation methods and identification markings of cable tray wall penetrations, and use of solid rather than coated reactive metal conduit fittings in the Reactor Building. Six of the seven issues evaluated were factual requiring corrective action, and one issue was not factual.

The following deficiencies were found with regard to conduit: (1) conduits had excessive bends between pull points, (2) poor quality conduit materials had been received, (3) cable overcrowding had occurred, (4) flexible conduit installations were questionable, (5) deficiencies existed in the good industrial practice of protecting installed conduit. Evaluation of the conduit fitting issue revealed a deficiency related to the control of reactive metals within the confines of the Reactor Building.

The evaluation of the conduit issue revealed three design deficiencies which had the potential to adversely affect each site's reliability and suitability-for-service related to the established requirements. The three deficiencies related to the conduit installation criteria specified by Engineering in the design output document Construction General Specification G-40 or the retroactive (backfit) aspect of those established requirements pertaining to past installations. The question of "backfit" resulted from formerly deficient design output documents. The specific deficiencies noted were: (1) conduits had accumulated bends of more than 360 between cable pull points, (2) conduit overfill occurred because of inadequate routing assignment controls, and (3) flexible conduit installations were questionable in regard to minimum length required to accommodate thermal and seismic movements, minimum bend radius, and the implementation of manufacturer's connector torquing requirements.

Concerns which dealt with the quality of conduit materials were substantiated to varying degrees from site to site. The evaluation identified deficiencies involving the procurement process, receipt inspection, material issue, and installation procedures. Additionally, the employee concern related to conduit cleanliness revealed that an infraction had occurred in the good industrial practice of providing protection to the conduit system when the permanent pull box covers, etc., were removed. This lack of protection allowed dirt and debris to enter the conduit, creating the potential for damage to the cables during pulling activities.

Deficiencies were identified in the existing programs related to the Engineering evaluation of retrofit requirements of newly established or revised criteria related to the past installations of flexible conduits. In addition, programs which were developed to document conditions adverse to quality were neither effective nor accurate in assessing problems for significance or generic applicability. It was also noted that, when problems were identified in the appropriate nonconformance reports, inadequate responses from the affected sites masked or hampered the resolution of the issues identified. In some cases the correction methods specified by Engineering (in response to the problems identified) were inappropriate to ensure consistent, complete, and accurate resolutions. These inadequate correction methods contributed to site procedure violations.

Evaluation of the conduit fittings issue found that Engineering had not effectively controlled or accounted for non-coated zinc reactive metals inside containment. This lack of control and accountability introduced the potential for more hydrogen to be produced within the confines of the containment than was anticipated by the calculation packages prepared by Engineering.

In general, to provide assurance that each site was suitable-for-service (given the established requirements) relative to the installed conduit systems, requests were made for Engineering to evaluate past conduit installations that had the potential to adversely affect the safety of plant operations. In response to the problems identified as excessive conduit bend violations and conduit overcrowding, Engineering was evaluating the entire cable installation program and, in so doing, would effectively address these as well as other similar cable problems. The issue of flexible conduit installations prompted a request for Engineering to perform a complete re-evaluation of the existing installations related to 10 CFR 50.49 (safety-related) equipment and pipe mounted devices that are subject to thermal and seismic movement. Commitment was made by Engineering to thoroughly investigate this issue and establish complete and acceptable guidelines for each site to evaluate and/or qualify existing installations. Commitment was also made by Engineering to identify and rework any deficient conduit systems including flexible conduit installations.

In regard to the backfit issue, the Division of Nuclear Engineering and the Office of Nuclear Power (respectively) were requested to ensure that the proper (backfit) evaluation was performed and documented, and that a clear line of responsibility was established to ensure accurate resolution of those problems identified as conditions adverse to quality. In response to those requests, the Division of Nuclear Engineering revised the appropriate engineering requirements procedures to clearly indicate that the proper retrofit evaluation of all new/revised requirements was required and that this evaluation would be documented. The documentation was required to contain the logical reasoning in support of the actual determination of retroactive application. The Office of Nuclear Power response described the current Condition Adverse to Quality Report program which places the responsibility for the determination of generic applicability of the condition within two organizations and stated that the tracking of those deficiencies would be performed in a single program.

The inconsistencies in the procurement practices related to the quality level of conduit materials and the associated deficient site work controlling procedures were requested to be clarified and/or corrected. The response from Engineering generally imposed more stringent controls for the procurement of conduit materials. This was to be accomplished by deleting the section in the material specification which allowed the waiver of any and/or all of the inspections, tests, or test reports.

Additionally, the appropriate design output document will be changed to require adherence to the revised material specification. In light of those quality assurance requirements, (i.e., documentation) Engineering committed to investigate the industry practice and TVA's specific needs to determine whether further upgrading would be required for conduit procurements. Commitments were made by each affected site to strengthen the appropriate work controlling procedures in an effort to identify defective or suspect conduit materials. Similarly, each affected site committed to strengthen the work controlling procedures (utilized to install conduit systems) to provide added protection of the installed conduit by placing permanent or temporary covers on openings in an effort to prevent dirt or debris from entering the conduit system.

Discussion of the corrective action required to resolve the conduit overfill issue was contained in Subcategory Report 10900, Cable.

To provide a more accurate estimate of hydrogen release inside containment during a design basis event, requests were made for Engineering to implement more stringent controls for non-coated zinc reactive metals and to evaluate the potential effect of an indeterminate amount of die cast zinc conduit fittings within the confines of the Containment Building.

In response, Engineering committed to revise General Construction Specification G-40 to control zinc materials inside the Reactor Building and to utilize TVA specification 21.001 for conduit material procurements to ensure only coated materials were supplied by vendors. A commitment was also made to evaluate or obtain accurate inventories of die cast zinc (reactive metals) inside containment and include their inventory in the hydrogen calculation packages. Additionally, procedures would be developed to describe or control the inventory and/or calculation methods used for future updates of the appropriate calculation packages.