NEBRASKA PUBLIC POWER DISTRICT

COOPER NUCLEAR STATION ♦ DIAGNOSTIC SELF ASSESSMENT TEAM

P.O. Box 98 ♦ Brownville, Nebraska 68321

September 1, 1994

Mr. Ronald W. Watkins, President
and Chief Executive Officer
Nebraska Public Power District
P. O. Box 499
Columbus, Nebraska 68601

Dear Mr. Watkins:

This letter forwards the Diagnostic Self Assessment Team (DSAT) report of the Nebraska Public Power District's (NPPD) Cooper Nuclear Station (CNS) assessment. This self assessment was conducted at your direction and that of the District's senior nuclear officer, Mr. Guy R. Horn, vice president - nuclear. The team members observed activities and reviewed records at CNS and the NPPD general office from July 25 through August 19, 1994. The observations were discussed with your staff throughout the assessment period. Concerns were discussed with you and a formal exit meeting with your staff was held on August 19, 1994.

In commissioning this team your goal was to obtain an independent review of the operation of CNS and to determine the root cause(s) for the station's declining performance. The sixteen-member team was drawn from nine nuclear utilities, the Institute of Nuclear Power Operations (INPO) and nuclear field consultants. The team possesses over 250 years of experience in the design, operation, maintenance and performance evaluation of nuclear facilities. Some team members have had recent experience at facilities where declining performance problems have been and are being addressed.

The team reviewed performance in the four broad areas of operations and training, maintenance and testing, engineering and technical support and, management and organization. A combination of station practices and procedures, federal regulation, INPO performance criteria, and experience are the basis for the team's observations. Concerns, observations and issues contained in this report represent a team consensus with regard to the nature and extent of the problem. Since this team is not a regulatory authority and is acting on your behalf, issues of a federal, state, or local regulatory nature must be considered by you.

A number of significant observations were developed by the DSAT. The team found weaknesses in several areas that prevented the plant from reaching high standards of performance. The significant items are listed below:

- Corporate and station management have not established or encouraged high standards for personnel and unit performance. Complacency and a philosophy of "do business the way it has always been done," contribute to the station's inability to keep pace with the nuclear industry's rising standards of excellence. Furthermore, a lack of self-critical review and weakness in the assessment of station and industry events has prevented the station from learning from their experience and that of the industry.

- Weaknesses in long-range planning and scheduling have contributed to the station's inability to address long-term problems and implement long range improvements. Current programs and management controls have not required or encouraged the use strategic or tactical planning. Non-routine activities are frequently planned orally and initiated without the benefit of a thorough plan.

- Independent oversight has been ineffective in that many of the current performance problems at the station were not recognized and corrected. Quality assurance audits, surveillance, and evaluations are generally compliance oriented and do not effectively assess performance beyond regulation.

- The SRAB and SORC have failed to aggressively challenge performance weaknesses when they are identified. These organizations are ineffective in raising problems and concerns to the appropriate managers for resolution.

- Several issues identified by the team have the potential to reduce the margin of safety in important plant systems. These issues include: inappropriately preconditioning systems prior to performance testing, uncertainties in the control of plant status, ineffective corrective actions, and weaknesses in configuration and plant design basis control.

In evaluating the performance of CNS, every effort was made to be as complete and accurate as possible in describing the problem areas. These

areas are representative of operations at CNS and should be combined with the results of other inspections, evaluations, and reports to develop a complete listing of all activities and programs requiring improvement.

During the period of this evaluation, the DSAT noted actions being taken by the station and corporate staff to address issues identified by the CNS staff, NRC, and this team. Recent changes in site management have introduced a heightened awareness of nuclear safety. New management has established a higher standard of performance for the CNS staff and clearly demonstrated the fact that the station will be accountable for adherence to these standards. Changes in programs dealing with surveillance testing, corrective action, work control and industrial safety are being implemented.

The fact that you have taken a more aggressive approach to problem identification and subjected yourself and your staff to this independent self assessment is a major and creditable first step. It will, however, only result in improved station performance if similar aggressive actions are taken in addressing the root causes identified in this report. While there is no regulatory or contractual requirement for you to respond to this report, I request that you provide me with a copy of your plans to address the root causes described in Section 3 of the attached report. I suggest that you provide the Institute of Nuclear Power Operations with a copy of this report and a copy of your corrective action plans when they are developed. The lessons learned at CNS will be of value to the nuclear industry in improving the level of nuclear performance.

The cooperation of your staff in identifying problem areas and the determination to improve performance expressed by many of the CNS staff is encouraging.

Sincerely,

Ralph E. Beedle
DSA Team Manager

cc: G.R. Horn
J.H. Mueller

NEBRASKA PUBLIC POWER DISTRICT

COOPER NUCLEAR STATION

DIAGNOSTIC SELF ASSESSMENT

JULY - AUGUST 1994

Cooper Nuclear Station Diagnostic Self Assessment

CONTENTS **PAGE**

COOPER NUCLEAR STATION
DIAGNOSTIC SELF ASSESSMENT

EXECUTIVE SUMMARY

From July 25 - August 19, 1994, Cooper Nuclear Station conducted a Diagnostic Self Assessment (DSA) to assess the station's performance. The objectives of the DSA were to identify areas requiring improvement and to determine the root causes for the station's declining performance. The assessment was initiated by the President and Vice President, Nuclear of the Nebraska Public Power District. The team, led by an experienced former nuclear utility senior executive, consisted of 14 technical evaluators and an administrative assistant. Areas assessed included operations and training, maintenance and testing, engineering and technical support, and management and organization. The facility was shutdown throughout the self assessment.

Overall, the team found weaknesses in many areas that prevented the plant from achieving high standards of performance. Corporate and station management have not established or encouraged rising standards for personnel and station performance. Complacency, and a philosophy to "do business the way it has always been done," contributed to the station's inability to keep pace with the nuclear industry's rising standards of excellence. Furthermore, a lack of self critical review and weaknesses in the assessment of station and industry experiences has prevented the station from learning valuable lessons that could have corrected many station performance issues. Several issues identified by the team have the potential to reduce the margin of safety in important plant systems. These issues include: inappropriate preconditioning of systems prior to performance testing, uncertainties in the control of plant status, ineffective corrective actions, and weaknesses in configuration and plant design basis control.

The team found weaknesses in the implementation of many of the administrative programs and processes that support the operation of the station. Weaknesses were attributed to a lack of guidance from management in the form of clear expectations and standards for performance. Adherence to procedure and program requirements was weak. Frequently, when interpretation of a procedure or requirement was necessary, the interpretation was not conservative with respect to plant safety. There is a tendency to make decisions to expedite the completion of work rather than to conform to high performance standards. Weaknesses in the implementation of the clearance order and valve line-up programs have

resulted in occurrences where equipment and components were not in the condition intended or maintained under the positive control of the control room staff.

In the area of maintenance and testing, the team identified weaknesses in the control and performance of maintenance activities. Inadequate planning of maintenance has resulted in excessive out-of-service time. Emergency diesel generator and high pressure coolant injection out-of-service time has increased over the past three years due, in part, to poor coordination of maintenance and testing activities. Weakness in the quality of maintenance has resulted in degraded and nonconforming plant equipment. Verifications to ensure quality of repairs to equipment important to nuclear safety are not consistently made during maintenance activities. Specific problems found in the application of quality control to maintenance activities include: lack of foreign material exclusion and cleanliness control, use of improper materials, and lack of fastener torque requirements. A lack of a coordinated work control process has contributed to additional equipment outage time, increased outage risk, lost maintenance production hours, an increase in the backlog of maintenance, and over-reliance on the operations shift supervisor to coordinate maintenance on a daily basis.

The team determined that corporate and system engineering support of plant operations was deficient in several areas. The lack of well-defined roles and responsibilities of the two organizations, as well as interfaces between them, has resulted in inefficient use of engineering resources. Design basis information is not readily available to station engineers. Control of design activities is not sufficient to ensure the station's design basis is maintained and that analyses are based on correct design basis information. Some design changes and other station modifications had not been reviewed for design configuration prior to installation. Additionally, many system engineers are unfamiliar with the information that comprises the plant design basis. For example, due to a lack of understanding of the relationship among plant technical specifications, the Updated Safety Analysis Report, and the design basis, a test engineer specified incorrect limiting stroke times for motor-operated valves in the RHR system. Inadequate training on design and licensing basis information provided to the system and corporate engineers contributed to their lack of understanding of these issues.

The team identified several weaknesses in the station's corrective action program. Many events or adverse conditions at the station result from

failed or absent barriers that could have been provided through implementation of lessons learned from in-house and industry operating experience. Corrective actions sometimes do not adequately address the root cause. Technical evaluations of industry operating experience are often untimely, narrowly focused, or inappropriately conclude that an industry problem is unlikely to occur at the Cooper Station.

In the area of management and organization, the team identified significant weaknesses in many areas of the organization. Weak or uninvolved corporate leadership did not assist the station in areas where their expertise could have been beneficial. Corporate management has not insisted that the management practices in place support high quality operation. For example, the station does not have a strong self assessment culture. Independent oversight is similarly deficient in that most of the current performance problems at the station were not recognized and corrected. Quality assurance audits, surveillance, and evaluations are generally compliance oriented and do not effectively assess performance. The SRAB and SORC have failed to aggressively challenge performance weaknesses when identified. These organizations are ineffective in raising problems and concerns to the appropriate managers for resolution.

Weaknesses in long-range planning have contributed to the station's inability to address long-term problems and implement long-range improvements. Current programs and management controls do not require or encourage the use of strategic or tactical planning. Non-routine activities are frequently planned orally and initiated without the benefit of a thorough plan.

The team determined the following root causes of the station's performance problems:

- management's ineffectiveness in establishing a corporate culture that encourages the highest standards of safe nuclear plant operation

- failure of management to establish the vision supported by adequate direction and performance standards to improve station performance

- failure of management to establish effective monitoring and failure to direct critical self assessment activities that recognize program and process deficiencies and identify necessary improvements

- management's failure to develop corporate and station personnel with the management and leadership skills necessary to ensure that strong leaders and managers are available to fill key corporate and station positions

The team noted corporate and station management have taken action to address some of the issues identified in this report. Examples include:

- recent changes in site management have introduced heightened expectations and standards of performance
- improvements have been made to the corrective action program to better identify plant problems
- use of special instructions to perform safety related work has been reduced
- tighter controls on implementation of clearance orders
- preliminary development of long range business plans and schedules

Continued management involvement is needed to maintain the momentum for change that currently exists.

COOPER NUCLEAR STATION
DIAGNOSTIC SELF ASSESSMENT

1.0 INTRODUCTION

1. 1 BACKGROUND

Prior to 1992, performance at Cooper Nuclear Station was generally considered satisfactory and consistent with industry standards. The station's scram rate was low and few significant events were reported. Few performance problems at the station were identified by outside agencies in 1991. Early in 1992 an Institute of Nuclear Power Operations (INPO) evaluation noted weaknesses in the communication and implementation of management expectations and management awareness of performance. The Systematic Assessment of Licensee Performance (SALP) review identified declining performance in plant operations and radiation protection. Weaknesses were also identified in the analysis and assessment of plant conditions.

In late 1992 and early 1993, several occurrences led to increased NRC scrutiny of the station. A temporary startup strainer was found in a reactor building closed cooling water pump. Although the station had previously evaluated the systems, in response to NRC Information Notice 85-86, and determined them to be free of strainers, additional strainers were found in safety systems by NRC inspectors. It was also discovered that the test method used to determine operability of the secondary containment did not insure operability under various plant conditions. The test had been used to verify operability for several years. Concerns were raised by the NRC concerning the effectiveness of the station's corrective action program after similar problems were noted to be recurring at the station.

Several key issues were identified in the 1993 SALP that indicated declining performance. These included: failure to aggressively pursue root causes of potentially significant equipment problems, a willingness to live with problems, a weak problem resolution and corrective action program and a lack of sensitivity to potentially degraded plant conditions. Similar problems were identified during other NRC inspections. Twenty-seven NRC violations were issued in 1993 compared to ten in 1992 and four in 1991. The station was assessed two civil penalties, totaling $400,000 in 1993, for issues related to the suction strainers and weaknesses in problem identification and resolution.

The station issued the CNS Near Term Integrated Enhancement Program document in early 1994 to focus management attention on issues that are important to improve overall performance in the near term. However, instances of inadequate problem identification and resolution, weaknesses in surveillance test performance, and events affecting safety equipment performance have continued to occur. Preconditioning of equipment and systems to optimal condition to increase the probability of passing the surveillance test, was also noted by the NRC. The station entered an unscheduled outage, in May 1994, to correct emergency diesel generator load shed deficiencies and resolve logic system test issues. Additional concerns have contributed to the length of the outage including untested containment isolation valves, untested actuation relays and programmatic issues. Plant restart has been further delayed pending resolution of NRC confirmatory action letter issues.

In June 1994, the Nebraska Public Power District met with the NRC to discuss the station's declining overall performance. During the meeting, the NRC indicated its intention to perform a Diagnostic Evaluation to better assess the station's safety performance. NPPD management, recognizing the need to enhance performance, initiated plans to conduct this Diagnostic Self Assessment (DSA) of the Cooper Nuclear Station. The DSA is intended to identify areas requiring improvements. Continuing discussions with NRC management indicates that the results of the DSA may be used by the Commission in their assessment of the station.

1.2 OBJECTIVES

The objective of the Diagnostic Self Assessment was to conduct an in-depth independent assessment of the performance of the Cooper Nuclear Station.

1.3 SCOPE

The DSA assessed performance in the areas of operations and training, maintenance and testing, engineering and technical support, and management and organization. The assessment included specific emphasis on assessment of CNS's performance history. The results of past NRC diagnostic evaluations and experience gained from other industry initiatives was used as a basis for the evaluation. Some of the significant problem

areas identified from these activities that were included in the scope of the DSA are:

- management's effectiveness in resolving underlying root causes and achieving improvement in overall organizational performance
- effectiveness of site and corporate management leadership
- effectiveness of the QA organization
- effectiveness of line organization performance (self) assessment activities
- ability and capacity of the organization to simultaneously support normal operations, deal with extraordinary plant problems, and respond to significant regulatory initiatives
- management tolerance of inadequate organizational performance
- management tolerance of equipment problems
- effectiveness of management processes and work control processes
- effectiveness and technical adequacy of engineering support
- understanding of the facility design basis and adequacy of conformance

1.4 METHODOLOGY

The DSA team used performance based evaluation techniques to assess both past and present NPPD performance. Most of the team members are INPO-trained peer evaluators and several team members are former NRC inspectors and managers who have experience in application of safety-oriented, performance based assessments. Appendix A provides a listing of the DSA team membership. The DSA also utilized the guidance from the NRC Diagnostic Evaluation Program Directives and Handbook in conducting the assessment.

The team's selection of specific issues and evaluation subjects was guided by its review of the plant history, including CNS performance information collected or developed by INPO. The team also included the information provided via NRC DET "requests for information" in their review. The DSA team reviewed plant event and problem histories, directly observed NPPD's handling of contemporary issues, evaluated plant and corporate NRC-licensed programs and their implementation, and conducted a vertical slice audit of one important safety system.

The DSA applied multi-level evaluation methodology used by the NRC in its performance of diagnostic evaluations. Level 1 of the evaluation focused on plant safety performance with respect to personnel, equipment and procedures. Level 2 of the evaluation concentrated on program adequacy and performance. Activities at Level 3 developed an understanding of effectiveness of management in directing the plant's activities and in responding to the problems identified in Levels 1 and 2. The DSA used the information developed in the Level 1-3 activities to identify root causes for significant verified problems identified at those levels.

1.5 FACILITY DESCRIPTION

The Nebraska Public Power District Cooper Nuclear Station, a 778-MWe (net) General Electric boiling water reactor, is located on the Missouri River south of Brownville, Nebraska. Commercial operations began in July 1974. The station was shut down throughout the assessment.

1.6 ORGANIZATION

The NPPD organization for support of the Cooper Nuclear Station consists of General Office and Station components of the Nuclear Power Group. The head of the Nuclear Power Group is the chief nuclear officer, titled vice president - nuclear. A chart of the organization is provided in Appendix B.

2.0 EVALUATION RESULTS

2.1 OPERATIONS AND TRAINING

The team found weaknesses in the implementation of many of the administrative programs and processes that support the operation of the station. Ineffective support programs have hindered the operator's ability to control and maintain systems and equipment in a manner that contributes to safe and efficient operation. In addition, oversight and control of shift routines and activities does not ensure the control room staff is fully aware of and in control of activities that may affect plant status and operation. Many of the weaknesses are attributed to a lack of guidance from line

management in the form of clear expectations and standards for performance. Management frequently failed to recognize program and personnel performance deficiencies. For those deficiencies that were identified, they failed to aggressively pursue the determination of root causes and corrective actions. Training was also not effectively used to provide the technical and professional skills necessary to enhance personnel performance in several key functional areas.

Positive observations included the station's aggressive cleanup effort to minimize contaminated areas in the plant. Areas of surface contamination have been significantly reduced in recent years resulting in ease of access for operation and maintenance in most areas. Operations and Training Department teamwork was noted in activities supporting control room simulator fidelity thereby ensuring operator training is realistic and relevant to plant operation. Improvements in operational communications to enhance shift watch standing effectiveness were also observed.

The team observed operations and training performance during an extended outage period. The areas observed included management planning and direction, implementation of management expectations through observation of on-shift activities and various program activities, equipment condition and control, and effectiveness of internal assessments. Support of operations by various site and corporate groups, including training, was also reviewed. A substantial number of interviews and document reviews were conducted. In addition, informal discussions, plant walkdowns, and control room observations were used by the team to evaluate operations performance.

2.1.1 Plant Status Control Is Not Rigorously Maintained

Administrative programs and processes intended to maintain plant status control are sometimes inadequate to insure that system alignments and clearance boundaries are known and controlled by the control room staff. Weaknesses in the implementation of these programs and processes have resulted in clearance order violations, valves and other components being found out of position, and inadequate control of work boundaries. Operation's ownership of the plant status control responsibility was not sufficient to ensure rigorous compliance to program standards. Additionally, the administrative programs for the control of seal wired valves and independent verification need strengthening.

(1) Some aspects of implementation of the clearance order procedure deviate from good industry practices for control of tagged equipment. Some of these practices reduce the ability of the control room staff to control the status of plant equipment and to remain cognizant of system status and availability. Other clearance order practices can desensitize operators and technicians to the importance of tagging requirements resulting in equipment damage or personnel injury. Additionally, some clearance order procedure requirements were bypassed through use of other processes. For example:

- CNS Procedure 0.9, "Clearance Orders and Caution Tag Orders," states that it applies to all equipment and work conducted at the station. However, work on safety systems is frequently performed using special instructions (SI) that establish work boundaries and isolation requirements. Frequently, these instructions do not use clearance orders and tags for equipment or personnel safety. Using SI work steps, instead of a clearance order, removes an important tool the shift supervisor has to monitor and control the condition of a system or component. A prerequisite for the shift supervisor to release a clearance order is the verification that the system is ready for service. Use of an SI removes this control from the shift supervisor.

- Until recently, test valves for local leak rate tests (LLRTs) were danger tagged as "no position." These danger-tagged valves were manipulated during performance of LLRTs with the danger tags still attached. This practice was used to shorten the time to complete the test and minimize the need for operator involvement. This practice is not consistent with the clearance order procedure or standard industry practice and is being eliminated.

- CNS Procedure 0.9 permits the control room operator to designate persons other than operators to implement a clearance order. Operators interviewed by the DSA team related occurrences when this has happened. This practice is not consistent with standard industry practice and is under review by operations management.

- Operators sometimes do not have the clearance order sheet specifying components to be tagged in hand while hanging and removing danger tags. This practice increases the likelihood for tagging the wrong component or removing the wrong danger tag.

(2) There is inadequate guidance on implementation of the valve line-up program. Action required for valves found out of the position specified on the valve line-up sheet, criteria for performing line-up checks after maintenance or outages, and requirements for periodic valve line-ups are not specified by procedure or policy. Components found mispositioned are typically not investigated to determine the reason for the mispositioning. Following the discovery of two mispositioned valves on the reactor recirculation system, valve line-ups were completed on six additional systems. More mispositioned valves were identified. As a result, a complete valve line-up was ordered and was in progress when the DSA team left the site. At that time 65 components, including valves, dampers, and breakers were identified as mispositioned. The high number of mispositioned components identified indicates a weakness in the station's ability to control and maintain system status.

(3) Drawing walkdowns conducted between 1986 and 1993 identified over 200 valves that are not included in valve line-up check lists. Operations personnel have not established a priority to include these valves in the line-up sheets. Considering the number of valves that have been found to be mispositioned that are listed on line-up sheets, the status of the unlisted valves is uncertain.

(4) Seven lead wire seals, used to prevent operation of critical valves associated with reactor safety without breaking the seal, have been found broken, missing or improperly installed in the past four months. Three of the deficiencies were discovered by the DSA team. The seals were replaced but no investigation was performed to determine the cause for the discrepancies. Missing or improperly installed seal wires remove a barrier to unintentional operation of valves important to safety.

(5) CNS Procedure 2.0.1, "Operations Department Policy," establishes numerous exceptions to the requirements for independent or

concurrent verification of valves, breakers and electrical leads. The aggregate effect of the exceptions is to prevent detection of misoperation or mispositioning of a component. For example, technicians land leads on sensitive equipment without concurrent verification that the lead and location are correct. This can result in the lead being landed on the wrong terminal, followed by an unintended actuation before the second person has the opportunity to detect the error. Typical industry practice is to provide concurrent verification for work on sensitive equipment and independent verification on component positioning that affects reactor or personnel safety.

2.1.2 Compliance to Standards and Procedures Is Frequently Not Conservative

The station has not established an expectation on adherence to standards, procedures and program requirements that conveys a philosophy accenting conservative compliance. interpretations of technical specification requirements are sometimes inconsistent and are sometimes made to minimize the impact on the issue at hand. The requirements established in some programs are bypassed through the misuse of other processes.

(1) Some activities at the station are conducted in a manner that does not communicate a conservative approach toward the interpretation of the CNS Technical Specifications. The DSA team observed, and was informed of, several maintenance repair activities that were performed without SORC approved procedures as required by the technical specifications. Discussions with the CNS staff confirmed this was an often-used practice. Frequently these activities were performed using special instructions written by the work crew leader. Additionally, some work was observed to be performed on essential equipment, without written special instructions, relying instead on the skill of the craft. Recently, management guidance has been given to reduce the use of SIs for safety related work.

(2) A change was made to the quality assurance program that reduced the level of commitment to the NRC without processing the change in accordance with 10CFR, Part 50.54(a). QA audit frequency was changed for certain audits from annually to biennially without

obtaining prior NRC approval. Area audits deleted from the 1993 schedule included: station operations, repair maintenance, environmental, and SRAB/SORC activities. QA management did not interpret the change to be a reduction in the level of commitment to the NRC requiring prior approval, even though the previous auditing program is based on annual audits. Additionally, ambiguities as to which revision of ANSI N18.7 the QA program is committed have not been resolved by the station although the need to do so has been recognized by QA management.

(3) The CNS Emergency Plan requires the shift technical advisor (STA) position to be manned at all times. The technical specifications and station procedures contain provisions for not staffing the position during outages. During the current outage the STA position was left unmanned for several days before the discrepancy was recognized. A failure to ensure that different but interrelated programs establish consistent requirements resulted in securing the STA function without first recognizing the discrepancy.

(4) Procedure and program requirements are sometimes ambiguous. For example, the Conduct of Maintenance procedure allows the maintenance manager to make exceptions to that procedure but fails to establish controls or documentation requirements for exceptions that are authorized. The Temporary Design Change (TDC) procedure states that TDC's are not considered permanent while another step in the same procedure describes what to do when a TDC is considered permanent. Ambiguities in procedures can result in worker confusion regarding management's expectations and reinforce an attitude to interpret the requirements in a manner that expedites work completion rather than conformance to expectations.

(5) Decisions to postpone the Emergency Plan's 50 mile ingestion pathway zone (IPZ) dose assessment model conversion to EPA 400 requirements were made without modifying the Emergency Plan or the Emergency Plan Implementing Procedures. The emergency planning coordinator did not view this as a potential licensing issue and considered verbal NRC approval adequate.

(6) A well established procedure validation and walkdown process has been circumvented through the use of special instructions. While not

intended to be used as procedures, special instructions have sometimes been used in place of procedures. Since special instructions are neither validated or walked down, errors go undetected until they are actually being performed in the field.

(7) Proceduralized preconditioning of equipment, prior to surveillance testing, has resulted in the inability to determine the as-found condition of some equipment. A lack of rigorous investigation and response to a NRC identified concern regarding the testing of secondary containment integrity resulted in recurrence of a similar event and an undetected degradation of the emergency electrical system. Although station management considers this issue to be adequately addressed through recent management directives and procedure reviews, the DSA team found that little guidance has been developed for operability determinations in cases where preconditioning concerns were identified during the procedure reviews.

2.1.3 Training Is Not Effectively Used to Improve Performance

Training in some functional areas is inadequate to provide personnel with the knowledge and skills necessary to perform their assigned tasks. Training is viewed by some CNS management as an obligation instead of an opportunity to improve personnel performance. As a result, line management has not recognized the need for accurately determining core needs for competency in some areas. Additionally, a lack of line management ownership of their respective training programs has resulted in the training department receiving little or no oversight and feedback to improve the quality of training. Examples include:

(1) The initial engineering support personnel training program for station engineers provides limited overall system knowledge. Position-specific guidelines for selected engineering support positions were not incorporated into training as specified by the issuance of INPO ACAD 91-017, "Guidelines for Training and Qualifications of Engineering Support Personnel," due to inadequate follow-up by training management. System engineer training consists primarily of self study and a demonstration of their knowledge of their assigned system to their supervisor before being "certified" as system

engineers. There is limited cross training of engineers to improve the knowledge of the other (mechanical or electrical) aspects of system operations. Examples of training/knowledge weaknesses of observed include:

- Several system engineers interviewed were unaware of where the design basis for their system is located or how to identify the applicable design basis information for their system.

- System engineers currently prepare special instructions for maintenance work activities on safety-related components. Corporate engineers often prepare the special instructions for design change package implementation. However, neither group has received training in work planning or procedure preparation.

- Corporate engineering personnel do not receive plant systems training.

(2) Skill of the craft training needs are not understood and are inadequately defined. Many job performance measures (JPM's) are evaluated in the training shop environment to a generic skill. Few follow-up motor skill evaluations are conducted on specific in-plant equipment. Maintenance supervision relies on procedures and skill of the craft training to ensure maintenance activities are properly performed. The expectation is that journeyman need only basic skills of the craft training. Once this training is complete, maintenance supervision believes that the journeymen can handle most tasks in the plant using procedures or special instructions. Subsequently, maintenance supervision (with the exception of the operations manager who is responsible for the I&C training program) does not promote further training of maintenance personnel. However, weaknesses observed in the conduct of maintenance indicate additional training may be needed. Refer to section 2.2.2 for additional detail.

(3) The health physics (HP) technician continuing training program is limited in that it does not build an in-depth technical program following the fundamental training program. Although HP supervision

conducts continuing training during periodic meetings, the continuing training process needs to be defined from a Training Department perspective that includes a skills and needs basis and expanded to provide more technical detail and challenge for HP personnel.

CNS Directive 54, "Management Overview of Training and Evaluation Activities," issued in 1992, directed management to participate in periodic training observations and provide feedback on training quality and effectiveness. Maintenance management and supervision have not conducted any of the observations required by CNS Directive 54. Additionally, the engineering manager has not conducted any observations since 1992. The operations manager has provided feedback to the operations and I&C training programs. However, the DSA team observed that the operations manager's expectations for the shift supervisor maintaining a stand back overview during emergency events is not incorporated into simulator training indicating additional oversight and monitoring may be needed.

2.1.4 Degraded Material Condition and Long-Term Problems Have Potential to Affect Plant Operation

The overall number and individual importance of equipment problems represents a potential challenge to effectively monitor and operate the plant. The team does not consider this to be a significant issue at this time, as evidenced by a low number of significant events and complicated plant trips. However, degraded material conditions and other long standing problems may unnecessarily burden operators responding to various plant conditions and transients by requiring actions not identified in response procedures. The DSA team found a willingness by station management to accept some degraded conditions without an aggressive effort to correct the problems. Lack of action to correct material deficiencies and other long standing problems will result in an ever increasing number of operator work arounds and other problems that further challenge the operators ability to effectively monitor and operate the plant. Contributing to this problem is a lack of an integrated work control process that includes a mechanism for problem identification, prioritization, scheduling, status tracking and trending of recurring deficiencies. Examples include:

(1) The "B" reactor feed pump minimum flow valve leaks by its seat at 200 gpm, and as a result, is kept isolated by shutting a manual isolation valve. This is identified with a caution tag that was hung on 8/26/93. Isolating the leakage improves plant efficiency by avoiding heat losses to the condenser but requires operators to manually open the isolation valve if the minimum flow path is needed.

(2) Drywell "F" sump low level cutout switch doesn't reset until level is high. The reset under these conditions can cause a high fill rate alarm. This problem was identified in June 1993. Living with this condition could result in operators becoming less sensitive to drywell leakage annunciators and as a result take less than prompt action should actual leakage occur.

(3) The reactor vessel level injection solenoid isolation valve leaks past its seat. As a result, a manual isolation valve must be closed. This injection (fill) line is from the core spray system and would be used during emergency operating procedure conditions when reactor vessel level instrument reference legs are needed to be back filled. With it isolated, an operator would be sent to the reactor building, second level to open the manual valve.

(4) The demineralized water level control valve leaks by the seat. It has been isolated, requiring operators to manually open the valve prior to starting the mechanical vacuum pump from the control room.

(5) Long-standing problems in the service water systems due to silt accumulation have resulted in operational work arounds and increased maintenance on critical service water components. Examples include:

- Silting has resulted in problems with instrument sensing lines plugging and loss of the associated indication or control function. Silting concerns have caused the station to change the manner in which they operate the RHR system during shutdown cooling operations. The RHR system heat exchanger outlet valve, which is not designed to be throttled, is throttled to control cooling to avoid throttling of service water valves designed for this purpose. The concern the station has with throttling SW valves is the additional erosion caused by the presence of silt. In addition, instruments that indicate service

water d/p on RHR heat exchanger divider plates are pegged low due to problems with sensing line plugging. Loss of this indication prevents operators from being able to perform the precaution in an in-service test surveillance procedure that requires verification that d/p is less than 10 psid in order to prevent damage to the RHR heat exchanger divider plate.

- Spargers used in the service water bay for keeping silt in suspension have been in need of maintenance for several years. The plant design has five sets of spargers. The system is designed to work with automatic valves feeding the sparger header. Due to excessive wear of the spargers, only two spargers are in operation at any time. This condition has existed for several years but was not identified in the current maintenance back log.

- Service water pumps that are not in operation were rotated by hand at least once per every six hours by operators and prior to each time the pump is started in the non-automatic mode. This practice was stopped during the DSA.

- Service water booster pump maintenance is high considering the relatively low use of the pumps.

- Maintenance procedures for setting the impeller clearances on the pump require a one hour operation to ensure that the casing is clear of sand prior to work on the pump.

- Traveling screens are operated continuously to prevent binding from silt accumulation. Previous problems with screens require quick response from maintenance to avoid accumulation of silt preventing operation. If response is delayed, plant operation may be affected.

(6) Some long-standing equipment degradations noted during operation and maintenance are uncorrected and are not being tracked by the corrective action program or work control system for future resolution.

- Coolant leakage from the "A" RHR heat exchanger mid-body flange joint is being collected by a semi-permanent drain hose

embedded in the shell insulation. The leak had been first identified in 1986 via a maintenance work request that was subsequently cancelled in 1990. Although the cancelled MWR was annotated to delay the job until an outage of sufficient duration, no replacement MWR was created.

- A temporary patch has been installed on the REC piping from the reactor recirculation pump motor generator oil coolers in 1977 and apparently not considered as a temporary repair or modification. The patch was identified during a recent walk-down, removed and permanently repaired.

2.2 MAINTENANCE AND TESTING

Maintenance activities are not sufficiently controlled to adequately assure that equipment quality and availability are suitably maintained. Some controls for maintenance activities are inadequately established and are frequently not properly applied to work, resulting in nonconforming and degraded plant equipment. Improper maintenance work has resulted in an increase in out-of-service time and rework. Quality control verifications are not consistently incorporated in work instructions and are not consistently performed to ensure that the work meets established requirements. Lack of a comprehensive work control system using traditional scheduling and planning techniques also results in additional equipment outage time, increased outage risk, lost maintenance production hours, an increase in the backlog of maintenance, over-reliance on skill of the craft in the absence of comprehensive work packages, and over-dependence on the operations shift supervisor to provide close coordination of maintenance activities and plant configuration.

Maintenance and testing were assessed through interviews, observations of maintenance work, witnessing of testing, and review of related documentation.

2.2.1 Work Control Is Fragmented and Lacks Coordination

CNS does not have a comprehensive work control system that includes work package and work instruction development, parts and logistics planning

functions, nor centralized short- and mid-term scheduling and coordination functions. The lack of a comprehensive work control system has resulted in extended system outage durations, an increase in the duration and number of equipment outages, repeated challenges to the outage risk assessment process, and a reliance on the operations shift supervisor to manage the control and coordination of work and the configuration of the plant's systems. Additionally, lack of an effective work planning effort is affecting the quality of work being performed by failing to consistently provide written and/or properly reviewed and approved work instructions. The lack of a LCO tracking system adds additional challenges to the ability of the shift supervisor and line management to direct work activities and to assess the impact of emerging work items.

2.2.1.1 Work Planning

Work planning is not performed by a dedicated staff of planners but by the shop work crews. Craft personnel are assigned to determine the extent of the problem, develop repair methods including application of vendor or engineering information, arrange for parts and materials, and process the job related paperwork. System and corporate engineers may develop work instructions and procedures for modifications and other plant changes. Management has accepted the extensive use of skill of the craft as a substitute for written instructions and procedures that should contain information essential to the successful, documented completion of maintenance tasks such as critical work steps and sequences, quality requirements such as torquing, critical dimensions, and inspections. Reliance on the craft to arrange for their own job materials combined with weak planning of work package quality documentation and inspection requirements has contributed to installation of incorrect parts.

The station staff has also missed the opportunity to build their library of formally issued maintenance procedures by not converting special instructions into fully approved procedures.

2.2.1.2 Scheduling and Coordination

Each maintenance department generally controls its own work priorities with little coordination with other departments. There is little centralized direction for work item prioritization. The station does not use train-specific outage windows, rolling schedule or other similar scheduling techniques. This

reduces management's ability to collect, group, and coordinate work to minimize equipment unavailability, control room work loads, and increase craft productivity and has contributed to repetitive and excessively long system and component outages.

The shift supervisor spends a significant fraction of his time processing work requests as they arrive at the control room service window, generally on a first come first serve basis. The DSA team viewed this as an administrative burden on the shift supervisor that detracted from his ability to direct and monitor plant operations. Although there is a "daily work list," it does not accurately reflect ongoing work. In addition, the work scheduled on the list is frequently not worked as planned. Consequently, the shift supervisor has no viable list of scheduled or authorized work to assist the in decision making for the coordination of work.

Operations is not consistently involved in assigning priorities to work but acts as a processor of items proposed by the work groups. Even items of potential operational significance do not always receive sufficient priority. A number of the degraded material conditions identified by the team involved operational work-arounds that should be corrected, e.g., silting problems in systems carrying river water, malfunctioning "F" drywell sump low level cutout switch reset, and others as discussed elsewhere in this report.

Work is not routinely scheduled to optimize completion of backlogged corrective and preventive work while equipment is out of service. Backlog has increased from 1,023 open items in January 1994 to 1,392 in June 1994 and to over 1,600 in July 1994. Safety related systems and equipment are frequently removed from service for a single routine task, returned to service, and then taken out of service a few days later for another similarly routine task. For example, the "A" reactor recirculation pump was taken out of service and restored three times between June 2 and 9, 1994 for electrical maintenance. The "D" service water booster pump was out of service three times between March 1 and 11, 1994 for an oil change, a gland water piping repair, and an alignment check.

During outages, plant procedures call for designation of specific senior managers as Outage Directors. Because of the number and magnitude of issues being addressed by the plant staff, no senior managers were considered available for this position. Instead, two more junior staff members are assigned to the position of shift outage director. The

governing procedures were not clear regarding the shift outage directors' organizational reporting lines nor which line manager has the ultimate responsibility for outage scope identification, growth, and control; schedule adherence and accountability; and, information dissemination and communication.

The lack of centralized outage management and information was evident when the operations staff dealt with safety system train outages and restorations. During the assessment, the staff switched residual heat removal from RHR Division I to Division II but encountered a number of challenges. First, some actions needed to restore Division II's operability were being identified during outage schedule meetings but were not being captured in an action list for assured follow-up. Prerequisites for the divisional changeover were being identified until the initially scheduled changeover date and beyond. Secondly, some work items were sent to the maintenance shops but the paper work was misplaced. The jobs did not start and were not recognized as potential impacts to the changeover due to the lack of tracking information. Thirdly, several major jobs were not on the daily work list such as re-insulation of RHR piping, scaffolding removal, and battery testing. Lastly, a system readiness milestone certification process to establish and confirm RHR divisional readiness and operability did not exist.

2.2.2 Weaknesses in the Conduct of Maintenance

The following aspects of the plant maintenance program's performance contribute directly to poor quality maintenance. Low management expectations and performance standards for the maintenance program and correspondingly weak performance by several quality related aspects of the program were evident.

2.2.2.1 Nonconforming and Degraded Plant Equipment

The team found that inadequate maintenance controls or poor adherence to those controls contributed to improper or unsuccessful repairs and return of the equipment to service. For example:

(1) Safety related level transmitters for the scram discharge volume were installed using 1/4 inch mounting bolts instead of the 5/16 inch or larger bolts specified by the original system engineer-prepared special

instruction and the equipment vendor. The larger bolts were required to meet the seismic qualification requirements for the transmitter. The CNS system engineer changed the special instructions to provide torque requirements for the 1/4 inch fasteners. Although the system engineer subsequently wrote a condition report documenting the improper bolting condition, the transmitter was assembled, tested and returned to service.

(2) RHR pump motors had periodically experienced loose bolting following vendor shop repairs since at least 1988. In response to a 1993 loose bolting problem with the "C" RHR pump motor, the station determined that the vendor shop did not require quality control verification of torque in its shop. Corrective action was not taken to check the bolting on the "A", "B", or "D" RHR pump motors nor were the CNS work packages upgraded to specify and verify bolting torque. Subsequently, the "A" pump motor was found to have loose bolting and a related oil leak in July 1994. Maintenance items were then written to check the other pump motors.

(3) Other examples include:

- reassembly of the "A" service water pump coupling without using the vendor's recommended torquing pattern and values

- reassembly of the "A" service water pump impeller using clearance values about one-half those specified by the vendor manual (0.021 inches vice 0.056 inches)

- installation of a #2 EDG fuel injection pump and replacement of the exhaust manifold using special instructions that did not include torquing of the bolts per vendor manual requirements

2.2.2.2 Quality Control

Weaknesses in the quality control program result in inconsistent specification of quality requirements and rigorous quality verification of field work on safety related equipment. As discussed above, work instruction are prepared by the craft persons or system engineers assigned to the maintenance task. Quality requirements are normally to be input to the work instructions by work item tracking staff. Many of the work packages

reviewed by the DSA team contained no requirements for verification of key process steps or conditions to ensure the quality of the work performed.

CNS uses a peer quality control inspection process. A qualified craftsmen who did not participate in the work temporarily assumes the role of inspector. The team and recent NPPD quality assurance audits found occasions where this independence was not maintained. Peer inspector training was also found to be inadequate in that it does not include methods for performing checks or observations in the field but rather addresses only the administrative procedures and maintenance technical skills. Practical observation training and demonstration of field observation proficiency is not included. The above weaknesses result in relatively few problems being identified by peer inspectors. The team found that no deficiencies had been documented as condition reports by peer inspectors since the new corrective action program was implemented in April 1994. Little management oversight of the peer inspection activities was noted by the team, indicating a lack of line management ownership or concern for the quality of maintenance.

Specific problems found in the application of quality control to maintenance activities were:

(1) Multiple examples of failure to specify foreign material exclusion and failure to verify system cleanliness. CNS has experienced recent foreign material induced failures in a valve motor operator and multiple air system solenoid valves.

(2) Fastener torquing requirements not specified nor used for diesel generators, RHR pump motors, and other equipment.

(3) Correct parts and proper materials not being consistently verified at the point of installation, frequently resulting in questionable or nonconforming conditions. Examples include a HPCI auxiliary oil pump control relay with an incorrect voltage rating; an undersized EDG starting air system relief valve and, various commercial grade check valves installed in the nuclea oiler, RCIC, RR, MS, and HPCI systems without proper dedication.

The aggregate issues of maintenance craft providing their own work planning (including specification of quality control requirements), the over-

reliance on skill of the craft of processes and procedures, and the peer QC program contribute to the inadequate quality of maintenance at CNS.

2.2.2.3 Rework

Station management does not effectively monitor rework (re-performance of corrective maintenance necessary because of unsuccessful or improperly performed repairs) as part of the existing performance monitoring process. Several plant practices tend to mask the occurrence of rework and degrade the effectiveness of work authorization and control processes. For example, maintenance work requests have been routinely held open for or re-opened after long periods of time. The team reviewed a number of examples of rework due to unsuccessful initial repairs. Examples include:

(1) Changes were made to 4160V breaker wheel and frame alignment using locally made tools and informal procedures that were not based on controlled drawings or vendor information. Those changes resulted in misalignment of and operability problems with auxiliary devices and subsequently affected breakers for an RHR pump, service water pump and service water booster pump, electrical bus ties and feeds.

(2) The "A" service water pump had been repaired in August 1994 and its impeller clearance adjusted. Over the next several days, the pump required impeller clearance readjustment at least twice more. No cause for the unstable clearances had been determined but the clearances used for assembly deviated from vendor manual values.

(3) Additional examples involved turbine equipment cooling pump mechanical seal leaks due to a missing O-ring, rework of diesel generator engine leaks three months after major overhaul, improper assembly of various containment isolation valves, and RHR service water booster pump motor-operated valves unsuccessfully overhauled during the refuel outage.

2.2.3 Deficiencies in Procedure and Instruction Content and Use

Management has not provided procedures for maintenance and testing that are adequately developed, reviewed and approved, and controlled in use. A great deal of reliance is placed on the "skill of the craft" that is assumed to derive from a very stable work force of crafts persons with unusually long incumbencies. In many cases, work is performed without specific work instructions, using only a maintenance work request to authorize and scope the work.

Administrative controls in procedures frequently have ambiguous or inadequate instructions and tend to weaken the local performance standards and management expectations for procedure adherence. For example, the determination of need for pre-test, post-test, and quality control requirements in Procedure 7.0.1.2, "MWR Generation and Review," are not clearly delineated. Section 1.2 of Procedure 7.0.4, "Conduct of Maintenance," states that the maintenance manager can make exceptions to the Conduct of Maintenance Procedure for non-safety related items but does not describe what exceptions are permitted nor how they are to be documented. The guidance for use of Interim Procedure Changes and Temporary Procedure Change Notices in Procedures 0.4, "Procedure Change Process," and 0.4.2, "Temporary Procedure Changes," are not explicit. Section 2.4.1 of Procedure 3.4.4, "Temporary Design Changes," states that temporary design changes are not considered permanent while Section 2.4.4 describes the steps to be taken when one is considered permanent.

Some work on essential equipment is performed in accordance with special instructions that are written by a variety of station personnel including managers, engineers, supervisors, and craft personnel. Frequently, these instructions are used without formal review and approval, including the SORC approval required by technical specifications. This has contributed to the use of maintenance work instructions that do not provide sufficient technical information to assure work is in accordance with vendor requirements or specifications.

The team found many examples where either skill of the craft or unapproved and inadequately controlled special instructions were used:

(1) A breaker contactor for core spray motor-operated valve 5A was replaced using a special work instruction written by the work crew leader but not approved by SORC.

(2) A complete overhaul of an RHR pump motor was performed on using unapproved special instructions. Subsequent problems involving loose RHR pump motor bolting were repaired on two MWRs in July and August 1994 using special instructions prepared by maintenance planning and system engineering.

(3) Various repairs were made to the emergency diesel generators without approved procedures, including:

- #2 EDG fuel injection nozzle overhauls in March 1993 using special instructions

- replacement of #2 EDG lube oil piping in March 1993 using skill of the craft

- removal and reassembly of the #2 EDG exhaust manifold in March 1993 using skill of the craft.

Even when procedures used for surveillances and field work are fully developed, reviewed and approved, they frequently result in inappropriate actions or work interruption due to unusable or incorrect information. For example:

(1) Testing in accordance with Surveillance Procedure 6.2.2.5.14, "RHR Initiation and Containment Spray Logic Functional Test," was suspended several times between July 24-26, 1994 due to errors in the procedure's treatment of relay logic. The errors were corrected by procedure changes. On July 26, the procedure caused an inadvertent trip of the 1A recirculation pump when the test shut the operating pump's discharge valve. The procedure had been extensively revised in the recent past but had not been subjected to verification and validation.

(2) The sensing lines for service water pressure switches which isolate the essential water sub-system from non-essential sub-system accumulate river silt and are routinely back flushed by technicians

prior to calibration. The back flush evolution is not included in the calibration instruction and discussions with I&C technicians, supervisors, and training instructors indicated no standardization of the practice. Further, the team found that, although the pressure switches were calibrated, the functional testing for the auto-closure feature was inadequate.

There is a lack of confidence by station personnel in the ability to revise and improve processes and programs in a timely manner due to an inadequate procedure revision and improvement program. As a result, both management and staff have become tolerant of procedure deficiencies and lax adherence. The backlog of unprocessed procedure changes has grown by about 65% since 1992. In the same period, the number of procedures which exceeded their biennial review time frames increased from about five to about thirty procedures per month. The number of open procedure change notifications has increased by about 60% and their average age has also increased. Although performance and status are reported monthly to station management, no comprehensive action appears to have been taken in response to these indicators. The team found that the inability to make expeditious improvements to procedures materially degraded the staff's attitude about procedure adherence and submittal of changes for improvement.

2.2.4 Weaknesses in Industrial Safety Practices

Standards for industrial safety are not consistently enforced by station management. Personnel frequently ignore station and corporate safety guidelines in the performance of work. Independent verification of clearances is not performed to provide for worker safety. Industrial safety practices of personnel performing work in the station are not in accordance with station guidelines and occupational safety standards. Examples include:

(1) Scaffold used for reactor equipment cooling piping was not equipped with toe boards, guard rails and/or mid-rails and had inadequate tipping protection. During the REC work, a welder was observed welding while standing on a steel rod pipe support with an improperly tied-off safety harness. Workers were periodically observed walking in overhead cable trays and duct work without fall protection.

(2) Inconsistent use of hard hats, eye protection, and foot protection were observed throughout the plant. For example, workers cutting pipe for the REC repairs were not wearing eye protection nor hard hats.

(3) Numerous problems were observed with clearance order administration and equipment status errors. Current practices for local leak rate testing allow operation of tagged valves and maintenance special instructions were used to isolate work boundaries instead of clearance orders and tags. The service water pump shafts were manually rotated using a bar on the coupling with the pump in pull-to-lock but without the protection of a clearance order.

Performance indicators for industrial safety accident rate at the station are well above the industry median. The stations industrial safety accident rate performance indicators have been above the industry average for the past four years and the station currently ranks 60th out of 71 plants in overall industrial accident rate performance. The team's observations were sufficiently numerous to indicate that management is not out in the plant observing activities and are not enforcing acceptable standards of performance.

2.3 ENGINEERING AND TECHNICAL SUPPORT

The control, use, and understanding of the station's design basis information was found to be weak. Station modifications are sometimes installed prior to receiving required design reviews. Inadequate training provided to the system and corporate engineers on design basis information, licensing basis and other station commitments contributed to their lack of understanding of the relationship between these issues. Some equipment performance monitoring programs are deficient and not effectively identifying degraded performance. Many of these programs have not been reviewed to identify weaknesses and areas for improvement. Corporate and system engineering support of plant operations is often weak and poorly coordinated. Roles and responsibilities for various engineering support groups are not well defined.

The team performed an in-depth review of the residual heat removal system and its associated electrical power supplies and support systems. The team also evaluated the effectiveness of the engineering and technical support functions by reviewing routine engineering support of the plant, resolution of

plant problems, plant modifications and design changes, configuration control and organizational issues. The team conducted numerous interviews with engineering support personnel, station and corporate management.

2.3.1 Design Control is Insufficient to Maintain Design Integrity

Control of design activities is not sufficient to ensure analyses are based on correct and current design information. Contributing to this lack of effective design control is a lack of readily available design basis information. Additionally, many system engineers were unaware of how to locate design basis information and what information comprises the plant design basis.

(1) The control of design calculations limits the ability of design engineering personnel to ensure that current calculations are being used as references when designing a plant modification. During interviews with engineering personnel, it was noted that there are over 24,000 calculations on file to support the station. However, it was found that the listing of calculations does not identify which calculations are current, such as identifying the calculation that superseded a previous calculation. During reviews of design change packages, it was noted that the supporting calculations seldom reference previous calculations, and none of the calculations reviewed identified any previous calculations as superseded. In one case, there were three different calculations to support a portion of a modification, and two of the calculations did not reference any of the other calculations associated with the modification. Additionally, a review of calculation control procedures identified the potential for a calculation to become approved and included in the calculation listing without the modification it reflected being installed in the plant. These activities can result in the incorrect calculation being used in station analyses.

(2) The control of plant changes that affect either physical station configuration or key plant analyses sometimes do not ensure the analyses are maintained current. During the 1993 refueling outage, the station used a process wherein a design engineer could prepare a set of design sketches to accompany an MWR, obtain SORC approval for the sketches as a design change, and authorize the change to be installed in the plant. A review of some examples of these changes noted that the calculations to support these design sketches would

sometimes lag as much as one year behind the installation of the change. Additionally, in the case of two of the SORC-approved MWRs reviewed, the design change that followed the SORC-approved MWR required some significant station work to ensure the completed modification would still comply with design requirements. For example, a damper in the standby gas treatment system was blocked open as a result of a SORC-approved MWR. However, when the design change was developed to finalize the design for blocking open the damper, it was found that there was a possibility that the purge flow from the containment could cause nitrogen and radioactive gases from the containment to back up into the reactor building exhaust plenum. As a result, the design change included system testing to establish the throttled position of another damper to ensure the flows would be limited and not allow containment nitrogen and gases to be drawn into the reactor building exhaust plenum.

(3) Controls over design information are not adequately established to ensure the correct information is provided for third-party analyses. For example, one engineering manager indicated he was not aware of any design engineering interface with GE regarding the fuel reload analysis and the control of design information necessary to support the various reload and transient analysis. During discussions of incorrect in-service testing valve stroke time requirements, one corporate engineer indicated the latest core reload analysis included a change to the stroke time for the LPCI injection valve. The analysis didn't identify the slower time as a concern. As a result, a documented basis for using the slower stroke as an acceptable testing value could not be identified. This lack of a basis is due to a lack of controls over the transfer of this design information.

(4) The understanding of design basis information is limited, with many engineering personnel unable to differentiate between the design basis for the station and the licensing basis. As a result, some aspects of plant testing and operation are not adequately addressed and design information may not be appropriately considered in some activities. For example, a lack of understanding of the relationship among plant technical specifications, the USAR, and the design basis, caused the in-service testing engineer to incorrectly specify the limiting stroke times for motor-operated valves in the RHR system. In another example, in response to questions concerning interactions between

the spent fuel pool cooling system and the RHR, engineers were unable to identify the basis for a USAR statement that the RHR system could provide fuel pool cooling if the fuel pool temperature were to approach 150 degrees Fahrenheit. Additionally, design basis information was frequently not identified as reference material when preparing design calculations. In reviewing approximately eight calculations that support design change packages, the team only identified two instances where the original design information was referenced.

(5) An additional indicator of a lack of understanding of design basis information is the use of tests to establish design input information. For example, when examining the possibility of back flows from the containment purge lines to the reactor building exhaust plenum, testing was performed to identify the correct setting for a damper that was placed in a throttled position. However, the testing did not verify that the system was capable of operating as intended in the design configuration. (i.e., verifying flows in portions of the system that were shown on process flow diagrams) when determining the "correct" throttled position for the damper. In another example, the system resistance of the RHR system was to be modified by replacing the flow trim in the LPCI injection throttle valve and the suppression pool cooling throttle valve. The system was verified to perform properly by measuring pump discharge pressure and flow rate, then using the original pump curve to determine whether the flows and pressures would meet technical specification requirements. This method of testing did not include considerations used in the original system design, such as system configuration for operations, or the changes in system configuration assumed in a post-accident condition. Typically these performance requirements are more complex that the values listed in the technical specifications.

2.3.2 Control of Station Configuration is Not Effectively Maintained

Changes to station configuration are not adequately reviewed or controlled to ensure the station configuration reflects station design. A number of items have been identified that are not consistent with design or licensing documents.

(1) A number of instances of alterations (undocumented modifications) to the design of plant equipment have been identified. These include: a semi-permanent leak collection hose attached to an RHR heat exchanger, a weld patch on the reactor equipment cooling system, and the removal of check valves from the standby gas treatment system. Many of these alterations have been implemented through the maintenance work process without being recognized as modifications. Alterations to plant equipment, through the maintenance work process, do not receive the in-depth analysis and review require to support changes to the design of plant equipment.

(2) The communication of design requirements to the station has not been effectively controlled to enable the station to establish the appropriate procedural controls to prevent placing the plant in an un-analyzed configuration. For example, it was recently identified that the reactor equipment cooling system could be cross-tied in a way that would prevent the system from performing its required function following a design basis accident. Similarly, corporate engineering personnel noted that the station procedures permitted some electrical loads to be cross-tied in a way that differed from the station electrical load analyses, and recently submitted a letter to the station manager to identify the need to revise these procedures to prevent these system alignments. Additionally, station procedures allow the shift supervisor to modify valve lineups from those shown in design change packages.

(3) The lack of readily available design basis information also contributes to difficulties in establishing the correct essential/non-essential system classifications. Some important station equipment has been incorrectly classified as non-essential, such as the control room envelope. Determining the correct classification to be used when performing maintenance or procuring spare parts is sometimes difficult to ascertain.

(4) A comparison of some drawings to procedures and valve lineup checklists identified approximately twenty-one valves on one drawing that were shown on the drawing in a position different than the normal valve position during plant operations. Further discussions identified that the station had taken a position that the procedures controlled valve positions, and the drawings identified the valve

locations. This undermines configuration control because the drawings are a principal design output document and, as a design output document, should reflect the normal system alignment used in the system analysis. Additionally, a limited scope drawing verification program identified several hundred discrepancies, including incorrect labeling of components, incorrect identification of some components, and incorrect references for continuation of systems.

2.3.3 Corrective Action Program Is Not Effective in Correcting or Preventing Problems

The station has experienced many recent events or adverse conditions that result from failed or absent barriers that should have been provided by effective evaluation and implementation of the lessons learned from in-house and industry operating experience.

2.3.3.1 In-House Operating Experience Program

CNS has not consistently demonstrated the ability to identify, aggressively pursue and permanently resolve their own problems occurring at the station. The inability to resolve recurring problems was attributed to failure to conduct thorough root cause investigation or implement the necessary enduring corrective actions. These deficiencies have been noted in the CNS Integrated Enhancement Program.

The DSA team recognizes that the station has made significant changes in the way problems are reported and evaluated. In April 1994, a single problem reporting system, having a low reporting threshold, was implemented. It is evident that aspects of the program have been embraced by station employees, particularly on the working level where over 95% of condition reports are being generated. (Problem reports are being generated at a rate of about 1,420 per year, as compared to about 138 per year in 1992.) Training has been given on the new program, thorough guidelines have been developed on root cause analysis techniques, and expert mentors/coaches have been provided to facilitate implementation of the new guidelines. A corrective action program manager has been assigned, and a group of root cause team leaders has been formed to improve the consistency of root cause analyses.

Notwithstanding these accomplishments, weaknesses continue to exist in the administration of the corrective action program as evidenced by the following:

(1) A growing backlog of problem reports is challenging the station to work on the important issues and avoid being distracted by the number of problem reports generated on events or conditions having lesser significance. Recent statistics show the backlog for significant condition reports (category 1 and 2 CRs) contain more overdue and older issues than the backlog of non-significant condition reports (category 3 and 4 CRs). This indicates that work on backlog items may not be appropriately prioritized.

(2) Root causes are continuing to be determined by an informal apparent cause process rather than rigorous application of the techniques contained in the CNS Root Cause Guidelines.

(3) Examples were found where planned corrective actions don't clearly focus on the root causes. For example, the root cause for failure of Westinghouse DB-50 undervoltage trip assemblies was lack of management commitment to operating experience review program implementation. However, the corrective actions primarily address prevention of the hardware failure and do not address such management commitment issues as performance monitoring and effectiveness reviews, resource and staffing, responsibility and accountability for program implementation, and performance of interface organizations.

(4) Accountability for the corrective action program is fragmented and the vision for the near-term and long-term program has not been finalized.

The DSA team identified the following recurring in-house events to be representative of continuing problems in this area:

(1) On February 1, 1994, while operating at full power, a core spray pump minimum flow valve unexpectedly closed and then automatically opened when the system test return valve was stroked open during valve operability surveillance testing. An

investigation was unable to recreate the anomalous equipment behavior. Because the core spray flow instrument had a history of problems associated with air in the sensing line and the flow transmitter had been removed from service and calibrated earlier that day, the most likely cause was attributed to instrument spiking caused by air in the sensing lines. Continuing evaluation of the event had subsequently dismissed air entrapment when the event recurred in April 1994.

The work history for core spray flow transmitters was then reviewed and numerous problems associated with erratic and erroneous flow indication dating back to 1985 were documented. As recently as March 1993, erratic flow indication had been noted while the core spray pump was running, and the pump minimum flow valve was found to be cycling. An operability determination completed in March 1994, concluded that the system was operable because, in part, unexpected cycling of the core spray minimum flow valves occurs only during testing (note the inconsistency of this statement with the March 1993, event described above). In July 1994, the station concluded that due to the effects of air on the flow transmitter, the minimum flow valve could cycle continuously, and that because the valve operator is not designed for this duty, it could fail in non-conservative position during an actual demand.

(2) In June 1993, the NRC identified a concern regarding the way secondary containment operability testing was being performed. The test was being conducted after substantial preventive and corrective maintenance had been performed, thereby precluding any opportunity to identify degradation that may have occurred prior to the maintenance. No as-found performance data was available. No action was taken by CNS management to address the generic issue of equipment preconditioning, and in May 1994, the NRC identified another case of preconditioning associated with the procedure for sequential load testing of emergency diesel generators. Some diesel generator loads were shifted before the test, and/or circuit breaker cleaning and lubrication was conducted prior to breaker functional testing.

(3) In March 1993, during a plant outage, the B RPS bus unexpectedly lost power resulting in several group containment isolations and a half scram. Investigation of this event was unable to determine the cause. In June 1993, the B RPS bus again lost power and the containment isolation signal resulted in a seven-minute interruption of shutdown cooling. Following this second event, a defective underfrequency monitoring unit in the RPS motor-generator control circuit was discovered and was attributed as the cause of both events. Further investigation of this problem revealed that an engineering work request had been written and approved in July 1990, recommending that the non-essential motor-generator output breaker trips be removed due to repetitive spurious actuations during the previous two refueling outages. The EWR was subsequently closed by mistake before a design change was initiated. The root cause analysis of the recent spurious actuations addressed only the defective underfrequency relay, not the previous similar events, the inadvertent canceling of the EWR, or the breakdown in control and tracking of corrective actions.

2.3.3.2 Industry Operating Experience Review

CNS has not benefited sufficiently from the experience of other stations in the industry. Performance in this area is weak because technical evaluations of industry operating experience documents are untimely, narrowly focused, based on incorrect assessments of the station equipment performance history, or inappropriately conclude that industry problems were unlikely to occur at the station.

The industry operating experience program relies primarily on a single manager to distribute industry operating experience (OE) documents to responsible departments for evaluation and development of corrective actions. The team found that the OE program manager and supporting department managers are not held accountable for carrying out their assigned responsibilities, and in-depth, independent technical reviews of the evaluations are not routinely performed. Further, periodic effectiveness reviews have not been effective in discovering the depth of the problems in the operating experience program (and the implication of these problems on the overall program adequacy) when individual cases of failed or absent

barriers were discovered. Due to the number and variety of recent station events that involve precursor industry events, the station is performing an extensive review of industry operating experience documents dating back to 1982.

The following example was judged by the team to be representative of problems in the industry OE area: In September, 1993, the station evaluated INPO SER 5-93, and NRC IN 93-62. Both of these documents address BWR thermal stratification problems and its consequences. The review concluded that existing station practices and training were adequate to address the concern, and that such an event was unlikely to occur at the station. During a reactor scram in December 1993, reactor vessel temperatures did stratify, and heatup/cooldown rate limits were exceeded. Although this condition was essentially identical to events described in the industry operating experience documents, it went unnoticed by the shift crew, and was also not detected during the subsequent post-scram review. It wasn't until February 1994, when reports of additional industry events were provided to the station, that the post-scram records were reviewed and it was identified that the limits violation occurred.

The following additional events (and their industry precursor documents) involve industry lessons learned that were not taken advantage of by CNS:

- Inadequate sequential load testing of emergency diesel generators led to undetected failures in the load shed logic on May 25, 1994. (NRC IN 991-13, NRC IN 88-83)

- Failure of Westinghouse 480 volt circuit breaker undervoltage trip assemblies led to unrecognized emergency diesel generator overload on June 14, 1994. (NRC IEB 83-08)

- Calibration inaccuracies in feedwater flow instrumentation led to non-conservative indication of reactor power and subsequent power by derating by 0.8 percent on March 11, 1994. (GE SIL 452 and 452 Supplement 1)

- Deficient abnormal operating procedure for loss of feedwater events resulted in unrecognized potential for placing the plant in the power instability region during a reactor water level

transient by tripping a recirculation pump on 12/14/93. (INPO SER 23-93)

- Multiple failures of GE type SBM control switches in August, 1994. (GE SIL 155 and Supplements 1 and 2)

- Control room habitability envelope test failure on April 11, 1994, due to excessive leakage and design deficiency. (NRC IN 86-76)

- Failure to control interfacing ventilation systems during secondary containment integrity tests led to undetected 10-inch penetration with no water loop seal since original construction on March 8, 1993. (NRC IN 90-02)

- Shifting emergency diesel generators loads as part of the test setup before load shed testing in May, 1994 - preconditioning issue. (INPO SER 27-93)

- High pressure coolant injection pump discharge valve failed on September 30, 1993, due to a dislodged motor pinion gear key. (Limitorque maintenance update, INPO SER 9-88)

- Primary containment declared inoperable and shutdown action statement entered on October 11, 1993, due to core spray dual-function valve (mini-flow valve) not meeting licensing basis. (NUCLEAR NETWORK OE 5033 on 1/10/92, and NUCLEAR NETWORK OE 5493 on 8/3/92)

The team recognizes that a change to the way industry operating documents are processed is being considered. The team feels that it is important for the station to study cases such as the ones above in order to determine the program breakdowns responsible for the problems.

2.3.4 Some Equipment Testing and Maintenance Programs Are Deficient

Programs for monitoring equipment performance to ensure safe plant operations have not been effectively developed or maintained to ensure the bases for the programs are adequate and the scope of the programs is appropriately defined. Many of these programs were developed at the time

of initial plant startup, or when the requirements for such a program were first established, and have not been reviewed since that time to ensure adequacy. During the last eighteen months, reviews of some programs have identified fundamental inadequacies in the programs. Examples include:

(1) The 10CFR50, Appendix J program for leak rate testing of containment penetrations and the associated isolation valves was recently identified to be insufficient. Following the identification of penetrations that did not meet expected requirements, a complete walkdown of containment penetrations identified approximately fifty penetrations that had not been previously tested as required. A further review of the adequacy of the testing processes applied identified a number of penetrations that had been tested improperly, such as not testing containment isolation valves in the direction they would be expected to prevent flow during post-accident conditions. Although the program was found to be deficient during this review, some individual testing problems had been previously identified, but had not identified the need for an overall program review. In one case, the boundary valves for a penetration that was not correctly tested had been identified in the technical specifications as the correct boundary valves for this system. Additionally, previous program reviews, including NRC inspections, had led the station staff to believe the program was adequate and problems identified were not indicators of significant program weaknesses. It should also be noted that the lack of available and controlled station design basis information limited the ability of station personnel to ensure the containment penetrations were correctly identified and tested.

(2) The in-service test program for testing important pumps, check valves, and motor-operated valves is deficient in its establishment of the bases for required stroke times for motor-operated valves. As a result of reviews of motor-operated valve stroke time acceptance criteria under the in-service test program, and a comparison with original system design requirements, a number of differences were identified. When questioned about the bases for the differences, station personnel indicated that this problem had recently been identified and a review was in progress at corporate engineering to ensure the valve stroke times were in accordance with design requirements. When asked about the bases for stroke times previous to this corporate review, station personnel indicated the acceptance

criteria were based on valve stroke time requirements identified in the technical specifications or the USAR. Generally, station personnel were unaware of the design valve stroking requirements established in the system design specifications. Additionally, monitoring of pump performance does not ensure that the pumps are operating within expected parameters. As a result of reviews of performance trends for the RHR pumps, unusual performance trends were identified, such as pump differential pressure readings that increased over four quarterly tests, although the normally expected pump performance would be stable or slightly declining. When questioned about evaluations to determine the causes of these unusual results, the program engineer and the system engineer indicated the causes for these results had not been analyzed because they did not fall outside the acceptable pump performance limits. Additionally, establishment of the appropriate pump and valve acceptance criteria is hampered by the lack of a readily available and controlled station design basis.

(3) The program for control of vendor manuals, which ensures these manuals are maintained current and reflect the latest vendor recommendations, does not sufficiently ensure the vendor manuals in use in the plant are the latest controlled copy. Currently, a controlled copy of the vendor manuals is maintained in the station library, but the copies of the vendor manuals available to the maintenance shops are not maintained current with the latest updates. As a result, workers in the field may be working with vendor manuals that do not reflect the latest approved information. Additionally, limitations on resources and conflicting priorities have resulted in backlogs of vendor manual changes awaiting engineering review and over eighty approved manuals for safety-related equipment that have not been reviewed to identify applicable preventive maintenance requirements.

(4) After finding cracks in the reactor equipment cooling system in 1979, GE recommended changing the chemistry in the system and establishing a program for ongoing monitoring for crack growth. At the time, a program was not developed to provide ongoing inspection of the weld joints. As a result, system leaks were not treated as indications of potential system degradation until the current outage when a sampling inspection program was undertaken to determine the extent of weld joint cracking.

2.3.5 Ineffective Engineering Support of Station Operation

A lack of clearly established roles and responsibilities for engineering organizations has resulted in an inefficient use of engineering resources and inadequate engineering support. Contributing to this problem is a lack of an effective management monitoring and assessment process to identify resource inefficiencies and where additional resources are required to maintain effective engineering support.

(1) Documented management expectations for system engineers include many typical engineering duties, such as system walkdowns, maintenance support, and system performance trending. However, assignment of additional duties to system engineers has resulted in an excessive workload for the current level of resources. For example, the majority of engineering work is focused on performing evaluations of condition reports under the relatively new corrective action program. Some engineers indicated that the program requirements result in an average of over forty hours of work for each condition report. As a result of the number of condition reports being prepared, the site engineering resources are unable to process the condition reports as quickly as new ones are being generated, resulting in a growing backlog of condition reports for review. Additionally, non-traditional work assignments to engineering are contributing to the excessive workload. Due to a lack of maintenance procedures and maintenance planning personnel, system engineers are called upon to prepare special work instructions for maintenance activities. As a result of these workloads, backlogs are increasing in a number of areas, such as industry operating experience reviews, NPRDS reports, vendor manual reviews, and procedure reviews. These backlogs are increasing despite system engineers typically working 50 to 110% overtime over the last eighteen months. Due to the increasing backlogs of various reviews and reports, the attention of the system engineers is being diverted from monitoring system performance and maintaining the necessary perspective when investigating the root causes of system performance problems.

(2) Due to the lack of clearly defined responsibilities between corporate and site engineering resources, determining work assignments is sometimes difficult and is currently in a changing condition. As a result, station demands on the corporate organization for support

during the current outage are resulting in significant delays in completing planned engineering activities, such as development of design basis documents, preparation of instrument setpoint calculations, and planned improvements in the modification process. Additionally, the lack of clearly established roles for the corporate engineering organization has resulted in difficulties in identifying the responsible organization for providing support for identified plant problems. For example, when problems were identified in the shutdown cooling and reactor equipment cooling systems, the expected role of the corporate engineering organization was not clear, resulting in one system engineer approaching a contractor for support that could have been provided by the corporate engineering organization. Similarly, corporate engineering personnel have been managing a drawing verification project, with the station role not clearly defined as part of the project planning process.

(3) Additionally, the lack of clearly established roles and responsibilities, as well as excessive system engineering workload and the lack of effective system training for system and design engineers, have contributed to plant modifications that do not correct the identified equipment performance problems, or may introduce additional problems to the system. For example, a modification to replace a core spray system flow transmitter resulted in the installation of a transmitter that is more sensitive than the transmitter it replaced, causing more exaggerated system response to air trapped in the instrument sensing lines. In another case, a modification to install a subsystem to provide backfill for the reactor vessel level instrument reference legs during post-accident conditions was attached to the high point vent piping for the core spray system without providing a vent for either system, resulting in air entertainment in both systems and indicated vessel level transients when the backfill subsystem is aligned to supply the reference legs.

Contributing to the above problems is the ineffective development and use of performance monitoring activities. Actions to monitor many of the current system engineering activities have recently been initiated, and demonstrate that the organization is struggling to keep pace with the inflow of work. Also, these indicators do not provide management feedback regarding completion of many of the formally assigned system engineering activities, such as performance trending and system walkdowns.

Additionally, the monitoring of corporate engineering performance is provided through a monthly report and schedule tracking activities. Currently, the monthly reports identify a number of areas where planned work is not being completed, and do not effectively track progress on short term work assignments in support of current station needs.

2.4 MANAGEMENT AND ORGANIZATION

Significant weaknesses were identified in many areas of the organization. This has been the result of lack of corporate leadership and support that fostered a management culture resistant to change, and inhibited the Nuclear Power Group from reaching for a higher level of performance commensurate with the rising standards of the rest of the nuclear industry. This manifested itself through a lack of self assessment and independent oversight, weak management systems for monitoring plant performance, lack of organizational discipline for planning and execution of plans, and failure to have in place an effective management development program to provide managers with the basic skills for managing systems/processes and leading people. These weaknesses have resulted in a reactive organization which has been unable to identify and correct declining plant performance.

The team drew it's conclusions by reviewing selected documentation and by conducting about three dozen formal interviews and many informal interviews from a vertical and horizontal cross section of the organization.

2.4.1 Impact of Management and Organizational Culture on Performance

Management/organizational culture at CNS has not provided an environment which encouraged open dialogue at all levels of the management and staff, and enabling effective identification and solution of long term problems with the plant, work processes and people. In the team's judgement this management culture, which has existed over a long period of time, has resisted change and has been one of the significant barriers preventing CNS from establishing rising performance standards for personnel and plant in partnership with the rest of the nuclear industry.

(One can define or describe organizational culture as a unique blend of values, beliefs, attitudes, norms, practices, myths, history and self image that becomes "the way things are done." It creates meaning and establishes reference points for determining the conduct of organization members).

The organizational culture that has existed at CNS affects performance in different ways and in many areas. For example:

(1) A welder observed what he thought was rust on a portion of REC piping. The rust was thought to be the result of a through wall leak in the piping. He didn't mention it to his supervisor until three weeks later, and then only after listening to a talk by the new site manager where the importance of the need for the staff to identify problems was emphasized. The timing was unfortunate however, since the REC system had been refilled. This required the system to be re-isolated and the piping drained to facilitate repairs. The initial reaction by the maintenance management was anger and frustration with the welder for not identifying it earlier. This type of management reaction represents a culture which discourages identification of problems. Reactions such as this have the potential for making employees feel they are placing themselves at risk for being an impediment to getting the plant back on the line.

(2) Several system valve mispositioning events were identified by operations. Operations management's proposed response was to re-perform all the valve lineups. The new site manager questioned the response and the overall policy for operating valves and why this policy has resulted in so many instances where valves were found to be out of their intended position. This raised the question regarding policy clarity, which was not very clear, and pointed to a need for changing the policy to establish better controls. This example represents a management culture in which the Operations management addressed only the symptom and failed to address the fundamental problem of why the valves were out of position in the first place.

(3) The station culture has created a worker's perception that they should refrain from proposing improvements that are beyond "minimum compliance" because they probably wouldn't be funded anyway. An example of this was the many missed opportunities to improve the control room emergency filter system (CREFS). This significant improvement, to provide the necessary design basis margin, was continually delayed over several years until it impacted system operability. The subsequent problems with the control room envelope, which was determined to be of marginal design and

unreliable, are well documented and has been one of the barriers to plant startup. This is a further example of the station culture and illustrates again it's impact through the inability or lack of willingness to pursue problems to resolution, that is to fully assure that the control room envelope would maintain an adequate supply of filtered air at the required pressure and beyond merely satisfying the vague technical specifications and USAR requirements. (compliance oriented).

In summary, the team concluded that the CNS has historically resisted change and improvement beyond minimum compliance, and have generally disregarded rising industry standards. Furthermore, management has tacitly or overtly approved of this isolationist approach for many years.

2.4.2 Ineffective Corporate Leadership and Support

Corporate leadership did not assist the site in areas where the presence of strong corporate leadership could have been beneficial. Corporate management has not assured that the management practices necessary to assure success in running a complex, high consequence operation are in place. These include high-level skills and practices, which are generic in nature and not all related specifically to the nuclear process. For example:

(1) A consistent system for the comprehensive monitoring of plant performance, comparing it against industry standards, then holding responsible management accountable for substandard performance has not been observed. Well thought out systems for management of plant activities were not in evidence. Direction was provided through extensive meetings, and accountability triggered mainly by unanticipated events, or prompting by external oversight observations. An example of an ineffective management system was the use of data generated by radiation protection performance. The report is distributed once per month via a single document that travels a serial route through the organization. No accountability forum appears to be used to assure that managers are aware when performance in their respective organization falls short. When corrective action is recognized to be necessary, such as the need for a cobalt reduction program, there appeared to be no clear planning or accountability for addressing the problem. Another example was the lack of monitoring of maintenance performance parameters. CNS does not

systematically track these parameters against performance standards. This results in a process that is managed mostly in a reactive mode. No strong role models for using a systematic approach to management were evident at CNS and no management training program toward this end appeared evident.

(2) Independent oversight has been conducted in a way that had a low probability of success. When problems occurred, they were not used as learning experiences. Corporate executive management did not ensure that these deficiencies were promptly addressed and corrected. The Corporate Board did not challenge SRAB regarding the absence of observations regarding deteriorating performance, in fact there is no evidence that SRAB meeting minutes were routinely reviewed and commented on by the corporate officers with the exception of the vice president, nuclear. Details and examples are provided in Section 2.4.4 of this report.

(3) Historically, comprehensive long-term planning has been insufficient to achieve substantial improvement in organizational performance. Recently plans have been put in place for an integrated business planning process. See details in Section 2.4.6 in this report.

(4) The Nuclear Power Group has not effectively utilized or developed more contemporary human resource and organizational development methods to assure strong management and supervisory performance. This has resulted in management performance weaknesses throughout the CNS organization, which has contributed to deteriorating plant performance. The Integrated Enhancement Plan/Business Plan currently contains some objectives toward this end and some actions, such as management development training, are ongoing. This program is however, separate from a program for management development under the sponsorship of vice president, finance and administration. Rather than use this program, NPG developed their own. This is another area where CNS could have benefited from strong corporate leadership. The example provided the team with further evidence that reinforced the view that CNS encouraged an isolationist approach with the rest of NPPD. See details in Section 2.4.6 of this report.

2.4.3 Weaknesses in Self Assessment

CNS does not have a strong self assessment culture. Although there is a guideline for the self assessment program, in some cases where a self assessment was done, it was ineffective due to a pronounced lack of a self-critical attitude. While the guideline does describe the methodology it does not include good direction and clear expectations regarding criteria for conducting formal, systematic assessments. A review of self assessment report files revealed only sporadic performance of self assessment. Also, during the DSAT review of maintenance, no reports existed when a request was made for the self assessments of MWRs and field observations required by section 8.10 of the Conduct of Maintenance procedure. When performed, the quality of the self assessments varied. Of the two reports reviewed in detail, the radiation protection effort was excellent, however the SRAB assessment was marginal.

The SRAB self assessment, which was done in the third quarter of 1991, concluded that their activities were being "effectively implemented and the Board is making a meaningful contribution to the safe operation of CNS." Contrary to this conclusion, the Board did not detect or confront performance issues which were occurring at the station. A significant lack of ability to be self critical was evident. Poor conclusions not withstanding, the assessment report contained a number of comments and suggested improvements that would have improved the SRAB function had they all been acted on effectively, however they were not. A less rigorous self assessment performed in late 1993, and correspondence between the vice president, nuclear and the SRAB chairman indicated that SRAB performance issues had not been resolved.

Self assessment should also be initiated whenever a significant opportunity for learning presents itself. The CNS staff took such an opportunity by evaluating themselves against an NRC DET report for a BWR reactor facility similar to CNS. A review of 75 findings in that 1991 DET report was conducted and determined that none of the findings applied at CNS. Had the staff performed a more thorough study and taken action on some the findings, problems that are now being experienced at the station could have been identified and corrected. A close reading of the station's response revealed extensive rationalization of the seriousness of the issues and a shallow assessment of why they did not apply at CNS. One example was Item 70, where the issue was insufficient headquarters support and

oversight. The response cited several examples where this did not represent a problem, including one that the SRAB micromanages the SORC. The fact that the SRAB is micromanaging the SORC instead of assessing the effectiveness of SORC, supports the team's finding regarding the effectiveness of SRAB. That is, the SRAB and SORC lacked sufficient ability to be self critical and were not able to detect or confront performance issues which were occurring at the station.

2.4.4 Ineffective Independent Oversight

NPPD independent oversight was not effectively managed. When they had the opportunity to improve, they either missed the opportunity or, if learning occurred, (as in the case of the SRAB self assessment), follow through of the learning process was deficient. The result was an inability to assess station performance. NPPD independent oversight failed to detect the current performance deficiencies existing at CNS. Review of SRAB minutes and SORC minutes along with interviews indicated that these oversight functions believed that CNS performance was essentially strong. Unfortunately, this false sense of satisfactory performance appears to have been initially reinforced by external oversight organizations including the NRC. The performance problems subsequently identified by the NRC and the DSA are generally long standing and do not represent a rapid decrease in performance. In actuality, CNS may not have experienced a significant change in performance, but they have failed to keep up with improving industry standards. It's only the belated recognition of this that gives the appearance of a rapid decline in performance.

The quality assurance function however, differs from SRAB and SORC in that it is a standing organization charged with oversight and possessing true organizational independence. SRAB and SORC, on the other hand, are committees convened periodically, and composed largely of managers with line responsibilities. Because of these differences the causes of their respective failure to identify the performance issues also differ.

(1) The team's conclusion regarding causal factors for the SRAB/SORC failure, was based on SORC meeting observations, review of minutes, and structured interviews and include the following:

- The membership of both the committees was composed of a large component of plant line management. It is apparent that

they have been unable to succeed at differentiating their line and oversight roles. In late 1993, the vice president, nuclear communicated to the SRAB chairman commenting on this concern.

- The corporate management failed to apply the basic understanding of the role of oversight to the nuclear operation to ensure that common pit falls were avoided.

- Neither committee rigorously carried out their entire charter; SRAB's being the SRAB charter and SORC's being the technical specifications with emphasis on paragraph 6.2.1.A.4.e. In 1993, SRAB did a self assessment which identified important areas for improvement; however, there was little evidence that permanent change actually occurred.

- Neither SRAB nor SORC appear to have taken advantage of the opportunity to understand their performance deficiencies in light of and at the time of the earliest indications of the current problems.

- SRAB did not appear to have challenged the QA function when performance problems became evident.

- SRAB was not effectively challenged on its performance by executive management when problems became evident.

- SRAB minutes did not indicate that they ever seriously challenged SORC oversight performance.

(2) The QA problems were more complex. QA generally exhibited low performance combining a) a lack of vision of quality beyond compliance, b) an insensitivity to the need to evaluate performance vs. reviewing programs, and c) lack of management attention to the QA program. It was determined that QA performance may have been diluted by excessive use of their organization for performing staff duties. Additionally, the QA organization was called upon to perform the functions that will now be carried out by the independent review group function. While management had called on QA to perform these additional functions, QA did not adequately perform the

functions required by the regulations and did not uncover most of the performance deficiencies now evident in the line organization.

(3) The QA audits, surveillances and evaluations were generally compliance oriented and performance-based issues were generally superficial and caused QA's credibility with the plant staff to suffer. Further, senior management did not rely on QA as a meaningful tool for evaluation of performance-based technical matters. As a result, QA's effectiveness was significantly impeded. For example:

- The DSA team concluded that QA did not adequately follow up on open/overdue issues to ensure that they obtained senior line management sponsorship for appropriate response to their findings and concerns. This was evidenced by the large backlog of open QA findings, and the growing average days that a finding remained open. Since this is clearly a management issue, CNS management must determine what, in the way of QA follow up, works best for them. In either case, the bottom line is that response to QA issues has been deficient and must improve.

- Furthermore, QA had a weakness in identifying repeat findings to management. CNS performance has been characterized by repeat failures/events that have not been highlighted by QA even though they were identified in audit reports. If QA has pointed out repeat performance deficiencies to the line organization, their efforts were unsuccessful, and rather than emphasize the repeat nature of the deficiencies, QA has typically closed the finding if a previous finding or NCR was still open.

- As evidenced by the above, in the instances where QA identified poor performance in the line organization, response by the line organization was inadequate, and characterized by defensiveness, resistance to findings, and slow response.

- There was no evidence that SRAB challenged QA to achieve a higher level of performance nor did it bring performance deficiencies to the attention of executive management.

2.4.5 Ineffective Management Systems

Management systems appear to be weak at CNS. A consistent system for the comprehensive monitoring of plant performance, comparing it against industry standards, then holding responsible management accountable for substandard performance has not been observed. Neither collective nor individual department level indicators or management tools are available to routinely and systematically assess performance toward established goals. During many management interviews it was stated clearly that these management tools were not used. Similarly, initiatives for correction or improvement frequently languished due to a similar lack of control. Some examples include:

- Important programs, such as cobalt reduction identified by the radiation protection self assessment, Integrated Enhancement Program progress/updates, and initiatives stemming from the 1992 SRAB self assessment were not accomplished because the commitments are either not systematically tracked and/or managers held accountable.

- Important maintenance parameters are not tracked and controlled in a systematic way.

- Existing backlogs of CR's TPCNs, PCNs, PTMs, MWRs, would benefit from a systematic management approach to assure that management expectations on prompt processing and backlogs are being consistently met.

- Monthly radiation protection reports with important management control information is circulated serially, requiring time to complete the review and the distribution is followed by no clear accountability.

In summary, overall corporate performance monitoring was determined to be weak. Furthermore, the level of skills necessary to set up and manage these systems are not apparent nor is there any training being conducted to provide these skills. Strong role models, which would provide expectations regarding the need for these systems have also not been evident. Since these are universal business skills not unique to nuclear power, it could be expected that the corporate leadership would ensure that CNS is practicing them, but again that leadership was not evident.

2.4.6 Inadequate Use of Standard Human Resource Concepts

The Nuclear Power Group has not effectively utilized or developed more contemporary human resource and organizational development (HR/OD) methods to assure strong management and supervisory performance. This has resulted in management performance weaknesses throughout the CNS organization, and has contributed to deteriorating plant performance. Furthermore, the corporate HR/OD resources appear inadequate to meet the need. There are individual performance issues that have contributed to many aspects of the current performance problems at CNS, whether it has been workers choosing against their managers' expectations and not using procedures, or supervisors failing to plan, communicate, maintain accountability or follow administrative procedures; or managers choose to perform in the reactive mode, ignore industry changes or do not properly incentivize their organizations. HR/OD tools that could have helped correct this category of problems were not generally made available to the personnel at the site or, if present (such as the performance review program) not used with enough skill to affect improved performance.

Adding to the problem was that the corporate HR organization is located over 120 miles from the site with only one clerical person present at the plant. This in spite of the fact that one-third of the company's employees are at CNS. Further, interviews have indicated that the company does not to possess a significant OD capability.

Management and supervisory training was available from the corporate HR organization, but has not been utilized to a significant degree by the site organization. Interview data implied that HR assistance initiatives made toward the site were rebuffed, ignored, or given low priority. During an interview, an I & C foreman indicated that he has had three to four days of supervisory training since assuming his role five years ago. Most managers have not received any supervisory or management training.

Based on interviews, the selection process for filling management positions has been biased toward technical competence with no apparent strong analysis of management potential. In the case of supervisor selection, there remains a strong seniority component. Currently available technology for targeted selections for filling vacancies have generally not been used, reducing the likelihood of selecting the best talent for open positions from

either inside the District or, up until the most recent past, from outside sources.

Position incumbency appears unusually long. Rotation for career development is limited. During interviews, some managers stated that there were incumbents who were reluctant to assume their current positions in the first place and had made those concerns known in the selection process.

The team was informed that there is a performance review program in place, but interview feedback indicated that, while the forms are completed, real use of the program to improve personnel performance is scattered and ineffective. Discipline does not appear to be used as a tool in shaping performance.

2.4.7 Ineffective Planning and Prioritization

CNS is weak in the organizational discipline of planning and execution of plans. This has been a significant contributor towards their difficulty in achieving improvement and solving long term problems. In general, activities are not well planned, contributing to an observation that programs and corrective actions are initiated but not carried through to completion. Current programs and management controls have not required or promoted the use of strategic or tactical planning. Existing planning and scheduling systems have been ineffective. As previously noted, management has fostered an environment in which production and work accomplishment has usually been given the first priority with pressure on the staff to achieve results with minimal delay. Non-routine activities are frequently planned orally and launched without the benefit of a thorough plan. Activities were observed to "out run" plans before planning was complete or even begun. Examples include:

- Initially, there was inadequate planning and work instructions for correction of improperly engaged spade lugs in safety related terminal blocks.

- There was a poorly developed plan based on informal, verbal criteria for selection of operating experience items to review in response to an NRC Confirmatory Action Letter.

- The initial NPPD response to NRC concerns regarding preconditioning was not comprehensively planned. This resulted in ineffective field direction, communication of management expectations and management oversight. Examples of proceduralized preconditioning conditioning were observed that were not properly nor expeditiously dispositioned in accordance with management's expectations.

- The new corrective action program was implemented in April 1994, however ownership, accountability, goals, and vision for the long-term program has not been clearly established.

- The CAP program manager and root cause team leader organization have been staffed but the group has not been institutionalized via charter statement or program plan.

- Indications are that the development of a new work control program is proceeding without a comprehensive, management accepted project plan.

- Task assignments and parameters for investigation and response to plant problems with valve lineup discrepancies and motor-operated valve testing discrepancies were unclear. The vice president, nuclear or the site manager had to intervene in both cases to ensure that safety issues were addressed and adequate plans developed.

- The absence of a centralized maintenance work scheduling process has resulted in additional equipment out of service time, lost maintenance production hours, and increased maintenance backlog. The lack of a work scheduling process also has placed a heavy administrative burden on the shift supervisor to coordinate work.

Strategic, or long-range planning, was also noted to be historically weak. Recently there appears to have been improvements in this area. In response to a growing awareness of performance problems management initiated a Near Term Integrated Enhancement Program IEP which represented a plan for near term improvement in specific areas identified as deficient. The program was published then updated in May 1994. In parallel to this effort, CNS management recognized the need for a more comprehensive, longer-term focus in today's nuclear environment, and developed a four-year business plan. The actions delineated in the IEP were integrated into the

Business Plan. In general, the new plan represented a good first step in long-range planning; however, it failed because:

- A systematic practice did not hold responsible managers accountable for timely completion of their respective actions.
- Branch Business plans, referenced in the Business Plan were not developed with appropriate staff involvement and buy in, and with sufficiently detailed tasks and responsibilities assigned to assure accountability.
- The "EXPECTED RESULTS" and "PERFORMANCE MEASURES" sections of the plan were not specific enough to enhance accountability.
- The plan did not get resource loaded along with the base line work load, and with the budgeting and control process firmly linked to the long range planning process to ensure that resources are available for improvement.

In summary, the team concluded that the IEP/BP was not fully successful due to the above factors. Further, it is the team's understanding that the business process is currently undergoing significant revision. The team did not have an opportunity to assess this new process.

2.4.8 Potentially Degraded Safety System Capability

Several issues identified by the station and the DSA team have the potential to reduce the margin of safety in important plant systems. Although some of these issues have been, or are currently being addressed by the station on an individual basis, they currently could represent a potential reduction in the margin of safety when viewed in the aggregate. The individual areas include the following:

(1) Preconditioning of equipment prior to performance testing may have corrected performance problems before they could be identified. In June 1993, the NRC identified a concern that prior to conducting secondary containment integrity tests, the station was performing preventive and corrective maintenance with the objective of passing the test, thereby precluding any opportunity to identify potential

degradation that may have occurred prior to the test. Subsequently, in May 1994, a similar situation associated with emergency diesel generator load shed testing was identified. In both cases, system performance deficiencies degradations were revealed when followup tests were performed in the absence of preconditioning. Since this time, additional examples of both procedurally established and unintentional preconditioning have been identified. Although actions have been taken to alert station personnel to identify and prevent preconditioning in the future, a review of station procedures is underway to identify additional cases, the DSA team found that insufficient guidance exists for evaluating these cases to determine whether the potential for reduced system capabilities exists due to past practices.

(2) Implementation and adequacy of the status control process does not ensure systems and components are controlled in the condition intended. Examples include the following:

- many examples of recently identified valve and switch mispositioning events
- valve lineup sheets have many known deficiencies
- clearance order program implementation problems have resulted in components being out of their required position and are violations of procedure requirements

In addition, in May 1994, a temporary blocking device (tie-wrap) was found installed on an undervoltage trip assembly of a non-essential 480 volt motor control center feeder breaker that rendered the load-shed function inoperable and could have potentially resulted in overloading of the emergency diesel generator. The blocking device was installed by procedure during the Spring 1993, refueling outage, but was inadvertently left in place due to lack of a procedure step to remove the device. The station conducted a special review of procedures that identified and corrected additional similar procedure deficiencies.

(3) There have been several recent events or adverse conditions at the station that indicate that lessons that should have been learned from

in-house and industry operating experience have not been incorporated into the station's operation. These situations have been caused by failure to conduct thorough root cause investigations, thoroughly evaluate industry operating experience, or implement enduring corrective actions. The station modified its problem reporting system, established a corrective action program manager, conducted root cause training, obtained the services of root cause analyses coaches/mentors, and is conducting a review of actions taken in response to some industry operating experience documents that date back to 1982. Nonetheless, there is a lack of rigor in recent root cause analyses, corrective actions that insufficiently address the root cause, unclear responsibility and accountability for the corrective action program, a large backlog of incomplete root cause analyses and corrective actions, questions regarding the adequacy of the industry operating experience review scope, and lack of management follow-through on the commitment to upgrade the corrective action program.

(4) The Station and corporate engineering organizations have not provided timely support to the station. Examples of issues that could potentially reduce the margin of safety include the following:

- Ongoing monitoring of the reactor equipment cooling piping had not been performed to detect continuing intergranular stress corrosion cracking (IGSCC) caused by previous system chemistry, resulting in the need for extensive system inspections when a leak recently developed.

- Only nine design criteria documents have been completed since a reconstitution effort began in 1986. In addition, activities to control station design are not sufficient to ensure analyses are based on correct and current design information; because, in part, many system engineers are unaware of how to locate design basis information.

- SORC approved MWRs were sometimes used to expedite modification to the plant. Instances were identified where the subsequent design change package corrected design errors in the MWR-implemented modification. Some design calculations were not prepared until the modification had been installed.

- The station identified deficiencies in the local leak rate test program that resulted in insufficient verification of the integrity of more than 50 containment penetrations. The DSA team identified lack of an adequate basis for acceptance criteria and valve stroke times contained in the pump and valve in-service testing program.

- Deficiencies were identified in the control of vendor manuals. In addition, about 87 safety related vendor manuals have not been reviewed to identify preventive maintenance requirements for associated components. A second review is required for about 30 additional manuals due to an inadequate first review.

- Some changes in station configuration control are not adequately reviewed or controlled to ensure the station configuration reflects station design. Examples include several hundred station-identified drawing discrepancies, relay settings that are not in accordance with current design calculations, standby gas treatment check valves that have been removed, drawings that do not identify expected valve positions, drawings that show valve positions that differ from valve lineup checklists, and procedures that permit shift supervisors to change valve lineups from those shown on drawings.

(5) Work activities on plant equipment are frequently started before a fully planned work package is available, and without first determining if other related work activities should be performed concurrently. This resulted in excessive system outage durations since systems are repeatedly removed from service because no work was able to be performed in accordance with vendor specifications due to insufficient procedural guidance and inadequate work plans. It was noted that these problems may be related to adverse trends over the last three years in HPCI system and diesel generator system unavailability.

(6) Maintenance is not consistently performed to assure equipment availability. Previous maintenance activities have resulted in nonconforming conditions, degraded plant equipment, increased out-of-service time, and rework. Examples include recent RHR pump overhauls using special instructions in place of approved procedures, replacement of emergency diesel generator components without a

replacement of emergency diesel generator components without a procedure, 4160 volt circuit breaker misalignment problems, and rework to adjust the service water pump impeller clearance.

Some long-standing equipment problems have not been identified for corrective action. In addition, the team found a number of station-identified problems on important equipment that represent a potential challenge to plant operations. Examples include continuing problems with the main turbine bypass valves, excessive silt in the service water system that is compensated by operation of shutdown cooling with full service water flow and throttled reactor coolant flow (through a valve that isn't designed for throttling), silting that plugs instrument sensing lines, drywell sump level switch reset problem, excessive seat leakage on a reactor feedwater pump that necessitates closure of a manual valve and extra demands on operators, spurious actuations of the standby gas treatment system fire detector resulting in manual isolation of the deluge valve and the need for local operator action in the event of a fire, and unexpected opening of HPCI, RCIC, and core spray system pump minimum flow valves during surveillance tests.

2.4.9 Additional Observations

2.4.9.1 Resources

CNS appeared to have had the financial resources available to conduct a quality operation. Staffing has been appropriately studied and is adequate in most areas. Where deficiencies were noted, appropriate actions are being taken with the possible exception of short-term responses to needs generated by an accelerated event investigation program. Funding appears to have been adequate. The Electric Utility Cost Group (EUCG) three year rolling average O&M costs, less fuel, $/installed KW, placed CNS in the second quartile, slightly less than the industry median. Senior plant management stated that funding has been adequate. Interviews of corporate financial managers indicated that the budgeting process generally provided the nuclear operation with requested funding.

With regard to staffing, a recent study indicated that staffing tended to be slightly low in the site engineering group and in maintenance. This was based on steady state, non-outage expected staff levels reported in the "1994 Staffing Analysis Report" by Tim D. Martin & Associates, Inc. The

engineering management indicated that engineering staffing increases were in progress. Maintenance staffing was more complex however, since the study indicated that maintenance was low, and in the judgment of the DSA team, based on historic backlog performance and current planning and scheduling issues, there has been no apparent significant shortage of mechanics. On the other hand, staffing for the planning and scheduling function may not be sufficient. Recent expansion of the operating experience assessment function has locally stressed station and corporate staffing. In summary the team concluded that, although the staffing study indicated only localized shortages, the current performance improvement efforts will probably place significant additional stress on the organization. However, without the benefit of effective work planning and prioritization and good long range planning, resource utilization effectiveness could not be determined.

2.4.9.2 Budget and Control

The team concluded that the systems in place for budget and control are conventional and adequate to support improving performance if coupled to the new Business Planning process. Budget and control activities have been conducted in a manner not atypical to other facilities. Financial requirements are generated at appropriate levels within the organization and rolled up to the corporate level. Reasonable challenges are given throughout the process. Reports containing actual O&M expenditures, on a booked basis, versus budget are compiled monthly by a site accountant and forwarded to the responsible managers. Nuclear normally budgets an O&M annual contingency of approximately 4%.

Capital budgeting was also determined to be conventional. The budget was typically not fully spent due to limitations in the execution of spending plans. Carry over of unspent capital was practiced giving greater assurance that funding for necessary improvements and repairs was available.

As mentioned previously, funding for the nuclear program appeared to be adequate for normal activities but the budget and control process is not well tied to the long range planning process. Instead, it appears that resource planning has traditionally been based on historical performance with programmatic escalators added in.

3.0 ROOT CAUSES

3.1 Senior management has been ineffective in establishing a corporate culture that encourages the highest standards of safe nuclear plant operation.

Station and corporate management has been ineffective in fostering a heightened sensitivity and awareness to issues that affect nuclear safety. Weaknesses in nuclear safety consciousness have resulted in station programs and processes that do not promote the highest standards of nuclear plant operation. Key elements of a nuclear culture - continuous improvement, learning from experience, conservative decision making and a questioning attitude - were found to be lacking at CNS. The net result was that long-term performance became governed more by the bounding conditions of problems, often regulations, rather than being under the careful guidance of a management team with high performance standards. These weaknesses were evident in many of the performance issues identified during the assessment including:

- work processes and procedures that favor production over doing it in accordance with industry standards

- programs and processes that are intended to meet requirements rather than high performance standards

- a lack of critical review and oversight by all levels of station and corporate management.

Station and corporate management failed to establish rising standards for personnel and plant performance that is evident throughout the nuclear industry. Complacency, exhibited by programs and processes that "do business the way it has always been done," has contributed to the station's inability to keep pace with the nuclear industry's rising standards of excellence. Lack of corporate support in strategic business planning, engineering, human resources and critical assessment of performance further demonstrates weaknesses in senior management understanding of and sensitivity to nuclear plant operations.

3.2 Senior Management did not establish the vision supported by adequate direction and performance standards to improve station performance.

The team found that the CNS management was focussed on immediate, real-time issues and frequently did not apply longer range vision, provide the necessary levels of direction with clear ownership and strong contemporary standards of performance to plant programs and problems.

- Failure to establish and enforce high performance standards at the station contributes to many of the performance weaknesses observed. Low performance standards often led the CNS staff to make decisions that expedite the resolution of the issue at hand without full consideration of the long term impact on safe and reliable plant operation.

- Combined with these low standards, and a lack of vision and direction has helped perpetuate unsuccessful programs and weakly resolved problems. Managers, caught up in immediate activities, have failed to recognize the need for broader, longer range actions. Many issues were exacerbated by narrowly framed solutions. Lack of performance standards resulted in shallow technical evaluations and a lack of recognition of, or acceptance of, long-term problems. The team found high levels of maintenance re-work and excessive reliance on skill-of-the-craft for field problem solutions. In several cases, fundamental quality requirements such as torquing, foreign material exclusion, and vendor instructions were not applied to safety related maintenance. Ongoing problems with plant and system status control, procedure quality and adherence, the lack of a strong work control program, weak industrial safety practices, ineffective independent oversight and quality assurance program, and a general problem of inadequate programs that do not meet regulatory requirements, all reflect standards which have not kept pace with industry practice.

- Mid- and long-range planning has only occurred on a limited bases. The NPG Business Plan has articulated an organizational vision which emphasizes high safety standards, reliability, and cost effective production. Although management has had a growing awareness of a less than adequate performance and has begun to apply their vision of

desired performance by way of the Integrated Enhancement Plan and the NPG Business Plan, implementation of these plans have suffered from lack of accountability and have also been overtaken by plant problems and restart activities.

- Corporate management, except for the vice president, nuclear, has had little apparent involvement in helping set the direction for the NPG.. Corporate management has not demanded strong oversight of NPG activities, and has been ineffective in providing direction and support in areas where the corporate staff should be capable, such as human resources and organizational and management development.

- The lack of vision and direction has also extended into program development and implementation. For example, many of the plant programs (ISI/IST, Appendix J, engineering programs for vendor manuals, equipment performance monitoring, etc.) have been identified as problematic by the station and were included in past improvement plans. Few of these have had extensive or structured input from management which reflects their published vision and expectations for performance. Insufficient management direction has been the primary cause for ineffective and untimely engineering support. Although existing programs contain management expectations for engineering duties, management's assignment of reactive workloads to engineers has effectively precluded the staff from fulfilling these expectations of dealing with the routine workloads and improvement efforts.

3.3 Ineffective monitoring and lack of critical self assessment have prevented management from recognizing program and process deficiencies and making the necessary improvements.

Many of the performance problems observed by the team and other external organizations could have been identified by effective management monitoring and self assessments of station performance. Examples of this include:

- Ineffective engineering support evidenced by their inability to recognize and correct system and equipment degradation, excessive backlogs and delays in completing important work such as design basis documents and vendor manual upgrades.

- Failure to recognize long-standing equipment problems noted during maintenance, such as the RHR heat exchanger primary water leak.

- Excessive rework, which contributed to increased system and equipment unavailability, caused by a lack of monitoring of work in progress, not providing adequate QC, and poor maintenance work procedures and practices.

- Lack of monitoring and feedback by the line organizations to the training department regarding the quality of, or lack of, training.

- Ineffective corrective action program monitoring and adjustment..

Independent quality oversight by NPPD has been similarly ineffective. The SRAB has failed to provide oversight by not challenging QA, not recognizing plant performance deficiencies, and not correcting recognized weaknesses in its own performance. Quality Assurance oversight has been ineffective because of its inability to detect performance deficiencies, inability to influence line management when weaknesses were identified, and an inclination toward compliance oriented performance.

3.4 An ineffective management development program has resulted in a lack of management and leadership skills necessary to ensure that strong leaders and managers are available to fill key corporate and station positions.

NPPD has not adequately addressed the management developmental needs of the organization and its employees. This is evidenced by:

- The lack of a human resources professional presence at CNS despite the fact that one-third of NPPD's employees work at the site.

- Supervisory and managerial selection is biased toward technical versus managerial abilities. Once placed into a supervisory position, minimal supervisory training is provided. The training that is provided is not based on any assessment of the individual's needs.

- Skills were lacking for conducting comprehensive monitoring of plant/departmental performance, comparison of this performance

against established standards, and holding the responsible management accountable.

- There is no apparent succession plan in place for developing a cadre of potential future leaders, managers, and supervisors.

4.0 EXIT MEETING

An exit meeting was held on August 19, 1994. The exit presentation material is provided at Appendix C.

APPENDIX A

COOPER NUCLEAR STATION
DIAGNOSTIC SELF ASSESSMENT
TEAM MEMBERS

Team Manager:	Ralph E. Beedle
Assistant Team Manager:	Donald A. Beckman President Beckman and Associates, Inc.
Operations and Training:	David R. Morris Director - Nuclear Assessment Clinton Power Station
	Wade H. Warren Technical Training Supervisor Farley Nuclear Plant
	Robert J. Barrett General Manager - Operations James A. Fitzpatrick Nuclear Power
Plant Maintenance and Testing:	Richard P. Clemens Outage Director Fort Calhoun Station
	Steven F. Verrochi Manager, Mechanical Maintenance Division Boston Edison Company

Engineering and Technical Support:	Robert G. Azzarello Director, Design Engineering Waterford 3 Steam Electric Station
	Charles R. Brooks Program Manager Institute of Nuclear Power Operations
	Joseph L. Connolley Supervisor - Test and Performance Engineering Fort Calhoun Station
	Daniel P. Kimball Manager, Safety Review Group Catawba Nuclear Station
	Gary Welsh Assistant Team Manager Institute of Nuclear Power Operations
Management and Organization:	John Doering, Jr. Chairman, Offsite Review Committee PECO Energy Company
	Steven B. Eisenhart Nuclear Specialist Virginia Power
	Harry Kister Senior Consultant Beckman and Associates, Inc.

Robert D. Ryan
Assistant Team Manager
Institute of Nuclear Power Operations

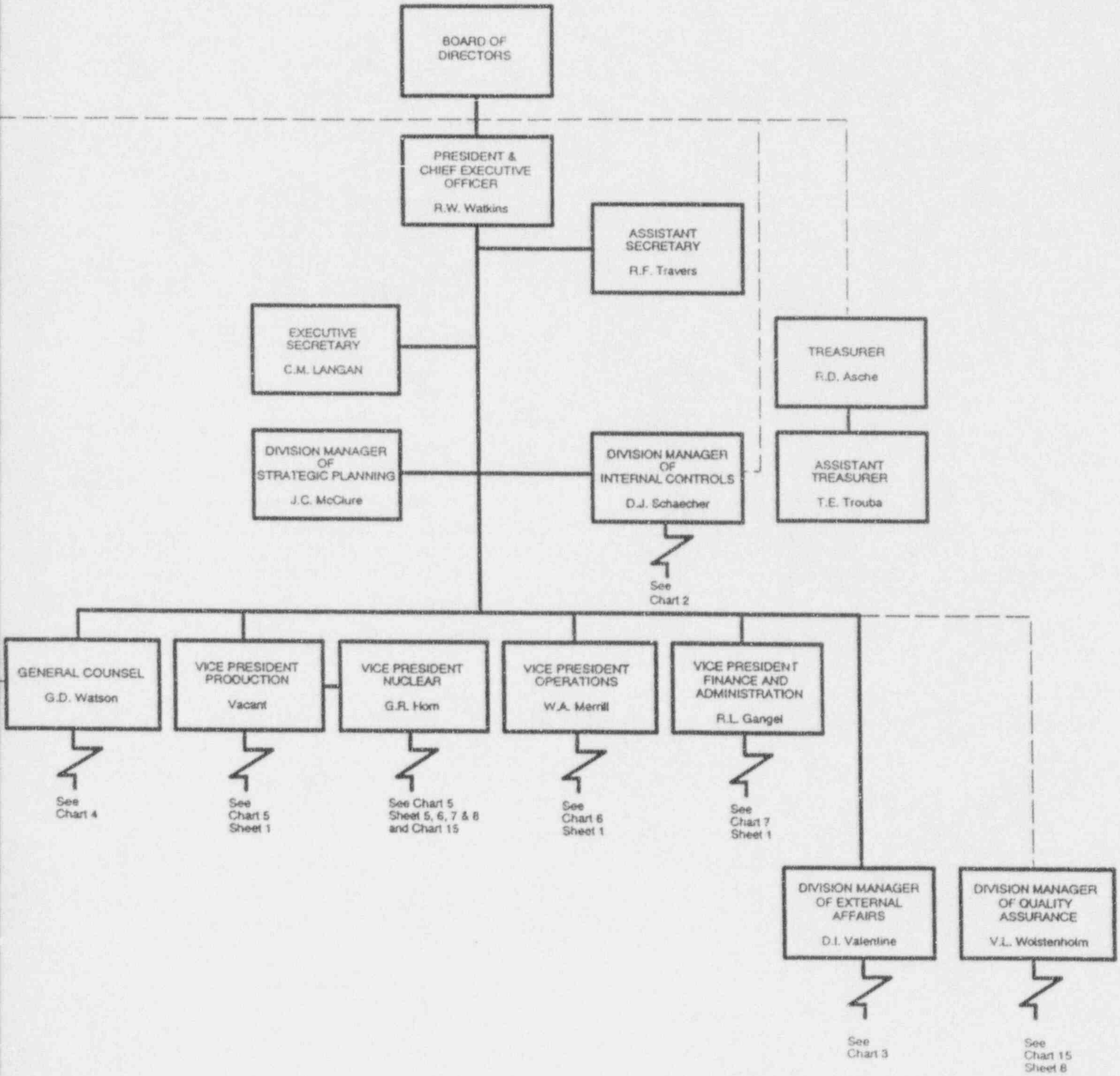
APPENDIX B

NPPD/CNS ORGANIZATION CHARTS

NEBRASKA PUBLIC POWER DISTRICT

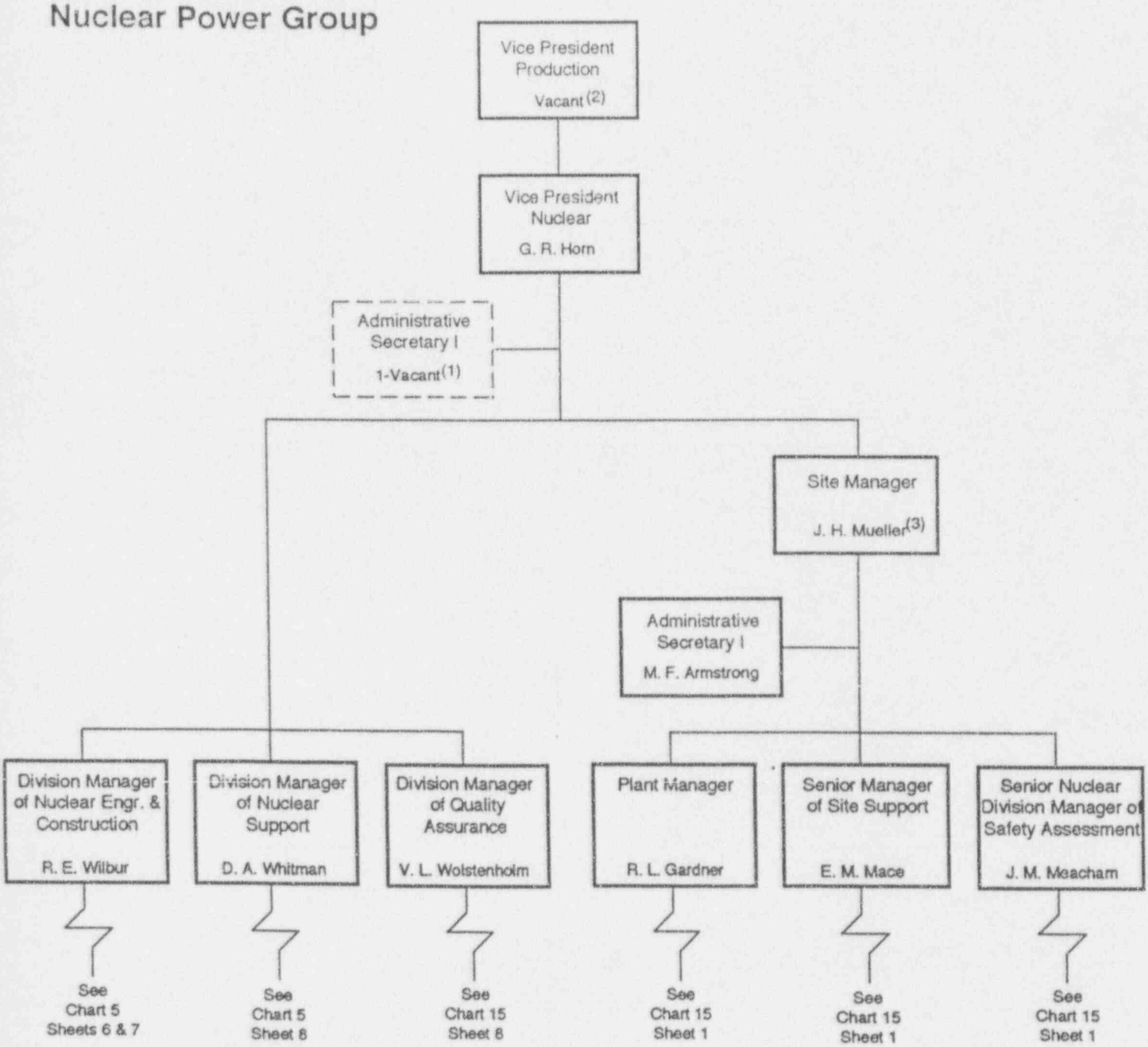
Organization Chart
General Office
Board and President's Staff

CHART 1
7-1-94



NEBRASKA PUBLIC POWER DISTRICT

Organization Chart
General Office
Production
Nuclear Power Group

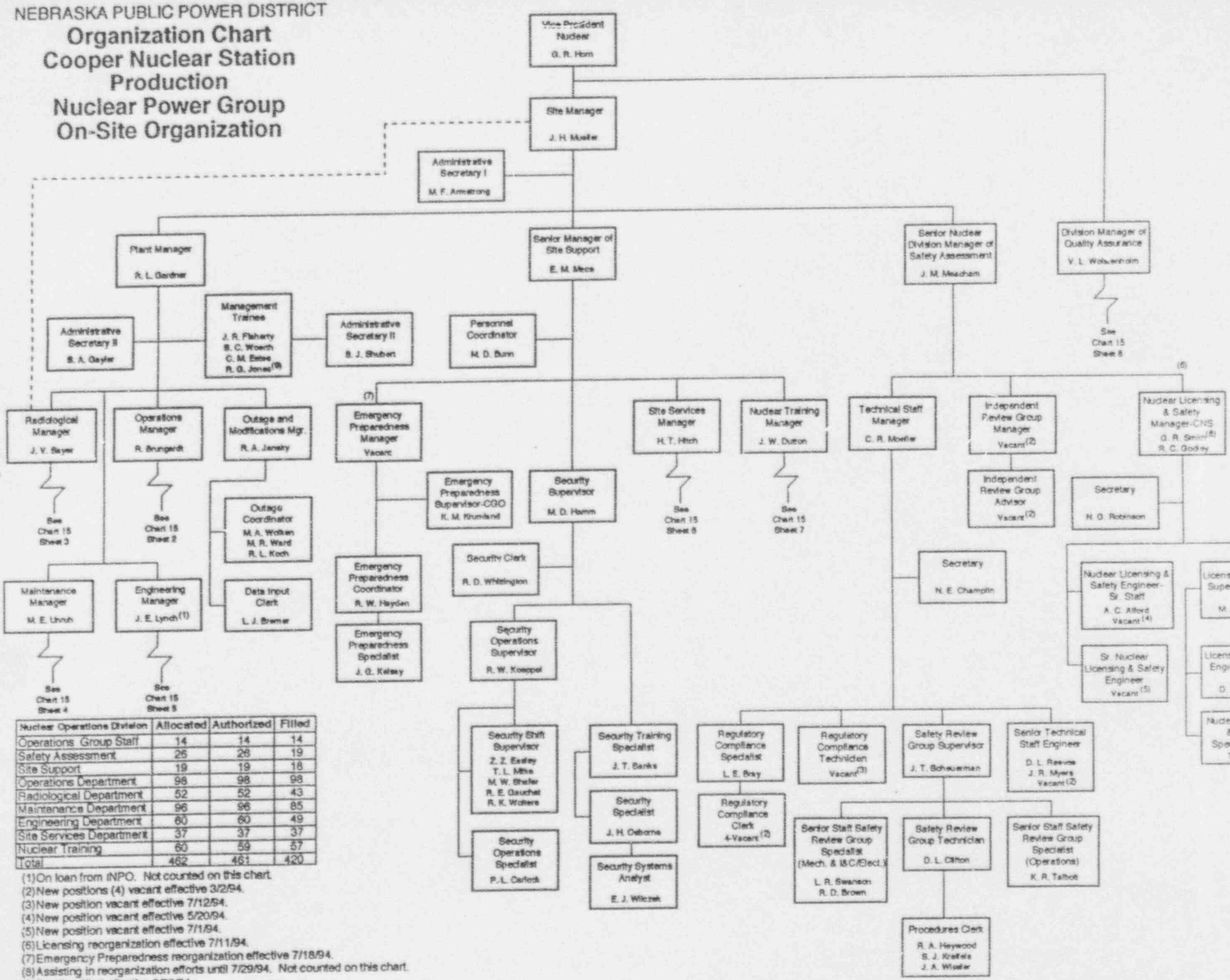


Nuclear Power Group	Allocated	Authorized	Filled
Executive Staff	9	8	8
Nuclear Engr. and Constr.	102	100	97
Nuclear Support	8	8	8
Quality Assurance	28	28	26
Safety Assessment	26	26	19
Nuclear Operations	320	320	289
Site Support	116	115	112
Total	609	605	559

(1) Position vacant effective 1/1/94.
(2) Position not counted on this chart. Position vacant effective 4/18/94.
(3) Position filled effective 7/11/94.

NEBRASKA PUBLIC POWER DISTRICT

Organization Chart
Cooper Nuclear Station
Production
Nuclear Power Group
On-Site Organization



Nuclear Operations Division	Allocated	Authorized	Filled
Operations Group Staff	14	14	14
Safety Assessment	26	26	19
Site Support	19	19	18
Operations Department	98	98	98
Radiological Department	52	52	43
Maintenance Department	96	96	85
Engineering Department	60	60	49
Site Services Department	37	37	37
Nuclear Training	60	59	57
Total	462	461	420

(1) On loan from INPO. Not counted on this chart.
(2) New positions (4) vacant effective 3/2/94.
(3) New position vacant effective 7/12/94.
(4) New position vacant effective 5/20/94.
(5) New position vacant effective 7/1/94.
(6) Licensing reorganization effective 7/11/94.
(7) Emergency Preparedness reorganization effective 7/18/94.
(8) Assisting in reorganization efforts until 7/29/94. Not counted on this chart.
(9) Position filled effective 8/29/94.

Chart 15
7-18-94
Sheet 1 of 8

APPENDIX C

EXIT PRESENTATION

COOPER NUCLEAR STATION

DIAGNOSTIC SELF ASSESSMENT

TEAM DEBRIEF

DESIGN CONTROL

* Design Basis

* Calculation Control

* Change Processes

CONTROL OF STATION CONFIGURATION

* Undocumented Modifications

* Drawing Discrepancies

* Controls for Equipment Alignment

INEFFECTIVE ENGINEERING SUPPORT

* Roles and Responsibilities

* System Engineering Activities

* Corporate Engineering Activities

* Monitoring of Performance

DEFICIENT EQUIPMENT TESTING AND MAINTENANCE PROGRAMS

* Containment Leak Rate Testing
* In-Service Testing
* Vendor Manuals

CORRECTIVE ACTION PROGRAM

CNS actions completed:

- **Single reporting system, low threshold**
- **Training, mentors/coaches**
- **CAP manager/CRT leaders**

Assessment Team Conclusions:

- **Backlog challenging**
- **Lack of rigor**
- **Corrective actions vs. root cause**
- **Accountability and vision**

INDUSTRY OPERATING EXPERIENCE

CNS has not benefited from the experience of others

* **BWR thermal stratification**

  - **Similar event unlikely at CNS**
  - **Occurs during December 1993 scram**
    Not detected
  - **Additional industry events**
    CNS recognizes

WORK CONTROL

* Inadequate Work Planning Resulting in:

  - Increased out-of-service time on equipment

  - Work not performed in accordance with vendor specifications

  - Tendency to work around controls due to lack of independence

WORK CONTROL

* **Inadequate Work Scheduling Resulting in:**

  - **Equipment removed from service over and over within short time frame**

  - **Work is approved on first come, first serve basis**

  - **No centralized review of work for priority**

WORK CONTROL

* Long-standing Equipment Problems not Tracked

* Supervisor Tied Up in Making Process Work

* Outage Risk Assessment Continually Challenged

* Increasing Backlog

WORK CONTROL

PLANT OPERATIONS

* Over-reliance on the SS to manage the control of work

* Over-reliance on the SS to manage the configuration of plant systems

* Lack of LCO Tracking

* Inability to adequately assure Defense-in-Depth of key safety functions

* Lack of Pre-planning

QUALITY OF MAINTENANCE ACTIVITIES

* Rework Required

* Non-conforming and Degraded Plant Equipment

* Increased Safety System Unavailability

* Inconsistent Quality Verifications

* Insufficient QC Independence

LONG-TERM EQUIPMENT PROBLEMS

* Willingness to Live With Problems/Work Arounds

  - RHR Heat Exchanger Leak
  - REC Piping Degradation
  - RHR Motor Bolting
  - Service Water System Silting

* Long-standing Temporary Design Changes

* Failure to Follow Through on Root Causes

PROCEDURE AND INSTRUCTIONS

* Inadequate Procedures
* Work on S/R Equipment Without Procedures
* Vendor Specifications/Requirements Not Included
* Procedure Change Process
* Procedural Adherence

INDUSTRIAL SAFETY

* Standards not Enforced

* Work Expediency

* Work Practices

    - Scaffolding and Fall Protection
    - Use of Personal Protective Equipment

* Clearance Order System Deficiencies

* Performance Indicators

CONSERVATIVE COMPLIANCE AND PROGRAM ADHERENCE

* Activities Conducted are Inconsistent on Communicating a Conservative Approach

* Programs in Place Work Around Other Programs

* Self Assessment Program

* Workers Unsure of Expectations

TRAINING PROGRAMS

* Lack of Management Monitoring/Assessment

* Lack of Management Followup of Expectations

* Lack of Quality Improvements

MATERIAL CONDITION

* Not significant as an issue in itself

* Significant to the extent material condition problems result from other master issues and root causes

  - Work Control

  - Standards

  - Weak Processes

STATUS CONTROL

* Weak Standards

  - Deviated from Existing Clearance Order Requirements

  - Clear Standards Did Not Exist for Who Operates Valves

* Strong Ownership Needed

  - By Operations

OPERATIONS AND TRAINING

POSITIVE ATTRIBUTES

* Demonstrated Aggressive Cleanup Effort to Minimize Contaminated Areas
* Simulator Fidelity - Pride of Ownership
* Demonstrated Efforts and Programs in Place to Monitor and Improve Operational Communication

RESOURCES

FINANCIAL

* **EUCG Data**
* **Interview Data**
    - **Sufficient Financial Resources**
    - **"Accommodating" Budget Reviews**

MANPOWER

* **Tim D. Martin Studies Found Deficiencies**
* **Staffing is Receiving Appropriate Attention (Watch Area)**

HUMAN RESOURCES

CONCERN

* Human Resource and Organizational Development (HR/OD) tools have not been used to improve individual and organizational performance.

* Corporate support for HR/OD is not strong.

  - The On-site HR Support is One Person
  - Management/Supervisory Training
  - Management/Supervisory Selection
  - Long Incumbencies
  - Performance Review Program
  - Change Management

PLANNING

CONCERN

CNS is deficient in the organizational discipline of planning and execution of plans.

SELECTED EXAMPLES:

- **Numerous difficulties in implementing the Corrective Action Program could have been avoided by planning.**

- **Development of a new work control program is being done without a comprehensive plan.**

- **Plans for needed maintenance program improvements, such as procedures, have not been developed.**

PLANNING

SELECTED EXAMPLES (continued)

* No plans exist for a cobalt reduction program.

* Business planning is only now beginning.

MANAGEMENT SYSTEMS

CONCERN

Management systems appear to be weak at CNS.

* A systematic means is necessary to:
  - have clear assignment of management responsibilities
  - establish clear and challenging goals
  - measure and report performance against goals
  - establish EFFECTIVE management accountability forums
  - track and follow through deficient performance until corrected.
  - Change Management

SELF ASSESSMENT

<u>CONCERN</u>

Self assessment at CNS is sporadic.

* Adequate Program Exists

* Quality of Assessments

* Failures to Self Assess

* Management Sponsorship

CNS lacked the requisite self-critical attitude.

* FitzPatrick Response

INDEPENDENT OVERSIGHT

CONCERN

The independent oversight organizations failed to perform their missions. Declining performance was highlighted by an external oversight function.

* **SORC/SRAB Failure**

    - **Membership**
    - **Self Assessment/Learning**
    - **Challenge**

INDEPENDENT OVERSIGHT

CONCERN (continued)

* QA Failure

  - Compliance vs. Performance
  - Resources
  - Interface with Line Management
  - Challenge

SYSTEMS FUNCTIONALITY

CONCERN

Systems indicate a potential reduction in MARGIN OF SAFETY may exist

- **Preconditioning**
- **Plant Status Control**
- **Corrective Action Program**
- **Configuration/Design Control**
- **Work Control**

ROOT CAUSES

Senior Management is ineffective in establishing a corporate culture that encourages the highest standards of safe nuclear plant operation.

ROOT CAUSES

Senior Management did not establish the vision or provide direction supported by high performance standards to improve station performance.

ROOT CAUSES

Ineffective monitoring and critical self assessment prevents management from recognizing and taking action to correct program and process deficiencies.

APPENDIX D
ABBREVIATIONS

AC	alternating current
ADAM	atmospheric dose assessment model
ADV	atmospheric dump valves
AEOD	Office for Analysis and Evaluation of Operational Data
AO	auxiliary operator
AOV	air-operated valve
ASME	American Society of Mechanical Engineers
BWROG	Boiling Water Reactor Owners Group
CAL	Confirmatory Action Letter
CAP	Corrective Action Program
CCW	component cooling water system
CEO	Chief Executive Officer
CFR	Code of Federal Regulations
CM	corrective maintenance
CNS	Cooper Nuclear Station
CO	clearance order
CRG	Condition Review Group
CRT	Condition Review Team
CST	condensate storage tank
CV	control valve
DBD	design basis documentation
DC	direct current
DE	diagnostic evaluation
DEH	digital electro-hydraulic
DG	diesel generator
DOG	deviation from outage guidelines
dp or d/p	differential pressure
DR	deficiency report
DSA	diagnostic self assessment
DSAT	Diagnostic Self Assessment Team
ECCS	emergency core cooling system
EDG	emergency diesel generator (DG)
EDSF	electrical distribution system functional inspection
EOP	emergency operating procedure
ESF	engineered safeguards features
EUCG	Electric Utility Cost Group

FO	fuel oil
FSAR	final safety analysis report
GE	General Electric (Corp)
GL	generic letter
HPCI	High Pressure Coolant Injection
HPES	Human Performance Evaluation System
HR	Human Resources
I&C	Instrumentation and Controls
IEP	Integrated Enhancement Plan
IGSCC	Intergranular stress corrosion cracking
IN	information notice
INPO	Institute of Nuclear Power Operation
IPE	individual plant examination
ISI	inservice inspection
IST	inservice testing
JCO	justification for continued operation
JPM	job performance measures
KW	kilowatt
LAO	licensed auxiliary operator
LCO	limiting condition for operation
LER	licensee event report
LLRT	local leak rate testing
LOCA	loss-of-coolant accident
LOOP	loss of offsite power
LPCI	low pressure coolant injection
MIS	management information system
MOV	motor-operated valve
MS	main steam (system)
MSIV	main steam isolation valve
MSLB	main steam line break
MWR	Maintenance Work Request
MSSV	main steam safety relief valve

NPG	Nuclear Power Group
NPPD	Nebraska Public Power District
NPRDS	Nuclear Plant Reliability Data System
NPSH	net positive suction head
NRC	Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
OD	organizational development
OE	operating experience
OER	operating experience review
O&M	Operations and Maintenance
PCS	primary coolant system
PCN	procedure change notice
PM	preventive maintenance
PMWT	primary makeup water tank
PRA	probabilistic risk assessment
PTM	plant temporary modification
QA	quality assurance
QV	quality verification
RB	reactor building
RCM	reliability-centered maintenance
REC	reactor equipment cooling
RFP	reactor feed pump
RHR	residual heat removal system
RCIC	Reactor Core Isolation Cooling
RPS	reactor protection system
RPV	reactor pressure vessel
RR	reactor recirculation (system)
SALP	Systematic Assessment of Licensee Performance
SE	shift engineer
SER	Significant Event Report
SFHM	spent fuel handling machine
SGTS	standby gas treatment system
SI	special instructions
SORC	Station Operations Review Committee

SRAB	Safety Review and Audit Board
SRM	startup rate monitor
SS	shift supervisor
STO	switching and tagging order
SW	service water system
TBV	turbine bypass valves
TDC	temporary design change
TOL	thermal overload
TPCN	temporary procedure change notice
TS	Technical Specifications
UFSAR	Updated Final Safety Analysis Report
USQ	unreviewed safety question
UVTA	undervoltage trip assemblies
VM	vendor manual
VOTES	valve operation test evaluation system
VP	Vice President
WO	work order