

## **SECTION 4**

### **EMPLOYEE CONCERNS SPECIAL PROGRAM RESULTS**

#### **FINDINGS AND ACTIONS**

This section presents the results of the ECSP's two years of evaluation of the nearly 6000 employee concerns within its scope. It addresses the two basic issues raised by the concerns: (1) the adequacy of TVA personnel practices and policies, and (2) specific aspects of the design, construction/modification, operation, and maintenance of TVA's nuclear plants.

The section is divided into two subsections. Subsection 4.1 presents a discussion of the most significant findings identified in various categories. Subsection 4.2 contains the results of an overall assessment of these program findings conducted by the heads or representatives of each Category Evaluation Group as well as the Manager of the ECSP. Subsection 4.1 lays a foundation at the category level upon which the program-level discussion in Subsection 4.2 is built.

#### **4.1 CATEGORY-LEVEL FINDINGS**

Several technical issues were reviewed at the category level by the Employee Concerns Task Group in the course of its evaluations. A number of these technical issues were considered to be significant because there was extensive analysis, physical modification, or rework required to demonstrate hardware adequacy at the plant sites. The Task Group's review of these technical issues provided part of the basis for the conclusions drawn in the general areas of performance needing improvement discussed later in Subsection 4.2.

The major technical topics evaluated by the Employee Concerns Task Group were, for the most part, not new. These areas of technical weakness had largely been identified earlier by TVA, and many substantial corrective actions had already been identified in the Nuclear Performance Plan and were under way at the time of the Task Group's evaluations. However, in some cases insufficient action had been taken or else planned action had not been aggressively pursued. In these instances, the ECSP evaluations acted as a catalyst to focus more attention on these areas.

The major technical topics fell into either the electrical, mechanical, or civil/structural disciplines, with the electrical discipline having the greatest number of the topics. Table 4.1 provides a listing of the technical areas of concern and the categories where the problems were evaluated. Appendix C, Category Level Overview, provides a brief synopsis of each topic grouped under its discipline. Findings, significance of the findings, and actions are presented in the appendix.

Findings affecting programs and processes also resulted from the evaluations conducted by various categories. Table 4.2 provides a listing of these programmatic areas of concern and the categories where the problems appeared and were evaluated. The table

TABLE 4.1

**MAJOR TECHNICAL TOPICS**  
(SEE APPENDIX C FOR TECHNICAL DISCUSSION)

**ELECTRICAL**

**TECHNICAL CATEGORY**

- CABLE (PULLING, SPLICING, TERMINATION, INSPECTION AND COATINGS)
- CONDUIT
- ELECTRICAL SYSTEM DESIGN
- CALCULATIONS
- SHUTDOWN BOARD VOLTAGE OPERATION

	CO	EN	OP	MC
	*	*	*	
	*	*		
		*	*	
		*		
			*	
	*			
				*
				*
	*	*		
	*			
		*		

**MECHANICAL**

- INSTRUMENT LINE INSTALLATION
- VALVE SUBSTITUTION
- PRESSURE BOUNDARY MATERIAL TRACEABILITY

**CIVIL/STRUCTURAL**

- HANGERS/SUPPORTS
- ANCHORAGE/EMBEDS
- CALCULATIONS

CO = CONSTRUCTION  
OP = OPERATIONS

EN = ENGINEERING  
MC = MATERIAL CONTROL

TABLE 4.2  
PROGRAMMATIC TOPICS

TOPIC	CATEGORY								
	CO	EN	OP	MC	WE	IH	MP	QA	IS
• DEFICIENCY REPORTING, RESOLUTION AND RECURRENCE PREVENTION	**	*	**			*	*	**	
• DEFINITION AND CONTROL OF DESIGN PROCESSES	**	**	**	**				*	**
• CONTROL OF WORK ACTIVITIES	**	*	**		*		**	*	**
• PROCEDURES ADEQUACY AND ADHERENCE	**	**	**	**		*	*	**	**
• PROCUREMENT AND CONTROL OF MATERIAL AND REPLACEMENT PARTS			**	**				**	
• AUDITS AND INSPECTIONS	*		*		*			**	
• DOCUMENT CONTROL/QUALITY ASSURANCE RECORDS MANAGEMENT	*	*		*				**	
• ON-THE-JOB TRAINING	*	*	**	*		*	*	*	

\* IMPLIED OR TO A LESSER DEGREE REFLECTED IN THE RESPECTIVE CATEGORY FINDINGS

\*\* STRONGLY REFLECTED IN THE RESPECTIVE CATEGORY FINDINGS

CO = CONSTRUCTION

MC = MATERIAL CONTROL

MP = MANAGEMENT & PERSONNEL

EN = ENGINEERING

WE = WELDING

QA = QUALITY ASSURANCE

OP = OPERATIONS

IH = INTIMIDATION & HARASSMENT

IS = INDUSTRIAL SAFETY

indicates the extent to which the topic is supported by various category findings. Specific actions either have been or are being taken for the programmatic findings. Appendix C provides a brief synopsis of each topic under the categories in which they appeared. The collective assessment of these programmatic areas is presented in Subsection 4.2.

Findings reflecting upon management and employee job performance resulted from the evaluations of the topics presented in Table 4.2 by the "technical" categories, i.e., Construction, Engineering, Operations, Material Control, Welding, and Quality Assurance. These findings reinforced the evaluation results of the three "non-technical" categories; i.e., Management and Personnel; Intimidation, Harassment, Wrongdoing, and Misconduct; and Industrial Safety.

## **4.2 PROGRAM-LEVEL FINDINGS AND ACTIONS**

Based on the review of the category level findings presented in Subsection 4.1, it was concluded that four general areas of weakness existed in TVA's nuclear program prior to February 1986. The first of these four areas deals with management and employee job performance problems. The other three areas focus on implementation of various programs and/or processes - in particular, the program for reporting, resolving, and preventing recurrence of deficiencies; the design process; and work control systems. The findings and contributing causes for each of these four areas are discussed in this subsection, and the actions, either already taken or in process, to correct the findings and causes are presented.

Most of the broad corrective action programs necessary to address the general areas of weakness presented in this subsection had been previously recognized by TVA and were targeted for improvement in the Nuclear Performance Plan. The assessment herein of the ECSP's findings acknowledges the appropriateness of these actions. However, approximately 1300 specific detailed actions were identified as a result of the program's individual evaluations and subsequent analyses. It is not known for certain how many of these actions would have been identified by other ongoing TVA activities associated with the Nuclear Performance Plan and other independent programs. However, it is believed that a substantial number would have been identified apart from the ECSP. These actions are serving to implement the broad actions of the Nuclear Performance Plan at the working level. As of September 1988, nearly half of these specific actions have been completed, but the remainder are still either under way or planned.

### **4.2.1 Management and Employee Performance**

Problems with management and employee job performance were the major contributors to many of the problems experienced in the TVA nuclear program prior to 1986. Over one-third of the alleged problems voiced by employees and evaluated by the Employee Concerns Task Group dealt with management performance, fairness of personnel policies, and work conditions for unionized employees. The evaluations of these allegations showed that TVA's management practices and

policies in many areas were generally acceptable. However, there were also indications that many line managers (1) did not regard the degree of excellence to which their work activities were performed as being primarily their responsibility, (2) were unknowledgeable or indifferent about established policies, and (3) were inept in employee communications. These evaluations showed that some employees also lacked a commitment to and responsibility for achieving excellence in performance. Findings in the other three general areas of weakness, which deal with technical programs and processes, revealed that problems in management and employee performance were the root causes or underlying conditions leading to many of the problems in those areas as well.

In the following discussion of management and employee job performance, reference is made to the management of quality in work activities. The term "quality" refers to the degree of excellence achieved in day-to-day work performance. Shortcomings in quality may impact the effectiveness with which a work activity is done but do not necessarily mean that the end-product of a work activity is inadequate to perform its intended function.

### Findings

Some TVA managers and their subordinates were inattentive to their responsibility for ensuring the quality of their work activities. Weaknesses in the management of quality were indicated by findings in all areas evaluated by the Employee Concerns Task Group. For example, under the general area of work control systems, there primarily their responsibility, (2) were unknowledgeable or indifferent about established policies, and (3) were inept in employee communications. These evaluations showed that some employees also lacked a commitment to and responsibility for achieving excellence in performance. Findings in the other three general areas of weakness, which deal with technical programs and processes, revealed that problems in management and employee performance were the root causes or underlying conditions leading to many of the problems in those areas as well.

There was evidence of ineffective communication between managers and their employees as well as between functional organizations. Many managers failed to communicate their expectations, the reasons for their actions, or the decisions of higher-level managers with their employees. In addition, in work activities which crossed functional boundaries, there was often a lack of coordination and cooperation between organizations.

The ineffective communications between management and employees was evidenced by isolated incidents of intimidation and harassment in the TVA nuclear organization. Furthermore, there was a perception held by some employees that an environment of intimidation and harassment existed and was widespread.

There were deficiencies noted in some managers' basic management skills. Examples included failure to keep commitments to employees or to properly complete required documentation such as performance reviews and failure to properly implement and enforce established policies in such areas as use of overtime and hiring of personnel. In addition, managers in general did not develop and provide on-the-job training for their employees based on actual job performance requirements and to communicate to the employees the managers' expectations for employee performance. This training should have been conducted in particular for engineers, engineering aides, and supervisors.

### Root Causes

The weaknesses in management and employee job performance discussed above were determined to have resulted from a set of underlying conditions or root causes that existed during the time frame represented by the concerns. It is significant that these conditions had been recognized by the TVA Board of Directors and the Manager of Nuclear Power and that major improvements had been planned and were already underway in accordance with the Nuclear Performance Plan concurrent with implementation of the ECSP's evaluation phase.

The problem with TVA's organizational structure and stability as described in Section 2 was one of the root causes of nuclear management and employee weaknesses. In the various organizational structures used for the TVA nuclear program, lines of responsibility, authority, and accountability were not always clearly defined or communicated. Functional organizations operated autonomously, often in competition with each other, with no unified sense of purpose. The numerous reorganizations did not allow working relationships to become well established and also led to attrition of key personnel.

The second root cause was the ineffective implementation of programs for acquiring, developing, training, and retaining qualified managers. These programs were not able to provide the managerial capability needed to keep pace with the expanding nuclear program. Managers lacking in supervisory experience were placed in job assignments for which they had not been adequately prepared through training or development programs.

A third root cause for the findings in the management and employee area was determined to be a lack of positive and persistent actions among some personnel to ensure tighter controls and more certain adherence to commitments. These habits lay at the foundation of the problems with management for quality as described above. Many personnel either ignored or downplayed the importance of their job performance as it related to various programs, the need for monitoring work activities, and the correcting of problems that were found. There was a general resistance among some personnel to change established work practices that did not conform to applicable standards.

## Actions

Several actions are either planned or under way throughout the Office of Nuclear Power in accordance with the Nuclear Performance Plan to address the findings and root causes in the general area of management and employee problems.

At the time the ECSP was initiated, the TVA Board had already taken the first major action for management weaknesses by bringing in a senior manager to integrate the TVA nuclear program. Under his direction, the managerial staff was consolidated into a centralized organizational unit with each part having defined responsibilities that interrelated to each other. With this organizational structure, progress is being made in eliminating the conflicts in management responsibility, authority, and accountability that previously had existed.

In recognition of the shortage of qualified managers to handle the complex nuclear plant construction and operational programs, TVA has initiated short-term and long-term programs to obtain the needed management competence. In the short-term, TVA has contracted with various companies in the nuclear industry to obtain experienced individuals to serve as TVA managers. In the long-term, TVA has been recruiting and hiring experienced and qualified managers as regular TVA employees. As regular employees have been hired and have demonstrated proficiency, the loaned managers have been gradually phased out.

In addition, a management training and development program has been instituted to upgrade the competence of individual managers. The management training portion of the program includes three new mandatory courses for managers. Each of the courses includes training to enhance both listening and oral communications skills. The management development portions of the program will be functioning by December, 1988. They will include a management assessment and promotability program that will identify, develop, and place employees with exceptional leadership potential.

Greater attention is now being given to the management of the quality function throughout the nuclear organization. Line management oversight and direction of nuclear quality-related activities has increased. Responsibility for the independent verification of various quality assurance activities throughout the Office of Nuclear Power, including those related to engineering, construction, and operation, has been consolidated under the Director of Nuclear Quality Assurance. The Nuclear Quality Assurance Manual has been restructured and revised to provide more effective corporate control of quality assurance activities. Procedures addressing quality assurance activities are being reviewed and revised as appropriate. A nuclear training organization has been established to develop and conduct management and

technical courses in various areas, including the quality function. Additional discussion of corrective actions for the management of quality is provided later in this subsection.

Numerous actions are underway to improve communications between management and employees and between functional organizations. Through the new management training courses discussed previously, TVA line managers' communications skills are being upgraded. The Manager of Nuclear Power is requiring his managers to "walk their spaces" on a regular basis. This action is forcing managers into the workplace and is promoting supervisor/employee interactions. Various aspects of the Employee Communications Program are being used to keep employees abreast of management policies and major events within the Office of Nuclear Power. Also, employee feedback is being gathered through the Employee Concerns Program to assist Office of Nuclear Power management to plan and modify the programs that are improving the nuclear program's work environment.

With respect to the perception held by some employees of a widespread environment of intimidation and harassment, all of the corrective actions described above when taken collectively should help to re-establish employee trust in management and eliminate this perception. In addition, all substantiated occurrences of intimidation and harassment either have been or will be reviewed by the Manager of Nuclear Power. Appropriate disciplinary action either has been or will be taken in all cases, up to and including termination of employment.

As a result of ECSP evaluations, some corrective actions were developed by line managers to address work conditions for unionized employees and fairness of personnel policies. Work rules for craft personnel will be standardized, guidelines will be issued on the use of overtime, and candidates for construction foreman positions will be reviewed by upper management to ensure selections on a fair and impartial basis.

#### **4.2.2 Deficiency Reporting, Resolution, and Recurrence Prevention**

Nuclear utilities are required by federal law to establish measures to ensure that failures, malfunctions, deficiencies, deviations, or other conditions not conforming to applicable quality standards are promptly identified and corrected. In significant cases, these measures are to ensure that the cause of the condition is determined, that action is taken to preclude recurrence, and that such action is documented and reported to appropriate levels of management.

##### **Findings**

Weaknesses were identified in TVA's previous programs for ensuring that conditions not conforming to applicable quality standards, i.e., Conditions Adverse to Quality (CAQ), were promptly identified, documented, evaluated, corrected, and reported to

management in a manner consistent with their importance to safety. These problems contributed to the observations made previously regarding TVA's management of quality in its nuclear activities. However, they did not constitute a complete breakdown in the overall management program and methodology under which TVA's nuclear plants are designed, constructed, and operated. This overall management program and methodology has numerous tiers of protection built into it - such as trained workers, approved procedures, redundant systems, audits, inspections, and tests - to ensure that the plants' operation do not constitute an unacceptable hazard to the public.

The deficiency reporting programs often did not clearly indicate when conditions adverse to quality were required to be identified and documented. For those deficiencies that were identified, there was a tendency to only fix the immediate problems. There was a failure to use these programs as a management tool to detect and correct adverse trends in performance. There were limited determinations of the underlying root causes of problems found and of the potential generic applicability of the problems to other components, systems, structures, procedures, programs, facilities, or plants. As a result, there was an inability to fully close problems. In some instances, even the immediate problems were not fixed as inaccurate reports of corrective action completion were accepted without question by those responsible for ensuring proper corrective action implementation.

At Sequoyah and Browns Ferry Nuclear Plants in particular, personnel tended to address problems that were found by immediately writing work requests to fix the problems without first documenting the problems for evaluation. As a result, short-term actions were provided but line management was not guided by the formal evaluation process into a thought process to determine root cause, generic applicability, and long-term action for problems found. Consequently, determinations were not always made as to whether or not unreviewed safety questions were raised by identified problems and assessments were not always made regarding the requirements for escalating the problems. Also, personnel at Sequoyah and Browns Ferry were not timely in their reviews of CAQ Reports from other TVA sites that had been determined to be generically applicable to Sequoyah and Browns Ferry.

### Root Causes

Several contributing factors were cited for the poor performance noted in the CAQ programs that had been in effect during the time period of the concerns. These factors were in addition to the Management and Employee Performance root causes discussed previously. Multiple corrective action programs had evolved from TVA's Nuclear Quality Assurance Manual requirements, each with its own weaknesses in processes and responsibilities. These multiple programs had not been unified under a single coordinated program, and interrelationships between the various programs had not been clear. Another cause for the weaknesses in this area was the lack of a

strong and persistent management involvement in the CAQ program. Other contributing factors included weaknesses in CAQ program procedures, an attitude that viewed deficiency reports as a negative performance indicator, and the attitude of fixing specific problems without seeking to prevent recurrence of the same or similar problems.

### Actions

In the Nuclear Performance Plan, TVA committed to improving its nuclear corrective action program to provide for (1) tracking of conditions adverse to quality and prompt escalation of those conditions which are not resolved in a timely manner, (2) trending of conditions adverse to quality and analysis of significant negative trends to identify their root causes for corrective action, and (3) analysis of problems at one nuclear plant to identify the need for remedial or preventive action at TVA's other nuclear plants.

In keeping with this commitment, a new CAQ program was implemented as of April 1987 throughout the Office of Nuclear Power. The new program consolidates the multiple procedures in TVA's previous programs, has standard definitions of terms and conditions, and uses standard forms for reporting. This program is focused to assure timely corrective action and to strengthen the steps for determining root cause and generic applicability to other plants. TVA recognized in the Nuclear Performance Plan that this new CAQ program is an ambitious effort to coalesce many programmatic activities and that, as this program evolves, further improvements or adjustments will be necessary.

In March 1988, the Manager of Nuclear Power initiated several temporary measures to further improve the timeliness and effectiveness of the CAQ process. CAQ Reports originated onsite will receive division manager review, as well as an overview by the site director. In the case of CAQ Reports originated in Knoxville or Chattanooga, the review will be made by the branch chief, or equivalent, and will require the concurrence of the division director.

These special reviews by senior management will ensure: 1) that the CAQ Report is written in a manner that clearly addresses the problem; 2) that a qualified individual performs an operability review as soon as possible to determine whether conditions exist that could prevent any safety-related equipment from performing its intended function; and 3) that an adequate generic review is made to determine whether any identified safety issue could affect another facility.

### **4.2.3 Design Function**

The design function (or design process) combines appropriate technical and management processes to systematically document each plant design to confirm design adequacy for purposes of safety analysis, licensing, construction, and

operation. To accomplish these purposes the design output documentation such as drawings, specifications, bills of material, system descriptions, and supporting analysis and calculations must be accurately developed and maintained. There should be clear traceability from design input (e.g., regulatory requirements, design criteria, codes and standards) to the actual physical configuration of the plant after it is built and while it is maintained during the plant's operational phase.

The design function, while controlled by the Division of Nuclear Engineering, involves the coordinated participation of several organizations within the Office of Nuclear Power, including Quality Assurance, Construction, and Operations. Further, the design function includes continuing plant configuration control and reconciliation between design requirements and the as-built plant features throughout the construction and operating phases of plant life.

### Findings

As mentioned in Subsection 4.1 and Appendix C, weaknesses were observed with TVA's design process. The main problems found dealt with adequacy of and conformance with procedures, adequacy of design documentation (particularly calculations), adequacy of the design review process, and timeliness of the field design change process in effectively resolving design discrepancies. These weaknesses taken collectively had contributed to the physical plant features being in conflict with design requirements in some cases.

### Root Causes

The causes for problems in the design process, in addition to the root causes discussed previously in the general area of Management and Employee Performance problems, included weaknesses in design, modification, and maintenance procedure content and implementation. Also, in view of the fact that some undertrained and less experienced personnel did not fully understand and document quality requirements, there was a failure of some managers to recognize their need to exercise more control in establishing and maintaining a design baseline at each of the plants. In addition, some plant operations personnel conducted maintenance and modifications affecting plant design without informing or including Engineering. They did not fully recognize the need for interfacing with Engineering to continue the design process beyond the construction phase and into the operating phase of the plant.

### Actions

Actions to address design process weaknesses and their associated causes either have been taken, are being taken, or are being developed through implementation of the Nuclear Performance Plan and as a result of ECSP evaluations. These actions are contributing to enhanced performance in the management of the design process.

In accordance with the Nuclear Performance Plan, Engineering activities have been centralized within the Division of Nuclear Engineering, and clear and unambiguous lines of authority and responsibility have been established within the division. Engineering support for each nuclear plant has been strengthened through the creation of a project engineering function for each plant to control plant-specific work. The project engineer has direct and close control over the work produced for the project and is responsible for the work's quality. Engineering procedures are being upgraded as part of an overall restructuring of the Office of Nuclear Power procedures system.

The Division of Nuclear Engineering has initiated a corporate-wide Specifications Improvement Program to develop master specifications and project-specific engineering requirements specifications covering construction, modifications, and maintenance of TVA's nuclear plants. In this major program, design requirements are being assessed and site implementing documents are being reviewed and revised as appropriate to incorporate proper technical guidance from newly developed specifications. Major programs are also under way at all sites to verify and establish plant configuration, to reconstruct the design baseline, and to review and evaluate modifications against licensing commitments and design bases.

In addition, a new Engineering Assurance organization has been established which reports to the Director of Nuclear Engineering on all matters other than quality assurance, in which case it reports to the Director of Nuclear Quality Assurance. This organization is responsible for auditing engineering and design activities to verify that design bases are established and that quality requirements are incorporated. Both engineering program audits and in-depth technical audits are conducted by the section. Deficiencies noted during these audits are reported to the Director of Nuclear Engineering and the Director of Nuclear Quality Assurance. The Engineering Assurance organization verifies the implementation of corrective action measures taken in response to audit findings. The Manager of Engineering Assurance has the authority to stop engineering work that does not conform to established requirements.

As a result of the assessment of the root causes of engineering concerns, the Employee Concerns Task Group determined that additional actions were required in three specific areas of performance to strengthen the actions already being taken in accordance with the Corporate Nuclear Performance Plan. These three areas were the design review process, the planning and integration of design activities, and performance measurement methods. Specific CAPs were developed by the line organization for these areas which the Employee Concern Task Group considered to be adequate. An Engineering Work Management System will be developed and implemented that will provide integrated and comprehensive control and support of engineering work. It will ensure that the necessary controls are in place to define, plan, schedule, estimate, budget, monitor, report, and direct the completion of

engineering work. Also, the line organization will be addressing the design review process and performance measurement methods by (1) defining design review scope and responsibilities, (2) adding methodologies for measurement of design output quality, and (3) requiring feedback from design output document users to design document preparers.

#### **4.2.4 Work Control Systems**

The term "work control systems," as used in this report, refers to the planning, coordination, execution, review, and verification of results of various Engineering, Construction, and Operations work activities. It includes work performed under design change requests and construction work packages, modifications performed under maintenance work requests, as well as regularly scheduled surveillances and inspections.

##### **Findings**

Instances of ineffective work control were noted throughout the nuclear organization. Weaknesses were identified in work planning and execution. There were times when communications and coordination were lacking between functional groups engaged in similar work activities. In some cases, work practices were permitted which were in direct conflict with formal training given to employees. Procedures at times were incomplete or did not contain sufficient detail to permit satisfactory task completion. Also, there were indications of a general attitude that strict procedural compliance was not necessary. However, the most significant work control weakness dealt with the closeout process for review of work results. TVA did not consistently verify and document that the end product of work programs and processes satisfactorily met specifications and regulations.

At Watts Bar Nuclear Plant, in particular, work that had been accomplished in earlier days of construction was found to be acceptable overall, but the documentation of that work had been poor when compared with today's nuclear industry standards. Current line management at the plant was found to have been knowledgeable of these past documentation problems and to have begun making improvements in reviewing and documenting work results. The Employee Concerns Task Group determined that some weaknesses in work control still exist today at Watts Bar, but to a lesser degree than before due to the steps being taken towards improvement.

##### **Root Causes**

Several major factors were found to have contributed to weaknesses in work control systems. There was a lack of guidance in TVA Standards, Policies, and Directives for several nuclear programs, such as Work Packages, Work Requests, Work Plans, and Maintenance Requests, and this had contributed to a lack of planning of work under

these programs. Monitoring and trending programs were lacking, thereby inhibiting the systematic control of work activities. Some implementing instructions for maintenance and construction work activities did not contain sufficient detail to enable work tasks to be performed correctly. There was an attitude among some managers and employees that strict adherence to procedures was not always necessary for performance of work. Lack of specialized training in certain work procedures and processes led in some instances to poor quality of work and to lack of uniformity in applying certain standard work processes.

### Actions

Through implementation of the Nuclear Performance Plan, weaknesses in planning, coordinating, executing, and monitoring work activities and in reviewing work results are being addressed. TVA has created a corporate-level Planning and Financial Staff to develop a consistent approach to planning and scheduling the work activities of TVA's various nuclear departments. The staff will conduct periodic assessments of nuclear sites and headquarters departments to verify that the implementation and execution of planning and scheduling programs are effective and consistent with corporate policy and direction. Through expansion of the corporate nuclear performance reporting system, key nuclear indicators are being collected for trending and analysis by the appropriate nuclear headquarters technical staff. Nuclear operations, maintenance, and surveillance procedures are being upgraded at all sites, and compliance with procedures is being enforced at all levels of the nuclear organization. A corporate nuclear maintenance staff has been created to oversee all nuclear maintenance activities, including the trending and analysis of equipment performance and maintenance history.

Prior to the ECSP evaluation, Watts Bar construction management had recognized significant problems in work control systems and had initiated a major overhaul of the governing site procedure. The revised procedure corrected the problems in work authorization and documentation, planning and coordination, and work package content and control. However, management had not identified critical performance indicators for monitoring the effectiveness of the work control program.

As a result of the ECSP evaluations, Watts Bar has committed to develop and implement a procedure for monitoring and trending the work control program. 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 problems, the procedure will be applied as needed to investigate adverse trends in the work control program.

## **SECTION 5**

### **STATISTICAL INFORMATION - SUPPORTING RESULTS**

This section pictorially presents and discusses data that were assembled at the conclusion of the ECSP for analysis. The information as portrayed in the various pie charts and bar graphs relates to the distribution of concerns, evaluation findings (deficiencies), and actions among the various categories, TVA site locations, and organizations responsible for taking action. The data assisted the Employee Concerns Task Group in confirming conclusions regarding significant problems at the time of the concerns, the distribution of problems at the various sites, and the types of actions being taken to fix problems.

Specific disciplinary actions taken for the isolated substantiated occurrences of intimidation, harassment, wrongdoing, and misconduct were administered and tabulated separately from all other actions resulting from the ECSP; therefore, these specific findings and actions are not reflected in the data presented in this section. Information on these specific findings and actions is presented in the Intimidation, Harassment, Wrongdoing, and Misconduct category. In addition, the broad findings and actions necessary to correct the root causes in the Intimidation, Harassment, Wrongdoing and Misconduct category were generally encompassed by the findings and actions of the Management and Personnel category. Therefore, the Intimidation, Harassment, Wrongdoing, and Misconduct category is not specifically depicted in several of the figures in this section.

#### **5.1 MANAGEMENT AND EMPLOYEE RELATIONS**

Figures 5.1 and 5.2 on page 5-2 portray the distribution of concerns and evaluation findings among the various categories. It can be seen from Figure 5.1 that nearly half of the concerns voiced were personnel-related, i.e., they fell into either the Management and Personnel category or the Intimidation, Harassment, Wrongdoing, and Misconduct category. The fact that there was such a large number of these concerns was at least circumstantial evidence that employees were dissatisfied with TVA management performance prior to February 1986. Although the evaluations revealed many areas in which management performance had been good, the need for significant improvements in some managers' basic skills, practices, and knowledge was indicated.

The number of actions for the Management and Personnel and Intimidation and Harassment categories were few when compared to the technical categories, but the actions themselves were broad and were directed at all levels of management. Figure 5.3 on page 5-3 shows that there were no actions for the Management and Personnel category directed at any of the sites. All actions for the category, though relatively few in number, required the attention of corporate management as depicted in Figure 5.4 (page 5-4). They were directed to TVA nuclear headquarters for resolution and dissemination throughout the nuclear organization.

FIGURE 5.1

DISTRIBUTION OF CONCERNS BY CATEGORY

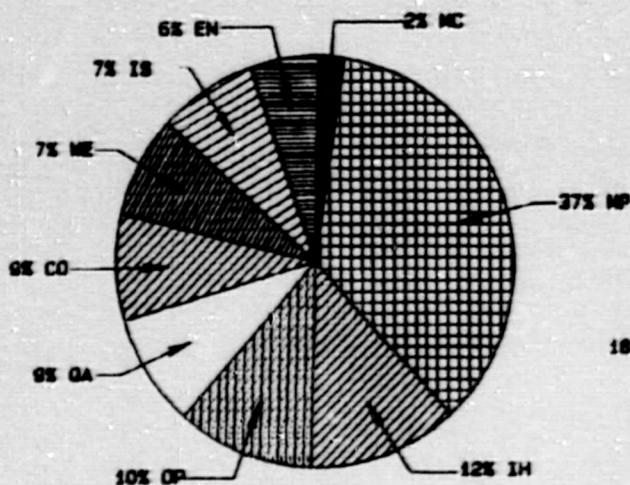
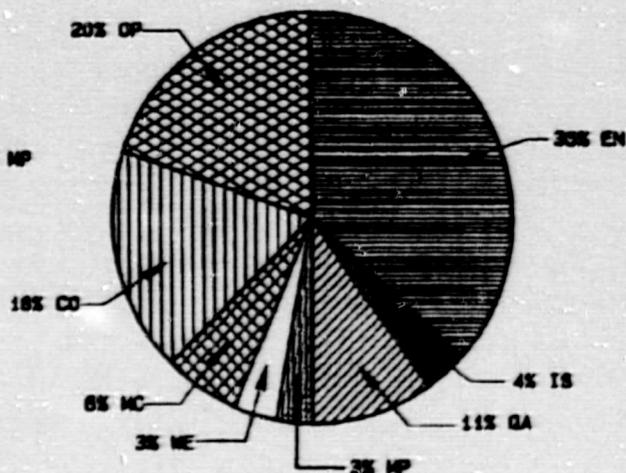


FIGURE 5.2

DISTRIBUTION OF FINDINGS BY CATEGORY



CO - CONSTRUCTION  
 MC - MATERIAL CONTROL  
 MP - MANAGEMENT & PERSONNEL

EN - ENGINEERING  
 ME - WELDING  
 QA - QUALITY ASSURANCE

OP - OPERATIONS  
 IH - INTIMIDATION & HARASSMENT  
 IS - INDUSTRIAL SAFETY

## 5.2 NATURE OF ENGINEERING PROBLEMS

Figure 5.3 shows that the greatest number of deficiencies at the sites resulted from evaluations in the Engineering, Operations, Construction, and Quality Assurance categories. Therefore, it is not surprising to find in Figure 5.5 on page 5-5 that the Divisions of Nuclear Engineering, Construction, and Operations were the organizations responsible for taking the most actions.

From Figure 5.2 (page 5-2) it can be seen that the Engineering category evaluations resulted in nearly twice as many findings of deficiencies as any other category's evaluations. Thirty-five percent of the findings in the program resulted from Engineering category evaluations while the second highest percentage of findings was 20 percent in the Operations category. Figure 5.3 shows that the number of Engineering category findings at each site was greater than those for any other category at each site. This is not surprising since TVA's engineering organization was responsible for the design of each plant. A look at Figure 5.4 above, however, shows that the Engineering category did not have the greatest number of non-plant-specific findings. These observations taken collectively indicate that, although Engineering category findings were greater in number overall than any other category's, these findings were mostly adjustments needed to the technical corrective actions at the sites.

FIGURE 5.3

DISTRIBUTION OF SITE FINDINGS REQUIRING ACTION (BY CATEGORY)

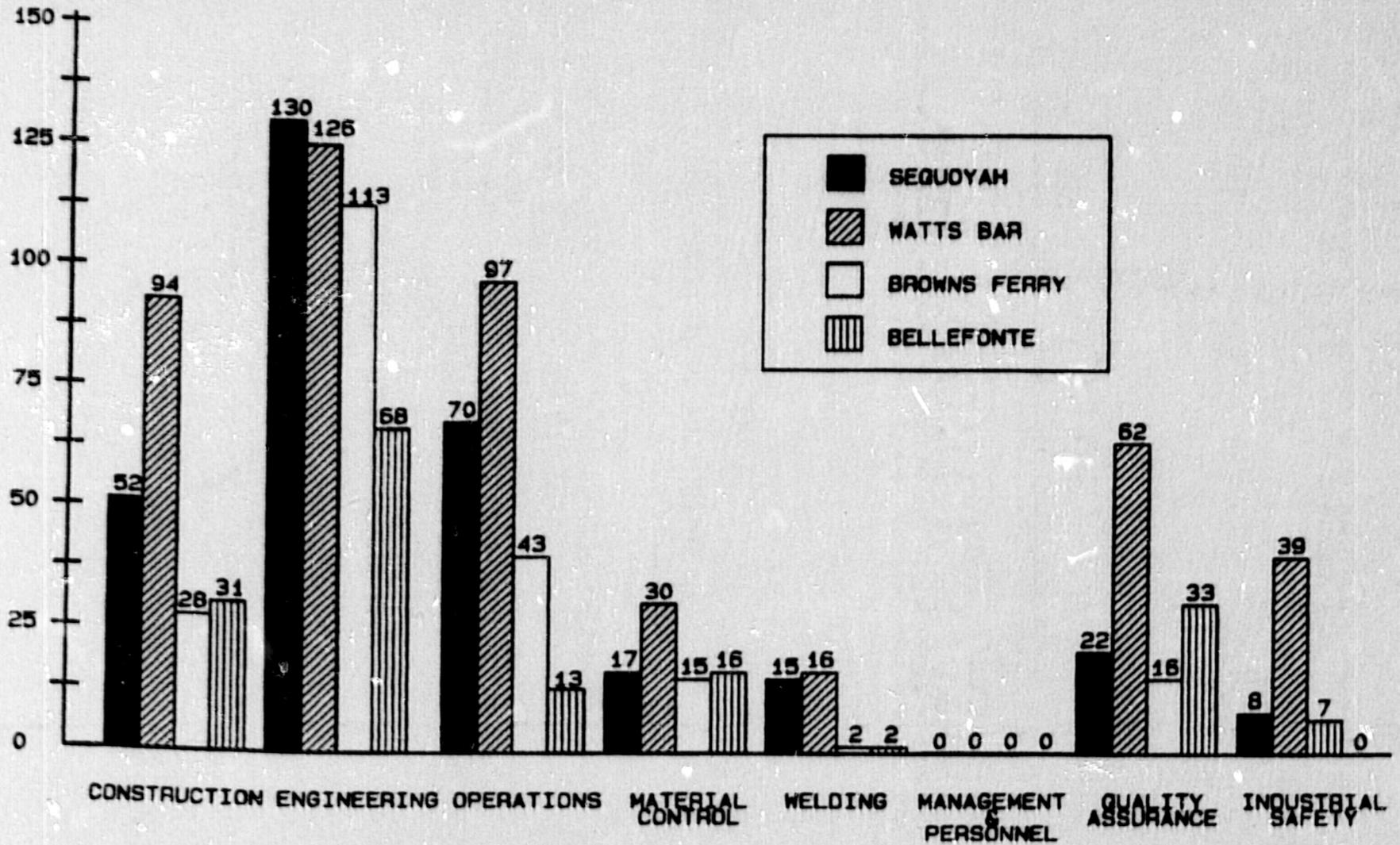
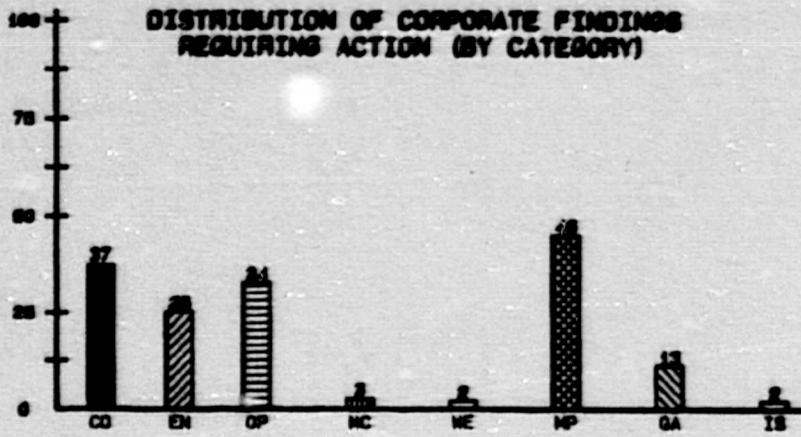


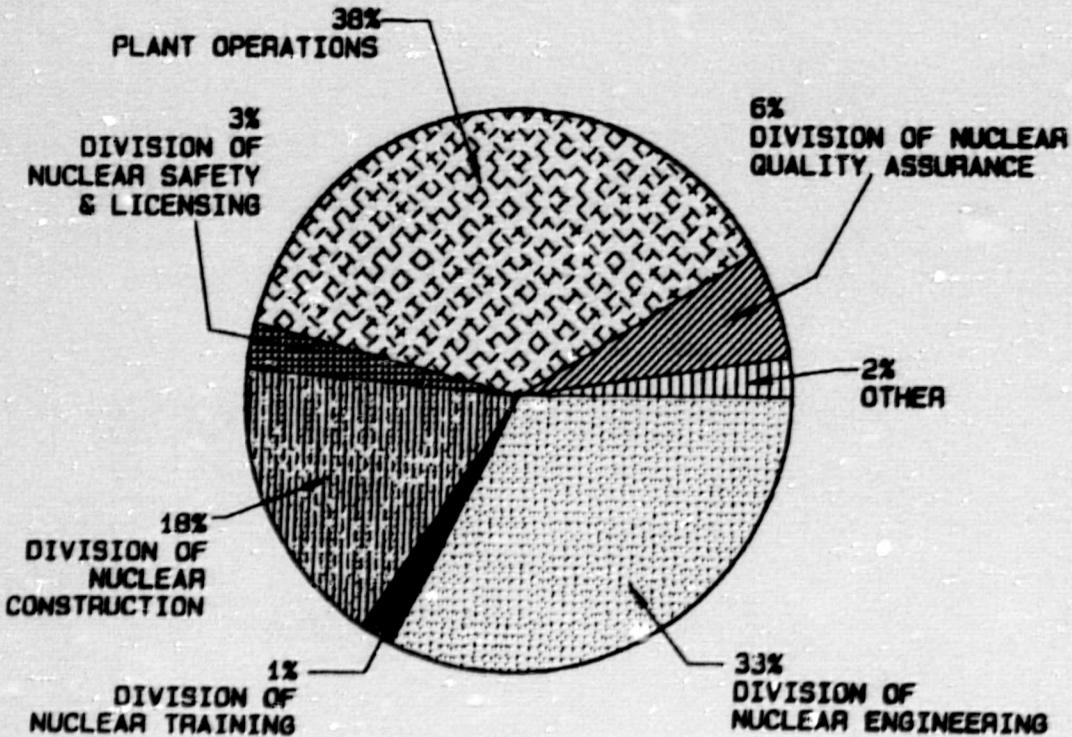
FIGURE 5.4



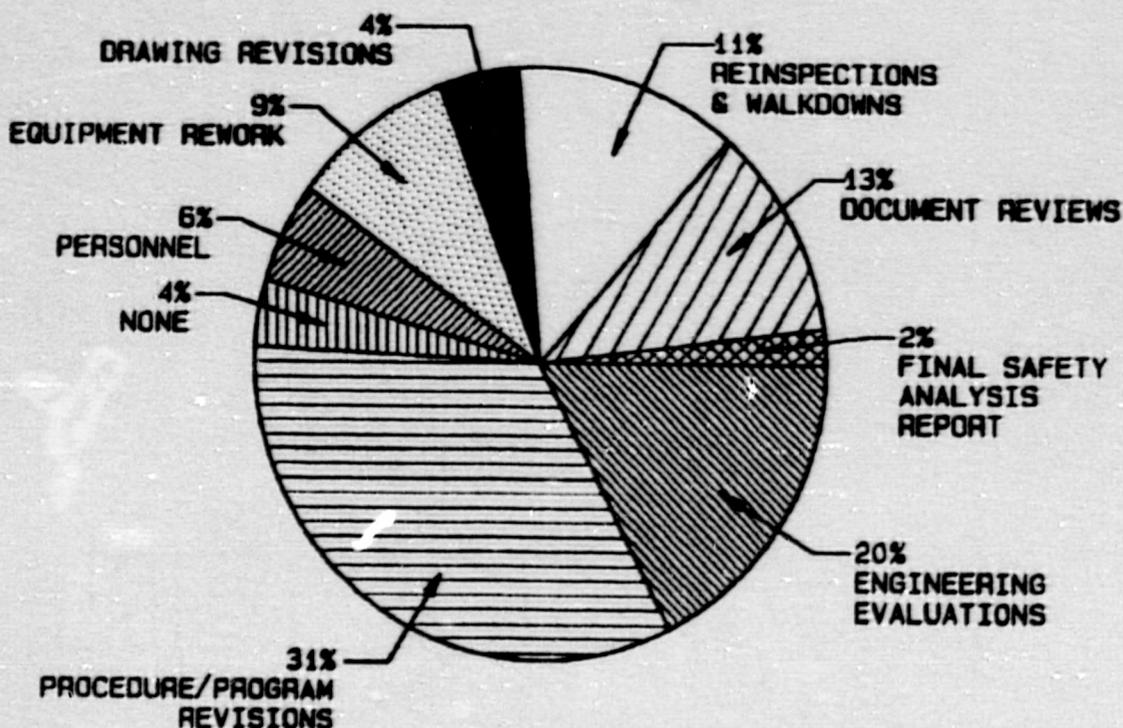
CO - CONSTRUCTION      EN - ENGINEERING      OP - OPERATIONS  
MC - MATERIAL CONTROL      ME - MELDING      IH - INTIMIDATION & HARASSMENT  
MP - MANAGEMENT & PERSONNEL      QA - QUALITY ASSURANCE      IS - INDUSTRIAL SAFETY

FIGURE 5.5

**DISTRIBUTION OF ACTIONS BY RESPONSIBLE ORGANIZATION**



**FIGURE 5.6  
DISTRIBUTION OF ACTIONS  
BY TYPE OF ACTIONS REQUIRED**



In fact, the preponderance of findings in the Engineering category related to weaknesses in the design process and in the technical adequacy of the design output of which TVA was already aware at the time of the Task Group's evaluations. However, as can be seen in Figure 5.6, 20 percent of the corrective actions for all categories involved the performance of engineering evaluations, and many of those evaluations are still under way. The results of those evaluations could identify new areas of weakness of which TVA was not previously aware. However, based upon the results of the Employee Concerns Task Group's evaluation effort to date, it is judged that this is unlikely.

### 5.3 TYPES OF ACTIONS

Figure 5.6 above depicts the types of actions being taken by the line organizations to fix problems found by the ECSP. It is significant to note that many of the actions to date involve reviews and revisions of procedure programs, drawings, and other documents and that most are not causing changes to physical plant hardware. Currently, only 9% of the actions are resulting in equipment rework. Some of these plant hardware changes are minor and include corrections to items such as pipe clamps and electrical terminal lugs. More extensive rework was required for instrument lines, cables, and hangers. Ongoing engineering evaluations, reinspections, and walkdowns could cause the percentage of hardware changes to rise. However, based on findings to date, it is reasonable to conclude that there is relatively minor potential for discovering additional serious deficiencies related to employee concerns.

## SECTION 6 CONCLUSION

The evaluation of the approximately 6000 employee concerns within the ECSP's scope confirmed that TVA's nuclear program prior to February 1986 did have some management and organizational inadequacies, some general weaknesses in implementing various programs and processes, and some technical problems. The majority of these various weaknesses fell within the bounds of the broad actions described in Revision 4 of TVA's Revised Corporate Nuclear Performance Plan, dated March 1987. As a result of ECSP evaluations, TVA line management developed approximately 1300 specific, detailed CAPs that are implementing at the working level some of the actions in the Nuclear Performance Plan. As of September 1988, nearly half of the 1300 CAPs have been completed, and the balance are either being worked or being planned based on project requirements.

Over three-fourths of the nearly 6000 employee concerns evaluated either were not substantiated, were not a problem requiring action, or were already being addressed by line management prior to the evaluation. Employing a conservative approach, TVA identified approximately 1300 specific actions as a result of ECSP evaluations; however, the majority of these actions did not require physical changes to the plants. A substantial number of the actions involved document reviews, clarifications, and revisions. A small number of the actions had a greater impact in that they resulted either in physical plant rework or in management policy changes throughout the organization.

Regardless of the relative impact of the actions, concerns that led to some type of action as a result of the ECSP evaluations were considered in the assessment of root causes of problems. Therefore, each of these concerns played a part in helping to identify root causes and actions that would preclude recurrence of similar problems.

The overall, multi-tiered management program and methodology by which TVA's nuclear plants were designed, constructed, and operated was generally effective in accomplishing its intended purposes. Although specific problems were found by the Task Group in various practices and activities of the TVA management system, there were and are sufficient checks and balances in the system to offset these individual problems and to avoid any condition constituting an unacceptable risk to the health and safety of the public. Examples of the numerous management practices and activities that were implemented in the several tiers of the TVA management system to provide the necessary checks and balances included 1) a broad-based training program for workers; 2) written procedures, reviewed and approved by affected organizations and personnel; 3) extensive inspection and testing programs for plant materials, parts, components, and systems; 4) overviews by line managers as well as by an active and independent quality assurance organization; and 5) redundant systems and equipment to act as backup in the event of operational malfunctions.

Nearly half of the concerns questioned the adequacy of TVA personnel policies and practices. The evaluation of these concerns revealed that TVA's management practices and policies in many areas were generally acceptable. However, there were occasions where the manner in which management had implemented some of its policies justified many of the concerns and required some specific actions to be taken. Many line managers during the period when the concerns were voiced (1) did not regard the degree of excellence to which their work activities were performed as being primarily their responsibility, (2) were unknowledgeable or indifferent about established policies, and (3) were inept in employee communications. The root causes of the management weaknesses identified by the Employee Concerns Task Group had been recognized by the TVA Board of Directors and the Manager of Nuclear Power, and major improvements had been planned and were already under way in accordance with the Nuclear Performance Plan concurrent with implementation of the ECSP's evaluation phase. As a result of ECSP evaluations, further actions were initiated in the areas of work conditions for unionized employees and fairness of personnel policies.

Various procedural problems and technical errors that reflected poorly on TVA's management of quality in its work were found by the Employee Concerns Task Group. In many cases the problem observed was inadequate documentation, and this lack of documentation had caused confusion and regulatory conflicts. As for those technical areas determined by the Employee Concerns Task Group to require improvements, many of the areas had substantial actions in place at the time of the ECSP evaluations. In a few cases, the Task Group identified areas where greater attention was required to address the problems. Bringing these areas to the attention of line management led to the development of CAPs that will institute the necessary changes.

The evidence did not indicate that TVA had willfully allowed cost and schedule to override safety and quality considerations or that safety and quality had been compromised to the extent that the health and safety of the public could not be reasonably assured. However, managers may have succumbed to cost and schedule pressures on occasion without realizing that work quality might suffer as a result.

The Employee Concerns Task Group found that the Nuclear Performance Plan covered most of the root causes of the concerns evaluated under the ECSP. This fact provided added confidence in the overall adequacy of the Nuclear Performance Plan as TVA's road map to its nuclear program recovery. There were some relatively minor areas noted where action in the Nuclear Performance Plan was either less than fully adequate, unclear, or missing. However, these areas were brought to the attention of the appropriate manager and adequate actions were developed.

Benefits have been derived from completion of the ECSP's evaluation and reporting phases; however, the program objectives will not be fully achieved until the line organization implements all of the identified actions. As of September 1988, nearly half of the approximately 1300 specific actions have been completed, but the remainder are still either under way or planned. TVA must continue to close out each of these actions to ensure that

a standard of excellent work performance is achieved and maintained and to resurrect the pride and respect that was once a symbol of TVA's accomplishments. The Nuclear Performance Plan's implementation is essential since many of the ECSP concerns are being addressed by the plan.

It is anticipated, as implementation of actions progresses, that TVA will learn more details about the problems being fixed and that appropriate changes in action may be required. A program has been established for monitoring all CAP commitments made by the line organizations in response to ECSP findings. This program will review changes to original commitments and will ensure that any such changes are consistent with the original objectives.

A final point should be made regarding the standards of excellence for which TVA must strive as it continues its nuclear program restoration. A review of the work standards in the nuclear industry within the last decade reveals a trend whereby expected levels of performance have continued to be more demanding. In view of this trend, TVA should be careful not to be content with standards of excellence that are merely sufficient to meet today's nuclear industry standards. Instead, TVA must be prepared to meet or exceed the more stringent work performance requirements of the future.

Overall, the Employee Concerns Task Group concluded that completion of the specific actions identified by the program and continued adherence to the numerous actions outlined in the Nuclear Performance Plan should lead to correction of the problems identified within the scope of concerns evaluated by the Task Group. The correction of these problems in turn will play an important part in TVA's overall effort to restore its nuclear program to normal operations.

## **SECTION 7**

### **BENEFITS OF EMPLOYEE CONCERNS SPECIAL PROGRAM**

With the submittal of this report, TVA has fulfilled the commitments made to its employees and the NRC for the ECSP with the exception of full implementation of identified actions. In meeting these commitments, TVA has concluded an effort that, for a program of this type, is unprecedented in magnitude in the history of the nuclear industry.

TVA has realized many benefits from completing the evaluation and reporting phases of the ECSP. First, and most important, TVA obtained a valuable source of information on conditions that needed correction. The Employee Concerns Task Group took a group of concerns of varying degrees of detail and covering diverse areas and produced an itemized worklist of approximately 1300 actions which can be tracked to completion in a systematic and orderly manner. The program provided a framework within which TVA could address alleged technical inadequacies at all sites and in a consistent manner where appropriate. The program also provided an additional means for determining whether or not the Nuclear Performance Plan is adequately addressing all areas of needed improvement in the TVA nuclear program. Along with the Nuclear Performance Plan, the program provided a documented benchmark for assessing future safe plant operating status. In addition to these technical benefits, a foundation has been laid for employee confidence in management to be strengthened because all employee concerns voiced prior to February 1986 have been clearly and positively addressed in an open forum. It is anticipated that employees henceforth will be less likely to harbor their concerns and more willing to pose their questions to management. In particular, employees who served as evaluators in the ECSP will return to their former supervisors more knowledgeable and inquisitive. Also, supervisors and managers will be more alert to establish and maintain open channels of communication with employees. On the whole, completion of the evaluation and reporting phases of the program lent further credibility to TVA's documented commitments to develop and implement an effective overall nuclear power program.

## **SECTION 8 RECOMMENDATIONS**

Although three general areas of weakness dealing with implementation of various programs and processes have been targeted by the Nuclear Performance Plan and were observed by the Employee Concerns Task Group to be undergoing improvement, greater management and employee attention and more aggressive actions are still recommended. Weaknesses still existing in each of the three areas, as well as with management responsiveness to problems, are described below:

- **Corrective Action Process - Conditions Adverse to Quality Reports** are still not being written in a manner that clearly defines the problem. Qualified individuals are not performing an operability review as soon as possible to determine whether conditions exist that could prevent any safety-related equipment from performing its intended function. There needs to be increased attention given to ensuring that actions taken are effectively implemented.
- **Design Process** - There continue to be errors in design output documents and weaknesses in integrating design requirements into implementing documents such as specifications and instructions. These continuing problems reflect adversely on the ability of the design organizations and of the independent review processes to effect measures that preclude design errors.
- **Work Control** - There continue to be errors in work documentation and in adherence to procedures. These indicate a need for a greater commitment on the part of managers and employees to achieve excellence in the day-to-day details of work activities. Less than fully effective reviews of work results continue to allow a perception to exist that less than full compliance with procedures is acceptable. Weaknesses still exist in planning, coordinating, executing, and monitoring work activities.
- **Management Responsiveness** - In addition to the observations above on implementation of programs and processes, a point should be made regarding responsiveness of management in addressing problems. There needs to be improvement in the timeliness with which line management plans and implements actions for problems. Also, actions that are planned and implemented need to directly and accurately address the problems.

In taking more aggressive actions for the general areas noted above, TVA should establish an overall performance monitoring system throughout the Office of Nuclear Power with criteria that allow quantitative measurement of progress being made in these general areas. Such an overall system should be comprised of a network of lower-level performance

monitoring systems developed and used by appropriate line managers. The lower-level systems should contain specific performance measurement criteria for line managers to monitor the specific areas of work performance that fall within their own scope of responsibility and within the overall bounds of the general performance areas listed above.

## **APPENDIX A**

### **PROFILES OF 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, 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. McGuffly\* (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.

**APPENDIX B**  
**RESUME OF WILLIAM R. BROWN, JR.**  
**MANAGER, EMPLOYEE CONCERNS TASK GROUP**

**WORK EXPERIENCE**

APR 88 - PRESENT	VICE PRESIDENT, NUCLEAR CONSTRUCTION, TVA
JAN 87 - APR 88	MANAGER, EMPLOYEE CONCERNS TASK GROUP, TVA
OCT 86 - JAN 87	ACTING DIRECTOR, NUCLEAR CONSTRUCTION, TVA
MAR 86 - OCT 86	DEPUTY DIRECTOR, NUCLEAR CONSTRUCTION, TVA
OCT 85 - MAR 86	PROJECT MANAGER, WATTS BAR NUCLEAR PLANT, TVA
MAR 82 - OCT 85	PROJECT MANAGER, BELLEFONTE NUCLEAR PLANT, OFFICE OF ENGINEERING DESIGN AND CONSTRUCTION, TVA
FEB 80 - MAR 82	ASSISTANT MANAGER, OFFICE OF CONSTRUCTION, TVA, KNOXVILLE
AUG 78 - FEB 80	CONSTRUCTION ENGINEER, DIVISION OF CONSTRUCTION, TVA, HARTSVILLE NUCLEAR PLANT
MAR 77 - AUG 78	ASSISTANT CONSTRUCTION ENGINEER, DIVISION OF CONSTRUCTION, TVA, HARTSVILLE NUCLEAR PLANT
MAY 76 - MAR 77	SUPERVISOR, ELECTRICAL ENGINEERING UNIT, DIVISION OF CONSTRUCTION, TVA, HARTSVILLE NUCLEAR PLANT
APR 73 - MAY 76	SUPERVISOR, INSTRUMENTATION UNIT, DIVISION OF CONSTRUCTION, TVA, BROWNS FERRY NUCLEAR PLANT
JUL 70 - APR 73	ELECTRICAL ENGINEER AND INSTRUMENT ENGINEER, DIVISION OF CONSTRUCTION, TVA, BROWNS FERRY NUCLEAR PLANT

MAR 68 - JUL 70 RESEARCH ENGINEER, THE BOEING COMPANY, CAPE  
KENNEDY, FLORIDA

NOV 66 - FEB 68 FIELD ENGINEER, CHRYSLER CORPORATION, CAPE  
KENNEDY, FLORIDA

NOV 65 - NOV 66 FLIGHT TEST ENGINEER, GENERAL DYNAMICS  
CORPORATION, CAPE KENNEDY, FLORIDA

EDUCATION

B.S. ELECTRICAL ENGINEERING, TENNESSEE TECHNOLOGICAL UNIVERSITY

## APPENDIX C CATEGORY LEVEL OVERVIEW

This appendix summarizes the most significant quality findings identified in various categories. Two groups of findings are presented: (1) those major technical findings that impact plant hardware adequacy, and (2) those findings dealing primarily with programs and processes.

### MAJOR TECHNICAL FINDINGS

The major technical findings evaluated by the Employee Concerns Task Group are presented under their respective engineering disciplines, i.e., electrical, mechanical, and civil-structural.

#### ELECTRICAL DISCIPLINE

##### Cable

Evaluations of electrical cable issues confirmed problems at all sites in the areas of cable installation, splicing, terminations, inspections, fireproofing, and maintenance. Engineering had not established adequate criteria to control and/or calculate cable sidewall pressure, maximum cable pull tension, and minimum cable bend radius. There was a lack of documentation verifying the adequacy of the cable routing computer program used by Engineering. The sites did not always adhere to procedures governing pulling, terminating, and maintaining cable. These problems taken collectively created uncertainties regarding the ability of some safety-related cables to perform their intended functions over the expected life of the plant. The deficiencies indicated a weakly integrated program for the design and design control of cable systems.

Most of the electrical cable problems were known by TVA prior to the employee concerns evaluations, and evaluations to varying degrees were underway. Engineering evaluation and verification of the adequacy of installed cable and replacement of deficient cable was being conducted. Completion of this action was required at each site prior to fuel load or restart. Deficient cable splices and terminations have been and will continue to be corrected through field walkdowns and replacement where necessary. Applicable site procedures have been revised to modify inspection, fireproofing and maintenance practices. The Electrical Engineering Branch is developing an integrated approach to cable design and design control to prevent recurrence of cable problems.

## Conduit

Findings identified for electrical conduit had the potential to impact the reliability and suitability-for-service of safety-related cable and equipment at each site. These findings included: (1) accumulated bends of more than 360 between cable pull points in some conduits, (2) overfilling of some conduits because of inadequate cable routing assignment controls, and (3) some questionable flexible conduit installations in regard to minimum length required to accommodate thermal and seismic movements, minimum bend radius, and implementation of manufacturers' connector torquing requirements.

Engineering was already evaluating the entire cable installation program at the time of the ECSP evaluations and was addressing problems with excessive conduit bends and conduit overcrowding. The issue of flexible conduit installations prompted a request for Engineering to perform a complete re-evaluation of the existing flexible conduit installations for safety-related equipment and pipe-mounted devices that are subject to thermal and seismic movement. Commitment was made by Engineering to establish a program at each site to evaluate and/or qualify existing flexible conduit installations. Construction will use this program output to identify and rework any deficient conduit systems or flexible conduit installations. Completion of these actions is required prior to fuel load or restart.

## Electrical System Design

Technical findings in the design of electrical systems at all sites dealt primarily with incomplete documentation of engineering decisions. This lack of documentation raised questions regarding compliance of the design with design requirements and commitments. Examples of specific areas in question included (1) the selection of certain circuit protection devices and breakers, (2) the bypassing of some thermal overload protection devices and switches, and (3) the adequacy of cable splices installed in cable tunnel manholes and preventive maintenance of the electrical splices in the manholes. Collectively, the findings indicated that a potential may have existed for failures of electrically powered safety-related systems and components that could have inhibited their ability to perform intended safety functions.

Problems with electrical systems design are being addressed through the performance of additional calculations as well as through revisions to applicable Final Safety Analysis Reports, design standards, and drawings. Also, electrical manhole preventive maintenance programs either have been or are being established at all sites, and evaluations on the adequacy of existing cable splices in the manholes are in progress. Some of the actions required to correct electrical systems design problems are required to be completed prior to fuel load or restart of any plant.

## Calculations

At all sites, numerous findings were associated with design calculations, including informal preparation, insufficient scope, and lack of availability and retrievability of calculations. These calculation documentation problems resulted in design margin uncertainties. Therefore, the ability of certain safety-related components, systems, or structures to perform their design functions could not be substantiated. In the electrical discipline, problems with calculations raised questions concerning proper fuse sizing, thermal overloads, and breaker setpoints. There were problems with the preparation and control of electrical load calculations resulting in uncertainties in actual electrical load margins. Weaknesses were also identified in the maintenance of historical records for diesel generator loading and margin.

At the time of the evaluations, Engineering had already implemented a major program to review, revise, and generate nearly one thousand electrical calculations, many of which are required prior to restart of any plant. A diesel generator loading evaluation is also being finalized and documented.

## Shutdown Board Operating Voltages

It was determined that electrical shutdown boards at all sites had been operated to varying degrees in excess of upper limits. This had created the potential for degradation and sudden, unpredicted failure of equipment, including safety-related equipment, powered from these boards.

Actions are underway at all sites to correct conflicting information regarding voltage requirements in Final Safety Analysis Reports and technical specifications. Also, steps are being taken to establish proper operational controls for voltage conditions on shutdown boards prior to restart of any plant. Measures are also being taken to determine the extent of equipment degradation. Any component found to have an unacceptable life cycle will be replaced before predicted failure.

## **MECHANICAL DISCIPLINE**

### Instrument Line Installation

Watts Bar, Sequoyah, and Browns Ferry had some instrument sensing lines installed with slopes that deviated from the minimum slope criteria as specified by the design output documents. Improper slope of the sensing lines could have affected the functioning of the lines and the accuracy of the associated instruments. Some faulty instrument line installations at these plants resulted from installation and inspection procedures that did not adequately implement the manufacturers' instructions for installation of instrument line compression fittings. Some instrument sensing line support clamps were not installed properly at Watts Bar and Sequoyah.

At the time of the ECSP evaluations, a program to resolve the problems with instrument line slope was already in place at Watts Bar Nuclear Plant. Programs to address instrument line slope problems at Sequoyah and Browns Ferry Nuclear Plant were subsequently developed. However, these programs were not addressing the effects of Design Basis Accident conditions on a sensing line's ability to function throughout all operational modes. Actions as a result of the employee concerns evaluations will be addressing Design Basis Accident conditions. Actions being taken will vary between sites due to their differing statuses. Basically, Engineering will be evaluating and correcting deficiencies in the design criteria and design output documents; Construction will be evaluating, identifying, and correcting the installation of instrument sensing lines to comply with revised site implementing procedures; craft personnel will be trained to perform their duties in accordance with the revised criteria; Quality Control will be inspecting the installations in accordance with site implementing procedures; and Quality Assurance will be monitoring and auditing the processes to provide confirmation of the quality of the program. Correction of the design and installation deficiencies is required prior to fuel load or restart.

#### Valve Substitution

At Watts Bar, in some cases different valves had been substituted for those specified on drawings without engineering review and approval and without the required design document changes. In some cases, the potential existed for the design baseline of affected systems to be impacted.

A Significant Condition Report was initiated to document this condition to ensure that the replacement valves are evaluated and that proper action is taken. Unit 1 safety-related valves will be evaluated to ensure they satisfy design requirements and are correctly identified in design and as-constructed documents. Engineering will be providing requirements for implementation into design, construction, and maintenance procedures to control valve replacements and substitutions to maintain the design baseline. Completion of these actions is required prior to fuel load at Watts Bar.

#### Pressure Boundary Material Traceability

In general, material control procedures at Watts Bar, Bellefonte, and Sequoyah Nuclear Plants did not ensure full compliance with regulatory requirements regarding verification and traceability of pressure boundary material. The material in question was primarily 2 1/2-inch and smaller piping and fittings received as loose (bulk) material and installed during plant construction activities. This problem was primarily one of documentation deficiencies, with the potential for hardware deficiencies.

In response to the ECSP findings, TVA plans to use statistical sampling programs at Watts Bar, Bellefonte, and Sequoyah as required to confirm the adequacy of installed pressure boundary material. Material in that sample that is not adequately traceable will be physically tested, inspected, or otherwise analyzed to determine compliance with the design basis. Also, Final Safety Analysis Reports, engineering specifications, and implementing

procedures are being revised as necessary to require material identification and traceability consistent with regulatory requirements and the engineering code requirements applicable to each site. Some of these actions are required for fuel load or plant restart.

There was a differing ECSP staff opinion regarding the adequacy of proposed actions at Sequoyah and Watts Bar for this issue. This difference in opinion for Sequoyah was escalated to the Manager of Nuclear Power for resolution. The Manager of Nuclear Power contracted with two nationally recognized experts in quality assurance and code material application for nuclear power plant construction to evaluate the traceability issue for Sequoyah. After evaluating the issue, the consultants concurred with Sequoyah's actions. The Manager of Nuclear Power accepted the consultants' conclusions and also concurred with Sequoyah's actions for the issue. Subsequently, proposed actions at Watts Bar were accepted by ECSP management based on the Manager of Nuclear Power's decision for Sequoyah.

## **CIVIL/STRUCTURAL DISCIPLINE**

### **Hangers/Supports**

There were a number of findings associated with hangers/supports identified at all sites, including drawings that specified inconsistent support locations, procedures lacking bolt tightening requirements, poorly designed supports for conduit, and lack of design control over field fabricated replacements for vendor supplied parts. At Watts Bar and Sequoyah, vertical tube steel sections were installed as structural members for hangers/supports in outdoor areas without cap plates. This created the potential for water and other debris to be trapped inside the tube steel and for damage to occur during freeze/thaw cycles. Mechanical shock arrestors (snubbers) required to meet design criteria for seismically analyzed piping systems were not installed and protected at all sites according to manufacturers' instructions.

Some of these problems at Watts Bar had been identified by TVA and corrective actions were underway at Watts Bar prior to the ECSP evaluations. Corrective actions at Browns Ferry and Sequoyah Nuclear Plants resulted from the ECSP evaluations. All sites are reviewing and revising site procedures as appropriate, open-ended vertical tube steel sections located in outdoor areas are being protected, and Engineering is making necessary criteria changes to incorporate manufacturers' installation and protection instructions for mechanical shock arrestors.

### **Anchorage**

There were findings associated with the upper-tier criteria and site implementing procedures for the tightening of bolts installed in self-drilling expansion shell anchors. Concrete anchor bolt installation and inspection criteria contained no specifications to prevent or detect bolt overtightening. Sufficient training was not always given, especially at the craft level, concerning the applicable bolt tightening criteria.

Prior to the ECSP evaluation, action either had already been completed or had been initiated to correct the majority of these deficiencies. Applicable upper-tier criteria were being revised to implement bolt tightening requirements. Laboratory tests were to be performed to evaluate the effects of bolt overtightening as related to the existing anchor installations. More comprehensive employee training programs were to be implemented to address bolt tightening criteria.

### Calculations

Problems at all sites were found in structural calculations for hangers, supports, and anchorages. Pipe support calculations for all sites were found in some cases to be based on incorrect analytical assumptions and to be incompletely documented. Four supports at Watts Bar exceeded engineering code limits for allowable stress.

Actions were under way prior to the ECSP evaluation that included verification of the retrievability and technical adequacy of civil/structural calculations. Before plant restart, civil/structural calculations for essential components will be identified and revised or regenerated as necessary. These actions will bring civil/structural calculation documentation to a quality level that will demonstrate the engineering bases for satisfying licensing commitments and requirements.

## **MAJOR PROGRAMMATIC FINDINGS**

Findings affecting programs and processes are presented under the categories in which they were observed. Cross-connection of common findings between categories is pointed out. Some well-publicized issues that were not substantiated are also presented. Specific actions either have been or are being taken for the negative findings, some of which are required for plant restart, but they are not presented in this appendix. The actions, as well as a more detailed discussion of the findings, can be found in the applicable category reports.

### **ENGINEERING**

Evaluations in the Engineering Category identified weaknesses in the Engineering organization's definition and control of the process for designing TVA's nuclear plants. There were inconsistencies between various types of project procedures due to overlap in scope of the projects. Policies, standards, and procedures were not consistently applied. Design input information such as design requirements, licensing commitments, and lessons learned from the operating experience of TVA's plants and other nuclear utilities were not always systematically incorporated into the design. Documents resulting from the design process did not consistently contain accurate, up-to-date requirements and as a result the users of these documents did not always clearly understand the requirements. There were instances where the cross-disciplinary interfaces within the Engineering organization did not

match in specifying design standards. Revisions and approvals of designs were not always adequately scoped, scheduled, or proceduralized. In some cases, quality deficiencies that appeared in engineering work were not tracked sufficiently and closed out.

## CONSTRUCTION

As a result of Construction Category evaluations, weaknesses were identified in the general areas of design, work control, and corrective action programs. Findings in the design area for the Construction Category confirmed findings in the Engineering Category. The output documents resulting from the design process and used by construction personnel to build the plants did not always arrive in a timely manner and did not always contain accurate and complete requirements. Therefore, some site procedures that implemented the design output documents did not fully specify the appropriate storage, handling, and installation requirements of some materials and components. Systems for controlling construction work activities at Watts Bar Nuclear Plant exhibited weakness in planning and coordination, the content of work instructions, and the work review function. Problems found with TVA's several programs for resolving "conditions adverse to quality" included untimely identification of deficiencies and lack of reviews for the root causes and generic implication of deficiencies. As a consequence, the same or similar deficiencies sometimes recurred at the same or other sites.

The quality of materials and methods used in backfill operations and the quality of concrete mixes at Watts Bar Nuclear Plant were found to be adequate. Backfill materials were found to be correctly used, placed, inspected, and documented in accordance with drawings, specifications, and procedures. Evaluations of the barrier trenches, whose function is to protect the soil supporting a major water intake pipeline from outflow during a seismic event, showed that proper materials were used, construction methods were correct, and the trenches were functionally and structurally sound. Comprehensive in-place testing and design evaluations proved that in-place concrete at Watts Bar and Sequoyah Nuclear Plants, whose adequacy had been questioned, was acceptable.

## MATERIAL CONTROL

Consistent with the Construction Category's findings, the Material Control Category found deficiencies in site implementing procedures governing key material control functions such as material identification, storage and handling, documentation and installation. The most significant result of these procedure deficiencies was inadequate documentation of some installed pressure boundary material. Evaluation results to date have not indicated that plant safety had been compromised by installation of unsuitable material. However, some installed material that had not been adequately documented is being evaluated to confirm that it is suitable for service.

## WELDING

Evaluations of Welding Category concerns by the Welding Task Group revealed no widespread breakdown in welding practices or procedures at Watts Bar Nuclear Plant. No deficiencies were found that would have affected plant operability or threatened the health or safety of the public. There were isolated instances of deficient welds that required engineering evaluation to confirm their suitability for service. There were also weaknesses found in specifications and procedures, inspector performance monitoring, documentation of welder qualifications, and communication between individuals and supervisors regarding the intent or reason for various welding-related practices and procedures.

In addition to the Welding Task Group's evaluations, the U.S. Department of Energy conducted a comprehensive, independent assessment of the quality of safety-related welding performed by TVA during construction of Watts Bar unit 1. The assessment included both a review of TVA's weld program implementing documents for compliance with original licensing commitments as well as an inspection of the installed hardware for acceptability under those commitments. The U.S. Department of Energy Weld Evaluation Project concluded from its review of the Watts Bar unit 1 welding program that the program was in compliance with applicable codes, standards, and regulatory requirements and had been in place since the first safety-related weld had been made. The Employee Concerns Task Group concurred with this conclusion.

## OPERATIONS

The Operations Category evaluations led to findings in the areas of the design process, corrective action programs, work control systems, material control, and adequacy of and adherence to procedures which reinforced the findings by other categories in the Engineering and Construction organizations. A need was identified for managers to develop and provide on-the-job training for their personnel based on actual job performance requirements, especially for and supervisors. In addition, a need existed for improved performance in certain areas of the maintenance program at the various sites. These areas included the overall corporate control and direction of the maintenance program; the utilization of operating experience information from TVA units and from outside TVA; the trending of equipment performance; and the application of design and construction standards and acceptance criteria to both maintenance and post-maintenance testing activities.

## QUALITY ASSURANCE

Findings in the Quality Assurance Category reinforced those in other categories regarding weaknesses in corrective action programs, procurement and use of material and replacement parts, and adequacy of and adherence to procedures. In addition, the quality assurance record system was weak with respect to retention, retrievability, and control of quality-related documents.

Weaknesses in the corrective action program were the most significant and included problems with inspections, audits, nonconformance control, and use of feedback from internal and external organizations. The site inspection program did not include all required attributes, did not ensure that all identified deficiencies were documented and resolved, and was not consistently executed and enforced. Quality assurance audit groups were not adequately staffed, not all required activities were audited, and the scope of some audits was deficient. Nonconformance control methods were cumbersome and complex; multiple reporting and resolution methods were in use and there were no inter-divisional procedures governing interfaces. Potential problems identified internally to TVA and by external organizations, such as NRC and the Institute of Nuclear Power Operations, were not consistently evaluated, trended, or reviewed for generic or plant-specific applicability.

### INDUSTRIAL SAFETY

In the Industrial Safety Category, there were no major deficiencies found in the physical facilities and related equipment. Also, industrial safety procedures and instructions were in compliance with upper tier documents within the Office of Nuclear Power and provided adequate protection to employees. However, it was determined that the employees frequently, and knowingly, violated the industrial safety rules and procedures. It was further determined that these violations were often accepted, or ignored, by supervision. Overall, the category concluded that there had been ineffective implementation of the Office of Nuclear Power's industrial safety policy and program prior to February, 1986.

### MANAGEMENT AND PERSONNEL

Evaluations in the Management and Personnel Category showed that management performance in many areas had been acceptable during the timeframe of the concerns. However, less than adequate management performance in some cases was a major contributor to many problems experienced by employees prior to 1986. The category determined that some managers had failed to convince their employees that they were seen as, or valued as, individuals by the organization. There were instances of favoritism in promotions and performance awards. Instances were noted of ineffective planning and coordination, poor communication, failure to keep commitments to employees, and failure to implement and enforce established policies and practices. Prior to 1986, TVA's nuclear program did not have a well structured management training program, and standards of performance were not well defined for either managers or employees.

### INTIMIDATION, HARASSMENT, WRONGDOING, AND MISCONDUCT

Incidents of intimidation and harassment directly related to the reporting of safety, quality-related, and non-quality concerns, including violations of Section 210 of the Energy Reorganization Act, and incidents of wrongdoing and misconduct did occur within TVA's nuclear organization at Watts Bar Nuclear

Plant before 1986. However, these incidents were isolated in nature and few in number. There was little evidence supporting the assumption that a widespread environment condoning intimidation and harassment or acts of wrongdoing or misconduct on the part of employees within TVA's nuclear program existed at Watts Bar Nuclear Plant prior to 1986.

There was, however, sufficient evidence to conclude that there may have been a perception held by some employees that such an environment did in fact exist throughout TVA's nuclear program. It was concluded that adequate actions have been identified and pursued by the Office of Nuclear Power to resolve this employee perception.