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Team Manager:	Albert F. Gibson
Assistant Team Manager:	Robert E. Carroll

Team Members:

Jonathan H. Bartley
Anne T. Boland
James A. Canady
Charles A. Casto
Bobby L. Holbrook
David E. LeBarge
Mark Lesser
Ronald L. Lloyd
Larry Mellen
David J. Nelson
Leonard D. Wert
William T. Orders
Charles Patterson
George A. Schnebli
Deborah A. Seymour
Melvin C. Shannon
Milton B. Shymlock
Walter W. Stansberry
Eldan D. Testa
John W. Thompson
William J. Tobin

Submitted by: [signature] 5/18/92

Albert F. Gibson, Director
Division of Reactor Safety
Region II

Date Signed

EXECUTIVE SUMMARY

This appraisal of operations was conducted to ascertain the level of performance at Brunswick Steam Electric Plant and to determine the causes of identified deficiencies. The appraisal is based upon the results of five special inspections and upon requalification examinations of sixteen operators. The appraisal integrates the findings of 22 inspectors and examiners from Region II, the Office of Nuclear Reactor Regulation, and the Office for Analysis and Evaluation of Operational Data.

The appraisal revealed that equipment failures and personnel errors have been caused by a failure of management to set high standards for the material condition of the plant and a failure to provide the leadership and support needed for improvement. In addition, lack of critical self-assessment has resulted in the failure to recognize problems and the failure to implement effective corrective actions. These management root causes are similar to those previously identified by the NRC in 1982, 1988, and 1989.

An Integrated Action Plan was developed by the licensee in 1989 to provide a plan for actions to be taken to correct problems identified by the NRC and by licensee audits. Implementation of the Integrated Action Plan was expected to produce rapid and sustained improvements in Brunswick's performance. While some improvements attributable to the Integrated Action Plan have occurred, continuing performance deficiencies indicate that root causes have not been adequately addressed.

Aging equipment and poor maintenance have caused a high rate of equipment failure which has challenged and adversely impacted performance in the areas of Maintenance, Operations, Radiological Controls, Security, and Engineering. Management has been tolerant of degraded material conditions and has initiated few significant upgrades beyond those prompted by the NRC.

Ineffective work controls, especially procedural controls and supervisory oversight, have resulted in several significant events. Management had been slow in identifying these work control deficiencies, but has recently acknowledged them and is developing corrective action plans.

Operator performance has improved over the past two years. Performance on licensed operator requalification examinations and responses to plant events have been good. However, performance deficiencies continue to occur. In particular, mispositioned valves and switches have been a continuing problem. Equipment failures and degradation, lack of teamwork between Operations and other organizational groups, and lack of critical self-assessment have contributed to these deficiencies.

In the area of Radiological Controls, collective annual occupational radiation exposures (which have historically been high at Brunswick) have been significantly reduced in recent years by an effective "As Low As Reasonably Achievable" (ALARA) program. Control of radioactive contamination and effluents has been hampered by equipment failures such as steam leaks and unreliable monitoring equipment. Emergency response capability remained satisfactory, but recurring deficiencies in providing Emergency Preparedness training indicate a continuing failure to take effective corrective action in this area. In the area of Security, performance of the staff continued to be a strength and work was in progress to upgrade facilities in response to previous NRC inspection findings. However, routine maintenance of security facilities remained weak.

The qualifications and performance of the Technical Support Unit have improved since 1989, but the Unit was still not providing the support needed for timely upgrade of the material condition of the plant. Resources were being consumed in reacting to equipment failures and little attention was being given to predicting and preventing future failures. Temporary conditions were not being permanently corrected in a timely manner, and some engineering evaluations were deficient.

The continuing performance problems identified by this appraisal indicate that previous corrective actions have not been fully effective. The management root causes for these performance problems are similar to those identified by the NRC over the past ten years.

APPRAISAL OF OPERATIONS

FOR

BRUNSWICK STEAM ELECTRIC PLANT

MAY 1992

U. S. NUCLEAR REGULATORY COMMISSION

REGION II

CONTENTS

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1. INTRODUCTION

1.1 Background: Historically, the licensee has not been successful in sustaining a high level of performance at Brunswick. NRC inspections in July 1982, revealed significant surveillance program deficiencies at Brunswick. These deficiencies reflected weaknesses in problem identification and correction, as well as ineffective management systems to control safety-related activities. Accordingly, the licensee developed a Brunswick Improvement Program (BIP) which was confirmed by an NRC order on December 22, 1982. The BIP specified 31 action items with the principal purpose to: ensure safety and operating efficiency at Brunswick; strengthen management control; reinforce discipline of operations, procedural compliance, and regulatory sensitivity; focus attention and resources on long-term needs; and ensure implementation of specific area improvements.

Although many short-term improvements in safety performance occurred at Brunswick following the BIP's implementation, an overall decline in Brunswick's performance during the period of July 1, 1987, through August 31, 1988, made it apparent that there was a general failure on the part of CP&L corporate and site management to ensure initial BIP related improvements were sustained and broadened. Specific examples of this included: instances of operator inattention to detail; high failure rates of safety related equipment, prompting two NRC augmented inspections (January and July 1988); management's tolerance of facility operation with potentially unreliable equipment; and management's inability to improve engineering support and ensure that several major design deficiencies were promptly corrected. Because these problems reflected inadequate management awareness and a weakness in the licensee's ability to identify and correct problems, a diagnostic evaluation (recommended by NRC senior management) was conducted at Brunswick in May 1989. The NRC diagnostic evaluation team (DET) identified the following causes for poor performance: (1) inadequate corporate management oversight coincident with a period of past site management weaknesses; (2) the failure to clearly define and communicate site goals, priorities, and expectations; (3) the failure of CP&L management to adequately review and understand Brunswick's level of performance, and the lack of individual accountability and teamwork; (4) an ineffective corrective action and root cause determination program; and (5) an ineffective engineering design and technical support program.

The licensee issued an Integrated Action Plan (IAP) in September 1989, to provide for rapid and sustained improvement. Some improvements since that time are evident, but continuing equipment failures and work control deficiencies raised questions about the effectiveness of the IAP. Consequently, NRC senior management directed that an appraisal of licensed activities at Brunswick be conducted.

1.2 Scope and Objective: This appraisal of licensed activities at Brunswick was conducted to ascertain the level of performance and to determine the cause of identified deficiencies. Performance was appraised in the areas of maintenance, operations, radiological controls, emergency preparedness, security, engineering, and corrective actions.

1.3. Methodology: The appraisal is based upon the results of five special inspections and on requalification examinations of sixteen licensed operators. The inspections and examinations were coordinated by a Region II manager and included the participation of 22 inspectors and examiners from Region II, NRR and AEOD, over an eight week period. Activities were scheduled so that typically no more than four inspectors and examiners were on site at the same time. A tabulation of the inspections which formed the basis for this appraisal is provided in Appendix A.

2. MAINTENANCE

Aging equipment and poor maintenance have caused a high rate of equipment failure which has placed challenges on the Brunswick Maintenance Program. Ineffective maintenance work controls, especially procedural controls and supervisory oversight, have resulted in several significant events. Management has tolerated degraded material conditions in the plant and has been slow in identifying work control deficiencies. Management has recently acknowledged these work control deficiencies and is developing corrective actions.

2.1 A high rate of equipment failure has caused unscheduled shutdowns, reductions in power, and challenges to safety systems. Since September 1, 1991, there have been approximately 20 unscheduled shutdowns or reductions in power due to equipment failures. Numerous component failures have been reported to the NRC in Licensee Event Reports involving primary containment isolation valves, HPCI, and other safety related components. Additionally, a number of Emergency Safeguards Feature actuations were also caused by equipment failures in 1991. Observations of equipment and interviews with station personnel indicate that equipment has been poorly maintained. Examples include heavy rust on anchor bolts and base plates, rust on electrical terminals, radioactive contamination inside instrument cabinets, and evidence of prior flooding inside cable trays and ventilation ducts. Recent failures are attributed to aging and poor maintenance. These failures have caused severe challenges to the station maintenance program, as well as to operations and engineering programs.

2.2 Ineffective control of maintenance and surveillance activities has caused several significant events. Examples of such events are as follows:

January 22, 1991: A maintenance technician was sprayed with radioactively contaminated water when a Residual Heat Removal (RHR) drain valve was opened. The valve had been installed without packing due to an inadequate procedure, and was not identified earlier due to an inadequate post maintenance testing process.

<u>January 25, 1991:</u> A Unit 2 scram occurred while attempting to calibrate a process computer control point on the feedwater control system with the unit at 100 percent power instead of shutdown (or in a refueling condition) as required by the procedure.

<u>March 26, 1991:</u> An attempt to change camshaft bearings on emergency diesel generator number 1 without an appropriate procedure resulted in damaging the camshaft, necessitating shutdown of both units for over a month.

<u>June 10, 1991:</u> An inadvertent isolation of HPCI occurred when a technician loosened a screw on an electrical terminal without a procedure in an attempt to trouble-shoot a circuit.

<u>October 4, 1991:</u> Emergency diesel generator number 3 was started with improper valve timing because a mechanic had failed to use a procedure for valve lash adjustment. The maintenance closure process did not detect that procedure data sheets had not been completed.

<u>January 6, 1992:</u> Emergency diesel generator number 2 failed to start after receipt of a valid start signal, because a solvent used to degrease the diesel on January 3rd had caused binding of the fuel racks and the racks had not been lubricated after cleaning. The cause was an inadequate procedure

These events, and others which occurred prior to and during this same period, are clear evidence of ineffective control of maintenance work activities. The principal causes of these events were inadequate supervisory oversight, inadequate procedures, and failure to follow procedures. Review of licensee quality control records for maintenance activities performed in 1992 revealed 14 examples of no supervision at the job site, 15 examples of inadequate procedures, and 11 examples of failure to follow procedures.

2.3 <u>Supervisory oversight has been inadequate because maintenance foremen have not been provided the support needed for success.</u> Foremen have received little supervisory training and some do not understand the importance of their leadership at the job site. During interviews, some said that the performance of their crews would be the same whether or not they were present. Two described the value of their presence as, "just another pair of hands to do the work". The quality of planning support provided to foremen has been poor in that work request/job orders (WR/JOs) contain errors and inconsistencies in detail. Twenty-two examples of planning deficiencies are documented in 1992 quality control records. Scheduling duties have reduced the time available for supervision. In the past, foremen had full responsibility for scheduling maintenance work. In recent months, the Site Workforce Control Group (SWFCG) has relieved them of some of this burden; but foremen are still expected to provide proposed schedules to SWFCG. A cumbersome administrative process for work control has also reduced the time available to foremen for supervision. A recent evaluation by the licensee found this process to be unnecessarily complex and inefficient.

2.4 Inadequate procedures and WR/JO instructions have contributed to events. The backlog of over 2100 requests for new procedures and procedure changes is large and is an indication of a large number of procedural deficiencies. Elimination of this backlog, without addition, would require about one year of effort by the current procedure writing staff. More independent technical review and management approval is required for issuance of procedures than for issuance of WR/JOs; thus, there has been a tendency to issue WR/JOs when appropriate procedures are not available. Planners said that they sometimes compensate for inadequate steps in procedures by providing alternate instructions in WR/JOs. The result may be maintenance work instructions with inadequate technical managerial review. The camshaft event on diesel generator number 1 was attributed to inadequate instructions on a WR/JO. Definitive criteria have not been established to specify activities for which procedures must be used in lieu of WR/JO instructions.

2.5 Failure to follow procedures has contributed to events. Several events which were attributed to inadequate procedures could just as well have been attributed to failure to follow procedures. The March 26, 1991, camshaft event and the June 10, 1991, HPCI isolation are examples. In these cases, workers performed work that was beyond the scope of existing procedures and WR/JO instructions. Such examples are due to a desire by workers for timely completion of jobs without waiting to obtain procedure changes, and a failure of management to clearly communicate expectations and provide direction regarding procedural compliance. The poor quality of procedures and the lack of supervision at job sites has contributed to these failures.

2.6 Management has been slow to identify and correct problems in the Maintenance Program. Until recently, senior station management did not understand the full extent of problems because they were not properly informed by middle management. During interviews with the NRC, maintenance foremen said that they had complained for years that excessive administrative duties reduced their effectiveness; but they said that no one listened until recently. The previous plant manager said that he was not aware that such problems existed. In the past, when maintenance performance deficiencies occurred, middle management inappropriately defended the maintenance staff and processes. The Nuclear Assessment Department and its predecessor, Quality Assurance, failed to identify these problems and, thus, failed to provide appropriate feedback to senior management.

2.7 Management's expectations have not been clearly communicated to the maintenance staff. At the time of this inspection, planners believed that they were doing a good job and believed that they were meeting management's expectations. Most had received "Commendable" performance ratings. However, senior management was not satisfied with the performance of planners and cited deficiencies in the quality of WR/JOs and in the scope of planning as the reasons. Similarly, craft foremen were satisfied with the skill of their crews; but senior managers considered skill of the craft to be a weakness. Senior management attributed these differences in understanding to a failure of previous middle management to properly convey expectations and to hold subordinates accountable.

2.8 Management tolerated the degraded equipment condition in some areas of the plant. Examples of conditions observed included:

(1) Heavy rust and deterioration of anchor bolts and base plates in the Service Water Building.

(2) Rust on junction boxes and terminal blocks for safety related equipment at the minus 17 foot elevation of both Reactor Buildings.

(3) Leakage of rainwater through the roof of the Unit 1 Control Building and of groundwater through the walls of both Reactor Buildings and the Service Water Building.

(4) Radioactive contamination due to equipment leakage in both Reactor Buildings and in outside areas around condensate transfer pumps.

(5) Leakage of water from the Unit 2 fuel pool into the 50 foot elevation of the Unit 2 Reactor Building.

(6) Rusted security fences and degraded security cameras (1991 NRC inspection findings).

Management was aware of these conditions; but, in most cases, did not take corrective actions until the conditions were identified as problems by the NRC. A typical initial response by managers and other plant staff members was, "you should have seen it a few years ago".

2.9 The licensee has taken steps to strengthen the maintenance work controls. For example:

(1) Seven Brunswick managers visited three plants to review work control processes and a Nuclear Engineering Department (NED) staff member was assigned to the Brunswick Maintenance Unit to provide assistance in improving the work control process. (For the most part, such visits to other plants, even within CP&L, have not occurred until recently.)

(2) A building was leased and equipment is being procured for a new craft training facility.

(3) The Maintenance Unit Manager and three of the five supervisors that report to the Unit Manager have been replaced since November 1991.

(4) A five week supervisory development course has been developed and several maintenance foremen are scheduled to attend beginning in May 1992.

(5) An Institute of Nuclear Power Operations (INPO) assist visit was requested and received to evaluate maintenance work controls.

(6) Contract requisitions were signed in March for five additional maintenance procedure writers and four additional maintenance planners.

3. OPERATIONS

Operator performance has improved over the past two years. Performance on licensing exams and responses to plant events have been good. However, performance deficiencies continue to occur. In particular, mispositioned valves and switches have been a continuing problem and recurring deficiencies were observed in shift crew communications. Equipment failures and degradation, lack of teamwork between Operations and other organizational units, and lack of critical self-assessment have contributed to these deficiencies.

3.1 Operators have been challenged by frequent equipment failures. During the two week inspection of Operations by the NRC (March 13-27, 1992), operators responded to a reactor coolant system leak into the drywell, a failed reactor pressure instrument, a major feedwater heater tube failure, two feedpump speed controller failures, a condensate booster pump failure to start, and a reduction in power due to two post-accident drywell radiation monitor failures. Such challenges are not unusual at Brunswick. As stated previously, there have been 20 unscheduled shutdowns or reductions in power due to equipment failures since September 1, 1991. In general, operators have responded well to such events, but each event and subsequent equipment repairs have increased the opportunity for operator errors. For example, a valve alignment error following repair of a containment atmospheric control sample pump resulted in a breach of containment in February 1992. Subsequent review by the licensee revealed such pumps had been repaired 10 times over a 22 month period prior to this event, but the repetitive failures had not been identified as a problem.

3.2 The Licensed Operator Requalification Training Program remains satisfactory. During requalification examinations administered by the NRC in April 1992, operators demonstrated the skills, knowledge and abilities necessary to safely operate the plant and respond to accident conditions. A significant strength of the operator training program is the capability of the reactor simulator to accurately model secondary containment and radiation release parameters. This provides a unique dynamic setting to instruct and evaluate the operators in these areas of the emergency operating procedures. The crews attentiveness to plant parameters, diagnostic skills and procedural usage were at a level necessary for safe operation.

3.3 Compared to the June 1991 Requalification Examination results, the crews examined during April 1992, demonstrated a lower level of communications, command and control effectiveness. Communications, command and control were identified as a weakness during requalification exams administered by the NRC in May 1990, and as a strength during the June 1991 examinations. The two crew failures during the April 1992 examinations (i.e., one crew was failed by both the NRC and the licensee, and another crew was failed by the licensee only) were attributed to inadequate communications, command and control.

3.4 Operators have worked around longstanding equipment deficiencies and administrative distractions. As of March 12, 1992, there were 200 temporary conditions that were classified as "work arounds" by the licensee. The following work arounds and distractions were observed by NRC inspectors:

(1) Caution Tags:

Numerous caution tags were observed on plant control boards. Some had been in place since 1984. The tags were to alert operators of abnormal conditions such as the switches for two reactor feed pump stop valve drain valves which actually controlled valves opposite from switch labels; torus level isolation valve switches that were erroneously grouped on the control board with the wrong penetration; and diesel building ventilation fans that must be manually started after a diesel starts.

(2) Disabled Annunciators:

At the end of February 1992, there were 32 disabled control board annunciators on both units. Examples included vital battery room ventilation low flow alarms (since 1988) and a radwaste building static pressure alarm (since 1984), both due to spurious actuation. The annunciators were disabled to eliminate nuisance alarms which could divert operator attention from more important annunciators. The licensee's goal was to maintain the number of disabled annunciators below 20 per unit. There was no formal process or objective to further reduce the number below this goal.

(3) Overranged Pressure Gauges:

Several local pressure gauges for safety and non-safety related systems are valved out of service during plant operation. Examples include gauges for HPCI, RHR and Reactor Core Isolation Cooling (RCIC) system pump discharge pressures. The licensee said that the gauges were isolated because pressure spikes had damaged gauges previously installed in these locations. Although the gauges are not required by Technical Specifications, they could provide useful information to operators during local system operation or for independent verification of control room instrumentation.

(4) <u>Several administrative issues reduced operator efficiency and attention to licensed duties.</u> For example: (1) the index for the Caution Tag Log was over 40 pages long and had not been revised to delete canceled entries since 1983, and (2) the book of Technical Specification Interpretations in the control room contained no index to indicate which were still active, and some Technical Specification pages were not marked to reference applicable interpretations.

The above work arounds and distractions are attributed to a failure of management to establish and effectively communicate performance expectations. In addition, a willingness of operators to accept these conditions has contributed to this continuing problem.

3.5 <u>Teamwork between operations and other organizational units has not been fully effective.</u> Examples of ineffective communications and coordination included:

(1) A miscommunication between Operations and Maintenance resulted in removal of a wide range gaseous monitor from service and entry into a limiting condition for operation (LCO) when no work was planned on the system.

(2) Steam jet air ejector hydrogen monitors are required by Technical Specifications but have historically been unreliable. Upgraded monitors were installed to support the new hydrogen water chemistry program, but were declared inoperable when the new chemistry program was suspended. Consequently, grab samples were taken as a compensatory measure to satisfy the Technical Specifications.

(3) The radioactive liquid radwaste flow totalizer had also been historically unreliable. A modification to upgrade the monitor was completed in January 1992, but the monitor was declared inoperable when its quarterly surveillance expired. No one had been assigned responsibility for preparing a surveillance procedure. Once again, compensatory measures were implemented to periodically estimate flow.

(4) Operations lacked confidence in decisions made by Maintenance and SWFCG. This lack of confidence was due to past errors made by these groups and to the limited operating experience of the Maintenance and SWFCG staffs. Scheduling decisions made by SWFCG were frequently changed by operating crews, and senior control operators spent much time reviewing work packages prepared by maintenance planners. As a result, operators are being distracted from their control room duties.

(5) Operators were not always informed of work being performed on their units. This was observed for fire protection and new fuel handling activities.

3.5 **Self-assessment and corrective actions by Operations have not been fully effective.** Contributing causes have been as follows:

(1) Operations has accepted deficiencies that adversely impact their performance. Although several types of deficiencies have been tracked as performance indicators by other groups, Operations has not normally reviewed them or attempted to control their status. Examples included disabled annunciators, caution tags, and other temporary conditions.

(2) Operations has not been self-critical. During interviews, a manager commented "we are the glue that holds this place together" and "we deserved a SALP category 1 rating, but were downgraded because other groups were rated as a SALP 3".

(3) Adverse condition report (ACR) 91-609 was written by Regulatory Compliance to report recurring valve mispositionings. Operations responded that the mispositionings were isolated instances and additional corrective actions were not needed. Mispositionings have continued to occur.

(4) There have been few internal audits performed by Operations. Most corrective actions generated by Operations resulted from outside group assessments.

4. RADIOLOGICAL CONTROLS AND EMERGENCY PREPAREDNESS

Collective annual occupational radiation exposures, which have historically been high at Brunswick, have been significantly reduced in recent years by an effective ALARA program. Control of radioactive contamination and effluents has been hampered by equipment failures such as steam leaks and unreliable monitoring equipment. Emergency response capability remained satisfactory, but recurring deficiencies in providing emergency preparedness training indicate a continuing failure to take effective corrective action in this area.

4.1 **Collective dose is being reduced by an effective ALARA program.** Although annual occupational radiation exposures at Brunswick were among the highest in the Nation throughout the 1980's, a declining trend has been apparent since then. The 1548 person-rem dose for 1990 and 778 person-rem dose for 1991 were the lowest annual exposures received at Brunswick in more than a decade. The 1991 exposure was especially noteworthy because drywell radiation levels were higher than expected due to the effects of hydrogen water chemistry and because two major outages occurred during the period. The licensee was on track to meet a dose goal of 700 person-rem for 1992. The declining trend in exposure has been due to a high level of management attention in this area and due to several initiatives by the Environmental and Radiological

Controls (E&RC) Unit. Station Management reviewed exposures daily in plan-of-the-day meetings and supported E&RC initiatives including chemical decontamination, temporary shielding, hot spot flushes, and replacement of feedwater check valves with those containing non-cobalt alloy seats.

4.2 Many areas throughout the plant were contaminated due to past and present leaks. Examples included soil under condensate transfer pumps, wiring inside instrument cabinets, instrument racks, and control rod drive hydraulic control units. Frequently travelled areas in the Reactor and Turbine Buildings were free of contamination, but most other areas were posted as contaminated. Performance indicators maintained by the licensee showed a decreasing trend in the size of the contaminated area. No deficiencies were observed in contamination control practices, but the following program weaknesses were identified:

(1) Placement of stepoff pads was not consistent; some were inside and some were outside boundary ropes.

(2) There was no health physics oversight on backshifts for the main personnel monitoring station at the breezeway exit. Frequent contamination alarms occurred at this station due to rubidium gas adhering to clothing and hair.

(3) The decontamination facility was located across a walkway from the above monitoring station, providing an opportunity for tracking contamination across the walkway.

4.3 Process and effluent monitoring equipment has not been reliable. LCO logs contained numerous entries for inoperable monitors including a drywell radiation monitor, offgas discharge radiation monitor, and Turbine Building high range noble gas monitor. Such equipment was normally repaired and returned to service within a reasonable period of time. Exceptions included a liquid radwaste flow totalizer that had been inoperable since 1984, and the Unit 2 Reactor Building roof ventilation monitor which had been inoperable since 1991.

4.4 Low concentrations of unmonitored radioactivity were released to the environment from the Turbine Building. Steam leaks inside the Turbine Building produced airborne radioactivity which was released to the atmosphere through an open roof vent and to the storm drain system via air conditioning condensate. The licensee discovered the storm drain pathway in 1991 and the roof vent pathway in 1992. The concentration of radioactivity released was estimated to be a small fraction of regulatory limits.

4.5 The licensee demonstrated satisfactory capability for responding to emergencies during a 1991 exercise, recent drills, and in response to an actual event. A repeat violation was identified regarding emergency response training. Although the training deficiency had little impact on the licensee's response capability, it showed a continuing failure to take effective corrective action. Similar training deficiencies had been identified during three previous NRC inspections since October 1989.

5. SECURITY

Performance of the security staff continued to be a strength. Corrective actions were in progress to upgrade security facilities but routine maintenance of these facilities remained weak.

5.1 Performance of the security staff has been a strength. This performance was attributed to adequate staffing and effective training and procedures.

5.2 Maintenance of security facilities has been poor. This was the subject of a Notice of Violation issued July 11, 1991, which cited degraded security equipment. Station management had been aware of this degradation, but had deferred corrective actions for budgetary reasons. Significant upgrades have since been scheduled for completion later this year including improvements in lighting, alarms, fencing and cameras. However, continued weaknesses were found in the routine maintenance of security facilities. No preventive maintenance program existed, and corrective maintenance was typically assigned the lowest priority for scheduling purposes. A NAD assessment found that the Brunswick Corrective Action Program (CAP) had not been used effectively to identify and correct 52 repetitive failures of security doors in 1991.

6. ENGINEERING

The qualifications and performance of the Technical Support Unit had improved since the 1989 DET evaluation; but, the Unit was still not providing the support needed for timely upgrade of the material condition of the plant. Resources were being consumed in reacting to equipment failures, and little attention was being given to predicting and preventing future failures. Temporary conditions were not being permanently corrected in a timely manner, and some engineering evaluations were deficient.

6.1 Failure to properly evaluate defective bolting used for structural support of walls resulted in continued operation of the plant with walls that did not meet the criteria for a design basis earthquake. The defective bolting included: (1) bolt heads which had been cut off and welded to structures giving the appearance of bolts where none existed; (2) bolts that were cut short eliminating or reducing thread engagement; (3) anchor bolts installed in concrete without the required steel anchor sleeves; and (4) combinations of the above. The licensee identified this condition in 1987, but an improper engineering evaluation resulted in underestimating the number of defective bolts and overestimating the structural integrity of walls inside the Emergency Diesel Generator Building. The improper evaluation was identified by the licensee in April 1992, in response to questions were raised by the NRC.

6.2 <u>The number and duration of temporary modifications due to lifted leads and jumpers have not been effectively controlled.</u> As of April 1992, 55 jumpers were installed as temporary modifications on the two units with some dated as early as 1984. Jumpers and lifted leads were used to disable the 32 annunciators mentioned previously. Except for the goal to maintain the number of disabled annunciators below 20 per unit, there was no procedural requirement or management expectation established to limit the number or duration of lifted leads or jumpers.

6.3 <u>Approximately 200 structures and components have lower margins of safety in seismic design than specified in Section 3 of the Final Safety Analysis Report (FSAR).</u> These deficiencies were identified by the licensee and each was evaluated by the Nuclear Engineering Department to show that affected equipment would withstand a design basis earthquake even though the margin of safety was less than specified in the FSAR; however, the cumulative safety significance of these deficiencies had not been evaluated. Many of the deficiencies were more than two years old. Examples included:

- Bent, twisted, and cracked supports
- Loose and missing bolts and clamps
- Insufficient stiffeners, gusset plates and welds
- Need for new supports
- Need to remove supports
- Reduced safety margin for deep draft nuclear service water pumps
- Defective bolting in EDG Building walls

Engineering design work had been completed for correction of most of these deficiencies, but they had not been corrected due to limitations in budget and outage time.

6.4 <u>The Technical Support Unit was not providing the support needed for timely upgrade of the material condition of the plant.</u> Most Technical Support Unit resources were consumed in reacting to equipment failures. Little time was available for predicting and preventing failures before they occurred. Little time was available for program development or long range planning. The corporate Nuclear Engineering Department was spending about one half of its resources in support of Brunswick.

6.5 <u>The size of the backlog of engineering work assigned to the Technical Support Unit has not been evaluated by the licensee.</u> The backlog is contained in programs such as:

- General Engineering Assist Requests
- Short Term Structural Integrity Program
- Engineering Work Requests
- Interdiscipline Review Requests
- Deficiency Resolution Information Program

In general, the human and financial resources needed to complete this backlog have not been determined. Some station managers believe that the backlog contained more work than can be accomplished in a timely manner. The licensee planned a significant reduction in capital expenditures over the next five years based upon a reduction in major modifications.

6.6 The capability and performance of the Technical Support staff has improved since the NRC DET evaluation in 1989. An effective program for certifying system engineers was developed, and 28 engineers have been certified. The engineers demonstrated a good understanding of the design bases and material condition of their assigned systems. Increased emphasis was placed on support of Operations and Maintenance, and the interfaces with these groups have improved. The educational level of the Unit was increased by hiring several degreed engineers. Very few members of the engineering staff have work experience outside of Brunswick, and few have technical contact with counterparts at other nuclear facilities.

7. INTEGRATED ACTION PLAN (IAP)

The IAP was developed by the licensee in 1989 to provide a plan for actions to be taken to correct problems identified by the DET and by licensee initiated audits. Implementation of the IAP was expected to produce rapid and sustained improvements in Brunswick's performance. While some improvements attributable to the IAP have been noted, the continuing problems described in this report are evidence that it has not been fully effective. The reasons why more rapid and sustained performance has not been achieved are the root causes described in Section 8 of this report. It should be noted that most of the individual task items in the IAP have been considered by the licensee to be completed, but closure of these items is pending licensee effectiveness reviews and independent audits. A significant exception is the implementation of an effective Corrective Action Program (CAP). Lack of an effective CAP has reduced the licensee's capability to sustain improved performance.

7.1 Some improvements in performance are attributed to the IAP. Examples include improvements in: (1) the effectiveness of operator training, (2) the quality of operating procedures, (3) tagging and labeling of plant equipment, and (4) the qualifications of system engineers.

7.2 Continuing problems are evidence that the IAP has not been fully effective. Most of the deficiencies identified by this appraisal were not specific task items in the IAP, but they were within the scope of performance that the IAP was intended to address. For example, reduction of the backlog of maintenance procedure change requests was not a task item; but the IAP was expected to improve maintenance performance. Replacement of rusted pipe supports in the Service Water Building was not an item but overall upgrade of the material condition of the service water system was expected.

7.3 Past weaknesses in Quality Assurance and Nuclear Assessment Programs contributed to an ineffective IAP. Prior to late 1991, assessments by Site Quality Assurance and NAD organizations failed to identify significant deficiencies in licensee performance. The work control deficiencies previously discussed are an example. Since that time, the effectiveness of NAD assessments has improved. The Brunswick Sitewide Assessment completed November 1991, and the Corrective Action Program Assessment completed March 1992, identified significant performance deficiencies and the causes of these deficiencies.

7.4 A weak Corrective Action Program contributed to an ineffective IAP. There were many instances where the Corrective Action Program did not elevate significant issues to the attention of appropriate management. For example, senior management was not aware of the full extent of maintenance work control deficiencies until recently; and no root cause analysis was performed for repetitive failures of security doors or containment atmospheric control sample pumps. Interviews revealed that some members of the plant staff were afraid of making mistakes and were reluctant to report problems to their management. These factors contributed to the weakness of the CAP. The IAP task items which were identified in 1989 were generally being fixed, but a weak Corrective Action Program had not been effective in identifying and correcting problems that had emerged since that time.

7.5 Inadequate management support caused weaknesses in CAP and NAD. The NAD organization began operation in January 1991, before staffing and procedures were complete. For the most part, initial assessments by this organization were not effective. As of April 1992, staffing and procedures were essentially complete; and performance had improved. On the other hand, since its implementation in December 1990, the effectiveness of the Corrective Action Program had not improved. Continuing deficiencies had been identified by NAD assessments and NRC inspections. A major contributor to these deficiencies was the insufficient size, training, and experience of the CAP staff. For example, there were only two technical reviewers assigned to the CAP staff; and they were expected to review all ACRs to ensure procedural compliance, to assist technical groups in root cause analyses and ensure specified corrective actions are adequate. These reviewers had no engineering degrees or experience and had received only introductory training in root cause analysis. In addition, the CAP staff did not have the capability to perform effective independent review of corrective actions.

8. MANAGEMENT ROOT CAUSES

Management has not set high standards for the material condition of the plant and has not provided the leadership needed for effective implementation of improvements. Lack of critical self-assessment has resulted in the failure to recognize problems and the failure to implement effective corrective actions.

8.1 Management has not set high standards for the material condition of the plant. Numerous material deficiencies, such as leaks, corrosion, seismic design deficiencies, disabled annunciators and other temporary conditions, have adversely impacted every area of performance at

Brunswick. A common response from station management when inspectors pointed out these deficiencies was surprise and "you should have seen it a few years ago". Budget constraints and the lack of an effective process for developing and justifying planned expenditures for improvements have contributed to these problems.

8.2 Management has not provided the leadership and support needed for improvement. Evidence of ineffective leadership includes lack of teamwork between organizional units, failure of management to clearly communicate expectations to the plant staff, staff fear of making mistakes, reluctance of the staff to report problems to management, and a failure to clearly assign responsibilities. Management's efforts with regard to improvement have been more effective in developing programs, changing people and reorganization, rather than providing the leadership and support necessary to assure success of improvement related endeavors.

8.3 Lack of critical self-assessment has resulted in the failure to recognize problems and the failure to implement effective corrective actions. Examples include the failure of previous Maintenance Unit management to acknowledge problems, the failure of Operations Unit management to take appropriate action in response to repetitive mispositioning events, and the failure to strengthen the CAP in response to NAD assessments and NRC inspection findings. A review of past improvement initiatives shows that most resulted from findings by outside organizations. Examples include the IAP, replacement of recirculation system piping, and service water system upgrades.

9. EXIT MEETING

The appraisal scope and results were discussed with those persons listed in Appendix B on May 15, 1992. No dissenting comments were presented by the licensee. This report contains no proprietary information.

APPENDIX A

APPRAISAL OF BRUNSWICK OPERATIONS

AREA	DATES	COORDINATOR	NUMBER OF EXAMINERS/ INSPECTORS	REPORT NUMBER
WORK CONTROL	2/17-3/27	D. NELSON	3	92-04
HP/EP	3/9-3/13	E. TESTA	3	92-06
SECURITY	3/23-3/27	W. TOBIN	2	92-08
OPERATIONS	3/16-3/27	C. CASTO	4	92-09
ENGINEERING	3/30-4/10	R. LLOYD	4	92-10
REQUAL EXAMS	4/13-4/17 4/27-5/01	B. HOLBROOK	3 2	92-300
OVERALL APPRAISAL	2/17-4/10	A. GIBSON	2	92-12

APPENDIX B

EXIT MEETING

The following persons attended the exit meeting at the Brunswick Station on April 15, 1992.

	Engineer Staff	NRR/EDO
E. Adensam	Project Director	NRR
K. Ahern	MGR-Operations	CP&L
C. Barham, Jr.	Executive Vice President	CP&L
W. Bateman	Chief, Regionals Operations and Programs	CP&L
H. Beane	Manager Quality Control	CP&L
M. Bradley	MMGR-BNP Project Assessment	CP&L
A. Burkhart	Staff Assistance Team	CP&L
S. Callis	Onsite Licensing	CP&L
B. Carpenter	Secretary	CP&L
R. Carroll	Project Engineer	NRC
L. Coflin	Manger Nuclear Assessment	CP&L
S. Ebneter	Regional Administrator	NRC
M. Ernst	Consultant for CP&L	(Non-CP&L)
L. Eury	EVP	CP&L
B. Furr	Vice President	CP&L
B. Geise	MGR-Simulator	CP&L
R. Godley	MGR-Regulatory Programs	CP&L
C. Gray	MGR-M&CS	CP&L
K. Hampton	Corporate Communications	CP&L
R. Helme	MGR-Training	CP&L
M. Hill	Special Assistant to VP-NSD	CP&L
J. Holder	MGR-Outage & Modifications	CP&L
R. Jones	Senior Vice President	CP&L
D. Kelly	MGR-External Relations	CP&L
M. Kesmodel	Director Improvement Programs	CP&L
R. Knight	Specialist-Regulatory Compliance	CP&L
P. Leslie	MGR-Security	CP&L
C. Lewis	MGR-Project Services	CP&L
J. Lieberman	Director Office Enforcement	NRC
R. Lo	Project Manager	NRR
L. Loflin	MGR-Nuclear Assessment	CP&L
A. Lucas	VP Nuclear Engineer	CP&L
D. McCarthy	MGR-Nuclear Licensing Section	CP&L
B. McFeaters	NGG Group Analyser	CP&L
J. McKee	MGR-Mechanical Procurement	CP&L
G. Midyette	Secretary to Department Head	CP&L
D. Moore	MGR-Maintenance	CP&L
R. Morgan	MGR-Nuclear Plant Support	CP&L
D. Nelson	Resident Inspector	NRC
K. Neuschaefer	Staff Assistance Team	CP&L
J. O'Connor	NED-Project Engineer	CP&L
M. Oates	MGR-BNP- Licensing	CP&L
T. Owen	MGR-Nuclear Outage & Modification	CP&L
J. Partlow	Associate Director	NRR

L. Plisco	Section Chief, NRR	NRC
B. Poulk	MGR-License Training	CP&L
R. Prevatte	Senior Resident Inspector	NRC
D. Quick	MGR-Management/Organization	CP&L
E. Quidley	Site Work Force Control Chairman	CP&L
R. Richey	VP-BNP	CP&L
C. Robertson	Manager Environment & Radiation Control	CP&L
J Rosenbauer	Sr. Stenographer	CP&L
L. Sillin, Jr.	Retaired CEO from Northeast Utilities	CP&L
W. Simpson	MGR Nuclear Business	CP&L
S. Smith, Jr.	Chairman/President	CP&L
J. Spencer	Plant General Manger	CP&L
R. Starkey	VP Nuclear Services	CP&L
M. Staton	Site Representatiave-NEEMPA	(Non-CP&L)
B. Styron	NED-On-Site Acting Manager	CP&L
D. Verrelli	Chief Project Branch 1	NRC
G. Warriner	MGR Control and Administration	CP&L
R. Watson	Serior VP Nuclear	CP&L
S. Zimmerman	Site Assistance Team	CP&L

APPENDIX C

EXIT SLIDES

APPRAISAL OF OPERATIONS

FOR

BRUNSWICK STEAM ELECTRIC PLANT

MAY 1992

U. S. NUCLEAR REGULATORY COMMISSION

REGION II

MAINTENANCE

- **WEAKNESSES**

  -Equipment Failures

  -Work Control

  -Supervisory Oversite

  -Procedural Adequacy

  -Procedural Compliance

- **CAUSES**

  -Problem Identification

  -Corrective Actions

  -Communication of Expectations

  -Tolerance of Conditions

- **IMPROVEMENTS**

  -Acknowledgment of Problems

  -Management Changes

  -Craft Training

  -Supervisory Training

OPERATIONS

- **WEAKNESSES**

  -Configuration Control

  -Command and Control

- **CAUSES**

  -Equipment Failures

  -Work Arounds

  -Teamwork

  -Self-Assessment

- **IMPROVEMENTS**

  -Knowledge and Skills

RADIOLOGICAL CONTROLS AND EMERGENCY PREPAREDNESS

- WEAKNESSES

  -Equipment Leaks

  -Monitoring Equipment

  -Environmental Releases

  -Emergency Response Training

- CAUSES

  -Equipment Condition

  -Corrective Actions

- IMPROVEMENTS

  -ALARA

SECURITY

- **WEAKNESSES**

  -Facility Degradation

  -Corrective Action

- **CAUSES**

  -Routine Maintenance

  -Management Priority

- **IMPROVEMENTS**

  -Staff Performance

  -Facility Upgrades

ENGINEERING

- WEAKNESSES

  -Control of Temporary Conditions

  -Adequacy of Evaluations

  -Work Backlog

- CAUSES

  -Management Expectations

  -Corrective Actions

- IMPROVEMENTS

  -Staff Qualifications

  -Support to Operations

INTEGRATED ACTION PLAN

- WEAKNESSES

  -Continuing Performance Problems

  -Condition of Plant

  -Self-Assessment

- CAUSES

  -Management Support

  -CAP

- IMPROVEMENTS

  -Operator Training

  -Operating Procedures

  -System Engineers

  -Tagging and Labeling

MANAGEMENT ROOT CAUSES

- Management has not set high standards for the material condition of the plant.

- Management has not provided the leadership and support needed for improvement.

- Lack of critical self-assessment has resulted in the failure to recognize problems and the failure to implement effective corrective actions.