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OFFICE OF NUCLEAR REACTOR REGULATION

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Enclosure

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EXECUTIVE SUMMARY

An NRC multi-disciplinary team, lead by the Special Inspection Branch of the Office of Nuclear Reactor Regulation (NRR), with the support of other branches in NRR, completed an assessment of the Surry Power Station, Units 1 and 2. The assessment, independent of previous regional inspections and management reviews, was conducted in accordance with NRC Inspection Procedure 93808 "Integrated Performance Assessment Process." The purpose of the independent assessment was to evaluate the licensee's performance in the areas of safety assessment/corrective action, operations, engineering, maintenance, and plant support for the period of January 1994 through December 1995. The assessment consisted of a preliminary, in-office review of documentation conducted during the period of January 22 through February 2, 1996, and an onsite assessment of performance conducted during the period of February 26 through March 8, 1996.

Details of the team's findings are contained in the following assessment report. The results of the independent assessment are reflected in the final inspection planning tree, Appendix A to the report. These results will be a factor in the allocation of NRC inspection resources. The team's findings were also presented at a public exit meeting held at the Surry site on March 21, 1996.

Within the area of safety assessment/corrective action, the team noted that the licensee had initiated effective programs for identifying equipment, human performance and program deficiencies. The tracking and trending of deficiency reports was used as an effective management tool to capture programmatic issues. Recent root cause evaluations improved over those performed early in the review cycle, by addressing human performance, management, and corrective action failures that were not previously evaluated. The new auditing program, using the Nuclear Oversight Specialist, identified significant issues; however the lack of procedural guidance may impede the continuing success of the program. Weaknesses in this area included a deficiency card system that resulted in a one month delay in the repair of the through wall leak in the RHR piping, and the slow resolution of long standing hardware issues such as the rod control cards and redundant equipment affected by the biological growth.

Within the area of operations, overall performance was good. Responses to the numerous plant challenges that included reactor trips, turbine/generator run-backs, loss of control room annunciators, and equipment failures, were handled well by the operating crews. Management is addressing a potential weakness with equipment operability determinations.

Within the area of engineering, overall performance was good. Management programs such as the Managed Activity Priority System and the Level 1 Program are designed to set priorities and focus attention to safety related issues. Problem identification and resolution of most plant deficiencies is prompt and effective. However, the team was concerned that in two instances there was a failure to promptly recognize safety significant problems involving the deterioration of Battery 2a, and the fact that the mean time to failure of the rod control circuit cards had been exceeded for several years. Other weaknesses included: the prolonged corrective actions to address long-standing problems such as the temperature control valves associated with the charging pumps.

Within the area of maintenance, overall performance was good. Outages were well managed with over 90% of the approximately 3000 planned and emergent work orders completed. Problem identification was found to be a strength. The deficiency report system has been effective in identifying problems throughout the plant. The self assessment program has been recently implemented with 2 of the 16 planned assessments completed. Weakness in this area was indicated by the number of equipment failures, during the early part of the review period, that resulted in plant perturbations. Corrective actions were being implemented to address the material condition issues.

Within the area of plant support the in-office review of security and emergency preparedness indicated generally superior performance over the designated period. No additional assessment of these areas was conducted at the site. The area of radiation protection was assessed both in the office and at the site. Overall performance in the area of radiation protection was superior.

ASSESSMENT OBJECTIVES, SCOPE, AND METHODOLOGY

To improve the effectiveness in which the NRC focuses it resources at operating nuclear power plants, the Office of Nuclear Reactor Regulation (NRR) has developed an Integrated Performance Assessment Process (IPAP). This process, described in NRC Inspection Procedure 93808, is designed to identify programmatic and performance strengths and weaknesses in the areas of safety assessment/corrective action, operations, engineering, maintenance, and plant support.

This report documents the team's performance assessment of the Surry Power Station Units 1 and 2 for the period from January 1994 to December of 1995. The assessment team consisted of five individuals from NRR, all of which whom had no normal oversight duties for the Surry site. The assessment was conducted in two phases; a preliminary documentation review performed in NRC headquarters, and a final performance based assessment which was conducted onsite.

The results of the team's preliminary assessment were documented in a report issued on February 12, 1996. Subsequent to issuance of that report, a two week onsite assessment of performance was performed. The results from the onsite assessment have been integrated with those of the preliminary assessment and are contained in this Final Assessment Report. Also contained within this report are recommendations for future NRC inspection focus. These recommendations are also depicted on a Final Performance Assessment/Inspection Planning Tree. The inspection recommendations are scaled to what would be normal NRC inspection effort at an average performing plant.

In performing its integration of results from the preliminary and onsite portions of the assessment, the team attempted to relate individual findings or issues to areas of perceived programmatic strengths or weaknesses. Also, an attempt was made to evaluate licensee performance in response to non-routine events such as those that might occur during postulated accident conditions. In all areas of the assessment, the team evaluated the effectiveness of the corrective action and performance assessment systems, as the effectiveness of these systems was seen as a major influence on overall organizational performance.

The final ratings and inspection recommendations take into account performance during the entire assessment period but are heavily weighted towards recent performance as the most effective use of NRC resources would be to focus on areas where performance weaknesses still exist or have not completely been resolved.

1.0 SAFETY ASSESSMENT/CORRECTIVE ACTION

Overall performance in the area of safety assessment/corrective action was determined to be good. The licensee has established and implemented effective programs for identifying and evaluating equipment, human performance, and program deficiencies. For example, the licensee's deficiency reporting program has been effective at capturing equipment and performance deficiencies, while a deficiency report trending program has been effectively used to capture more programmatic issues; a corporate integrated trend report has been used to identify specific concerns (both equipment and programmatic) for senior management attention; and nuclear oversight audits have been detailed and have identified meaningful performance concerns. However, the station annunciator window program does not contain clear objective criteria for performance ratings, and resolution to some longstanding equipment issues has sometimes been slow.

A recent reorganization of the quality organization has moved assessment activities to the line organizations. Audits are still conducted by the independent Nuclear Oversight group. The effectiveness of the line organization assessments has not yet been established. Also, four Nuclear Oversight Specialists have been assigned to independently evaluate the overall areas of engineering, operations, maintenance, and plant support. Initial indications are that the nuclear specialists are identifying some significant issues; however, their communication channels have not yet been fully developed. The team reviewed the new organizational structure and found that all required quality functions described in the approved QA topical report were still being fulfilled.

Recent root cause evaluations have shown improvement. The evaluations now address human performance and management issues and failures in the corrective action system that were not previously being confronted. Corrective action tracking appeared to be good, with specific items being identified in a commitment action tracking system for root cause evaluations, deficiency reports, and integrated trend reports. Findings resulting from audits were being tracked via a separate nuclear oversight tracking system. Overall, line organizations have responded well to findings and recommendations, with the exception of some hardware recommendations. For example, a recommendation to replace firing cards in the rod control system was not implemented until repeated failures caused two manual reactor trips. Also, actions taken to resolve issues pertaining to hydroid growth in the emergency service water system have been slow, and last year hydroid problems resulted in several instances of safety system inoperability.

Generally, the licensee has used probabilistic risk assessment (PRA) only in making specific scheduling decisions and in making modifications identified during the Individual Plant Evaluation (IPE). The licensee has not routinely used PRA in performing event assessments, in selecting assessment areas, or in evaluating proposed corrective actions. Based on discussions with operators, system engineers, outage schedulers, and others, it does not appear that a thorough understanding of PRA concepts and specifics has been developed by many plant personnel.

1.1 Problem Identification

In the preliminary report, the licensee's corrective action and performance assessment systems were stated to be effective at capturing equipment, human performance, and program deficiencies. The corrective action threshold was determined to be sufficiently low, with a manageable backlog of open corrective action issues. Audits and assessments were found to be insightful and to have identified some significant issues. The quarterly performance annunciator window program was stated to be effective, although some concern was expressed over the criteria used for deriving the status of many of the windows in the operations area.

While onsite, the team reviewed implementation of the following corrective action and performance assessment programs: the deviation reporting (DR) program, the deficiency card process, nuclear oversight audits, the corrective action request (CAR) process, line organization self-assessments, and nuclear oversight specialist activities. The team determined that the DR program was being used effectively by station personnel to identify deficiencies related to equipment, procedures, and human performance. Based on plant tours conducted by team members, it appeared that equipment deficiencies were being appropriately entered into the corrective action system at a sufficiently low threshold. Based on the large number (approximately 3000 per year) and type of deficiencies written, it appeared that the system was easy to use and was well understood throughout the station.

Just before the team's arrival on site, an issue surfaced regarding a through-wall pipe leak in the residual heat removal system. The leak was discovered by a contract health physics technician and documented on a deficiency card, a method intended to be used only for minor maintenance items such as housekeeping, labeling, etc.. Although station procedures require operations to review and approve deficiency cards, apparently these steps were not performed and no operability assessment of the pipe leak was done. Subsequently, one of the newly appointed nuclear oversight specialists reviewed deficiency cards and asked operations about the status of this pipe leak. It was discovered at this time that operations had not been made aware of the leak. Immediate actions were then taken to declare the affected system inoperable, leading to a unit shutdown.

The team was concerned that this example, although identified by the licensee's own nuclear oversight division, represented a weakness in an otherwise very effective program for problem identification. Specifically, multiple barriers were not sufficient to ensure that all equipment operability concerns received an appropriate operability review. A similar concern regarding the use of deficiency cards had been previously identified in an audit done by the licensee's nuclear oversight division. The licensee had not completed its root cause evaluation of this event prior to the end of the assessment.

Nuclear Oversight Audits

While onsite the team performed a review of two recent nuclear oversight audits: S95-04 on technical specification and license requirements, and S95-11 on measuring and test equipment (M&TE). Both audits were detailed, in-depth, and technically challenging. The audit of technical specifications and license requirements contained four findings including a finding that the reactor coolant temperature rate of change instrument was not being tested periodically to verify operability. The audit also recommended four enhancements. The M&TE audit contained 10 findings and recommended 8 enhancements, including findings related to the use of M&TE data sheet and M&TE storage. In both audits, extensive followup efforts were made to ensure the effectiveness of corrective actions by line organizations in response to the audit findings.

Corrective Action Requests

The team also reviewed the Corrective Action Request (CAR) process for escalating previous audit findings. This process was used five times during the 1994 and 1995 time period. Issues escalated via this process included an issue associated with overtime approval, outdated procedures in the technical support center, and inoperable rod position indication for control rod M-10. The use of the escalation process appeared to be adequate.

Annunciator Windows

A review of the licensee's quarterly annunciator window program revealed that although this program provided some valuable insights regarding equipment, program, and human performance trends, the program lacked clear criteria for determining window ratings. The red, yellow, or green ratings were based on NRC and INPO reports and licensee-generated data. In many cases it was not clear how the specific ratings were determined and whether sufficient data existed to develop a meaningful performance rating. It was also not clear whether the purpose of the window program was to communicate station performance to senior management or whether senior management was using the program as a tool to communicate its expectations about station performance to the rest of the staff. Many of the recent window ratings were changed by senior management to reflect a lower level of perceived performance. It was also not clear whether the annunciator window program had made effective use of the information in the quarterly deviation trend reports issued by Station Nuclear Safety. The licensee is currently assessing this program.

Station Nuclear Specialists

A recent reorganization of the licensee's quality assurance organization has resulted in the creation of four nuclear specialist positions, one each for operations, maintenance, engineering, and plant support. The team attended a weekly meeting of the nuclear specialists, who discussed their observations from the previous week with the station's director of nuclear oversight. The team also observed a meeting between the director of nuclear oversight and the station director where the group's findings were communicated. Based on these observations, the team concluded that the nuclear specialists were identifying some significant issues; however, the group appeared to be unsure how to best communicate their findings. The team learned that no specific procedures have been written delineating this group's specific responsibilities and its work product. Currently, the group's findings are informally communicated to the station director via a weekly meeting. The team was concerned that without a well-defined reporting process, the issues identified by the specialists may not continue to get sufficient management attention. Also, it appeared that the independence of the quality organization (nuclear oversight) could be weakened by the current informal nature of communications with the station management. The licensee stated that it will evaluate the need to develop procedures establishing the reporting process for the nuclear oversight specialists.

Line Organization Self-Assessments

Assessments, previously conducted by the station's division of nuclear safety, have been recently reassigned to the line organizations. The team discussed with the licensee the licensee's plans for monitoring the self-assessment process and reviewed the only two self-assessments that have been completed since the realignment. The two assessments were related to work control and to industrial safety. The team noted that the assessment of work control, issued the week before the team's arrival on February 21, 1996, was actually led by a member of the station nuclear safety division. The assessment made seven recommendations, including specific recommendations to appoint one central authority for following progress of the maintenance rule and for training maintenance personnel on the maintenance rule. Other recommendations were more generic, such as recommendations to reenforce management expectations to provide feedback on work package problems. It was not clear how the recommendations were being tracked, and it was to early to assess management's response to the recommendations.

The assessment of industrial safety was conducted within the line organization. This assessment covered 34 areas of industrial safety but identified only minor discrepancies and made no management recommendations. The assessment was in a question-and-answer format which made it difficult to determine exactly how the 34 areas were assessed.

Overall, although assessment schedules and some oversight of the process have been established, continued monitoring of the self-assessment process will be necessary to ensure the effectiveness of this program.

Conclusion

The licensee has established and implemented an effective process for the identification of deficient conditions, with the exception of the process for controlling the use of deficiency cards. The licensee's processes for identifying performance issues have generally been effective, as shown by a strong audit program, establishment of nuclear oversight specialists, and ongoing actions to improve the effectiveness of the annunciator window and self-assessment programs.

Inspection effort should focus on ensuring that proper controls are established for the use of deficiency cards, that objective and meaningful criteria are established for annunciator windows, that a process is developed and implemented for communicating nuclear specialist findings, and that management oversight of the self-assessment process continues until the ability of the line organizations to conduct effective self-assessments is established. The effect of the recent reorganization and the associated personnel reductions in the quality organization should be closely monitored during inspections. The team recommends that normal inspection effort be continued in the area of problem identification.

1.2 Problem Analysis and Evaluation

In the preliminary report, the area of problem analysis and evaluation was rated as being indeterminate. Root cause analyses were stated to have been adequate in identifying technical issues, but weak in evaluating issues associated with human performance, management, and the corrective action system itself. The quarterly DR trend report was stated to have effectively captured issues involving both equipment and human performance.

On June 15, 1995, the Corporate Nuclear Safety group issued an assessment of the root cause program which included four recommendations and three enhancements for improving the effectiveness of root cause evaluations. One of the recommendations was that root cause evaluations address why previous corrective action attempts were not successful in resolving recurring problems.

While on site, the team reviewed several root cause evaluations issued after the June 1995 assessment and found them to be much improved. Based on a review of four such evaluations, issues related to the corrective action program itself, human performance, and management are now being addressed in most cases. For example, root cause evaluations 95-017 and 95-12 (for steam generator channel head drain leaks and an undetected loss-of-coolant event) appropriately considered previous failures of the corrective action system to prevent problem recurrence. In root cause evaluation 95-017 there was also a good extrapolation from the specific event to a more generic problem with the machining of primary system components.

The team did, however, identify some instances where the root causes were narrowly focused on the specific problem and generic improvement opportunities were overlooked. For example, in root cause evaluation 95-08 on a dropped control rod, no recommendation was made regarding an apparently generic problem associated with the return of potentially defective equipment to the warehouse by maintenance personnel. Based on discussions with the authors of the root cause evaluations, there appeared to be a tendency to limit recommendations because of monetary concerns or a desire to close out items, in some cases. Although the team did not identify any specific examples where recommendations were intentionally eliminated, a concern was raised with licensee management over the need to monitor the effect of cost-cutting efforts on the willingness of personnel to make recommendations.

Follow up to specific root cause evaluations was generally good. All recommendations are tracked via the commitment action tracking system. Several specific recommendations were followed up by the team to ensure closure, including a recommendation to replace certain firing cards in the rod control cabinet. The team verified via direct observation that these cards had in fact been replaced.

The team also reviewed a study requested by the Management Safety Review Committee (MSRC) (MSRC Open Item 95-08A) to perform a collective root cause evaluation of the series of events which occurred during the last refueling outage. The study, dated March 7, 1996, was signed out at the end of the team's onsite assessment period. The study included some good recommendations related to the ineffectiveness of maintenance corrective actions for previous deficiencies in the human performance area including the ineffectiveness of short versus long-term corrective actions. The team found that although the report stated that many of the events which occurred during the refueling outage were related to operation's work practices, a detailed, collective evaluation of these events was not conducted. It was therefore difficult to conclude that the study met the original objectives detailed by the MSRC.

DR Trend Report

The team reviewed the fourth quarter station deviation trend report and discussed the methodology used in assembling the trend report with the responsible individual in the licensee's station nuclear safety organization. Overall, the trend report appeared to be a well-thought-out and valuable tool for identifying declining performance trends and focusing management attention on areas in need of improvement. In preparing the report, the licensee first groups and then statistically analyzes the DRs for performance trends. Specific recommendations for management action are then made based on analysis of the data. The fourth quarter report contained seven such recommendations, which were submitted to the Station Nuclear Safety Oversight Committee (SNSOC) for approval. Actions not already being addressed in other documents were given specific commitment tracking system numbers. Among the recommended actions in the fourth quarter report were actions to conduct a followup evaluation on the effectiveness of the component cooling heat exchanger chemical treatment system and to conduct a root cause evaluation of recurring material issuance deviations.

The trend report also provided the current status and evaluated plant performance related to items identified as "Executive Focus Items," "Management Focus Items," and "Recurring Equipment Problems," in the semi-annual corporate level integrated trend report. This coordination between the DR trend report and the integrated trend report was determined to be an effective way of focusing both station and corporate management attention on problem areas. Notwithstanding the overall positive nature of the program, the team identified some weaknesses in the program. For example, DR trend data which indicated declining trends were not clearly highlighted or graphically represented. Although improving trends were summarized in the front of the report, declining trends were not.

Integrated Trend Report

The team also reviewed the July-December 1995 integrated trend report issued by the Vice President of Nuclear Operations. The integrated trend report is a corporate level document that assesses overall performance of the nuclear organization. The report's conclusions are based upon a review of both internal and external data, including the DR trend report, NRC and INPO performance indicators, significant and precursor events, station annunciator windows, and component failure analysis reports. The integrated trend report also considers and evaluates current industry and regulatory trends. Based on a review of the above data, adverse trends are highlighted for senior management attention. In the latest trend report, five issues were identified as executive focus items (items warranting focus from executive management). The issues concerned human performance, life cycle management, management oversight of the reorganization of the Nuclear Oversight organization, fuel failures, and the accuracy of the Updated Final Safety Assessment Report (UFSAR). The integrated trend report also identified six issues for station management to focus on, including failures of the service water system, problems with work control, secondary chemistry issues, and many recurring equipment failures.

The team raised some concern over the apparent lack of progress in closing out the issues raised via the trend report. Of the approximately 25 issues identified since the program's inception in 1993, only five are identified as being fully resolved. Many of the issues identified by the team during the teams in-office review of documentation were issues that were also previously identified in the integrated trend report, including issues associated with the turbine-driven auxiliary feedwater pumps, the service water system, and radiation monitors. Although significant progress has been made towards resolving many of the outstanding issues, full resolution has often been slow.

Overall, the integrated trend report provides a good system for identifying declining trends in equipment, personnel, and program performance, both at the station and at the corporate level. Together with the DR trend report, the integrated trend report was identified by the team as an effective tool for focusing senior level and executive management on issues of regulatory significance.

Station Nuclear Safety Oversight Committee (SNSOC) and Management Safety Review Committee (MSRC)

While on site, the team reviewed minutes of the offsite MSRC and observed the conduct of an SNSOC meeting. Based on the review of meeting minutes, the MSRC has provided effective independent management oversight of specific station activities. Specific action items emanating from the MSRC included a pro-active action to enhance the employee concern in light of recent licensee re-engineering efforts. The MSRC also expressed concern regarding the station's overall performance during the recent refueling outage and commissioned a study to assess the common elements of a number of events.

During the SNSOC meeting observed by the team, there was an effective interchange of views regarding several deviation reports which had been submitted to SNSOC for closure. Several deviation reports were sent back for additional information. Evidence of SNSOC input was also seen by the team in its review of recommendations made via DR trend reports and the root cause evaluation process. Overall, the SNSOC committee appeared to be effective.

Conclusion

The licensee has instituted effective programs and processes for performing problem analysis and evaluation at the Surry site. Root cause analyses have recently been improved, with issues related to human performance and the corrective action system now being adequately addressed. Problem trending and analysis of programmatic issues via the DR trend report and the integrated trend report are a strength, as are the MSRC and SNSOC oversight committees.

The team recommends that reduced inspection effort be considered for the area of problem analysis and evaluation. The effectiveness in which management issues and generic concerns are addressed within root cause analyses should be continued to be assessed.

1.3 Problem Resolution

In the preliminary report, the team found that the licensee had done an adequate job of addressing the majority of lower level hardware concerns and that corrective action for NRC-identified issues had been good. However, corrective actions for several recurring major issues had not been effective.

While onsite, the team determined that, for the most part, corrective actions for many of the longstanding equipment issues have been at least partially implemented. For example, faulty firing cards, which resulted in dropped control rods, have been replaced in the rod control cabinets; however, some question still remains with regard to the expected life of the remainder of the circuit cards in the rod control system.

Corrective actions for problems with hydroid infiltrations in the emergency service water and component cooling water system have also been partially implemented. The effectiveness of these corrective actions has not yet been fully demonstrated.

Other longstanding equipment issues still exist, such as those concerning outdated control room annunciator panels, rod bottom indication for control rod M-10, core exit thermocouples, and a power range nuclear instrumentation (NI) detector. During the onsite assessment, the licensee also identified a concern over a longstanding leak in the reactor coolant pump thermal barrier heat exchanger.

Human Performance Issues

Problems with human performance, which have been significant contributors to many recent events, are receiving management attention, as was evidenced by the conduct of a site-wide standdown during one of the days the team was onsite. The actions taken by management to date to address human performance issues have not been totally effective. Examples of ineffective self-checking and procedure violations still occur, and it appears that in some cases management expectations have not been routinely reinforced at the working level. Short-term corrective actions have not resulted in lasting performance improvements. Many of these recent human performance issues have been in the area of operations, as was noted in the licensee's assessment of events during the previous outage. Senior management is aware of the continuing human performance problems and is following the issue via the performance assessment programs described in the previous section of this report.

Corrective Action Tracking

Corrective actions other than those associated with Nuclear Oversight assessments are tracked via the licensee's Commitment Tracking System (CTS). Currently there are approximately 250 open CTS items assigned to the various line organizations. The number of overdue and extended CTS items is tracked via the Commitments Management window of the station annunciator panel reporting system. Also, a monthly report of overdue CTS items is provided by nuclear licensing to the assistant station manager for nuclear safety and licensing. The latest data indicates four overdue CTS items, including actions related to low RPM on the emergency service water diesel generator (CTS item 3255) and the updating of design documents for refueling water storage tank (RWST) overflow level indication (CTS item 2707). Overall, closeout of CTS items and oversight of the CTS system appeared to be good.

Conclusion

Problem resolution has generally been good, with some examples of longstanding equipment problems that have only recently begun to receive adequate attention. Continued management attention is needed to ensure the resolution of human performance issues and longstanding equipment issues such as those concerning hydroid growth in the emergency service water system. The team recommends that normal inspection effort by devoted to the area of problem resolution.

2.0 OPERATIONS

Operations performance was considered generally good. Operators were knowledgeable and responded well to plant events. However, performance in the later part of 1995 indicated a declining operations trend. The two units collectively had seven reactor plant trips in the two-year review period with five of those trips occurring in a five-month period in 1995. Additionally, equipment problems caused reactor trips, complicated post-trip recovery actions, and resulted in turbine runbacks and in the loss of annunciators.

Violations issued in late 1995 also suggested that the quality of operations had declined. Of particular note was the enforcement action for failure to follow procedures for reactor coolant inventory control in a partially drained-down condition during an outage. The licensees's root cause analysis described a situation where a manager filling in for the control room supervisor inappropriately took command of the operation away from the senior reactor operator, didn't use the procedure for the evolution, and subsequently didn't perform the procedure properly.

The onsite inspection did not identify any examples of inadequate performance with the minor exception of an inadequate administrative procedure identified during an equipment tagout. The inspection generally confirmed the overall good performance of operations. The licensee's safety focus in determining equipment operability did not appear to be always conservative and should continue to be monitored closely. Additionally, operation's performance trends should be monitored to determine if licensee actions have been effective in reversing the declining trend observed in 1995.

2.1 Safety Focus

During the in-office review, the team noted that safety focus and management involvement in the operations area was weak and increased inspection was warranted. Inspection reports and licensee event reports described apparent examples of poor safety focus in failing to recognize the potential for inoperable components. For example, an enforcement conference was held to deal with the licensee's failure to promptly develop and implement corrective action after omitting to sample both auxiliary ventilation exhaust filter trains following a chemical release. Likewise, an apparent nonconservative decision was made to pump the containment sump when one of the two sump valves, a containment isolation valve, had already failed to close during testing. Another example of an apparent nonconservative decision occurred when essential service water (ESW) pump C failed its operability test due to low flow. The redundant ESW pump A was not immediately tested, even though it was reasonable to assume that the A pump was also fouled. Similarly, LER 95-10 described the inoperable condition of all four component cooling water heat exchangers (CCWHXs) due to fouling. In this case, the licensee cleaned one heat exchanger first and declared it operable before testing the other three.

Additionally, the initial report also noted an example of apparent poor risk management when turbine building flooding occurred due to leaking canal damming devices during outage work. The report observed that no flood watches had been posted and that the process of installing the damming devices was not described in a procedure.

The initial report also noted strengths regarding licensee safety focus. For example, the licensee declared the condensate storage tank inoperable even though only tank level indication was lost. The Station Nuclear Safety and Operating Committee (SNSOC) assessments were effective and focused on safety. Managers regularly interacted with the control room crews to address issues.

During the onsite phase of the assessment the team interviewed operating personnel and examined the apparent examples of poor safety focus and risk management. The interviews included shift supervisors, senior reactor operators, reactor operators, and nonlicensed operators. The results of the interviews were consistent and positive. Operators stated that they were confident that management supports safety and that they were free to stop in the face of uncertainty and to raise any doubts regarding inoperability.

The team explored the ESW and CCWHX examples and determined that actions taken were understandable. In the case of the CCWHXs, rising containment temperatures and the fact that immediate testing would reduce the cooling capacity dictated immediate cleaning as the prudent action. In the case of the ESW pumps, the shift supervisor had them cleaned immediately because aquatic growth on the pump intake had frequently caused pump performance degradation in the past and the normal course of action was to clean the pump.

The team noted that in this case it would have been more conservative to immediately test the other pumps to verify operability and the failure to do so was a valid example of a lack of safety focus.

The team determined that the decision to pump down the sump while an isolation valve was inoperable was allowed by Surry technical specifications and was reasonable given the low risk established by the valve's operating history and the fact that when the valve had failed in the past it had responded to flushing to remove grit from the seat.

The team examined the flood watch posting for the turbine building and concluded that the licensee had in fact properly posted a flood watch at the time of the event and was planning to augment that watch with a second watch at a different station for future evolutions.

Conclusion

Overall, performance in the area of safety focus was generally good. A concern by the team is the potential weakness in the equipment operability determinations where a single failure may affect redundant trains of safety-related equipment. The team recommends that normal inspection activity be implemented in this area.

2.2 Problem Identification and Resolution

During the in-office review, the team concluded that licensee performance in the area of problem identification and resolution for operations was good for problem identification and indeterminate for problem resolution. The reports indicated that operators had improved in their performance in writing problem reports. Although there were examples where operators did not initiate deviation reports when appropriate, inspection reports stated that operators had a generally low threshold for reporting problems. In the area of problem resolution, examples of a lack of lasting problem resolutions resulted in repeated challenges to operators. For example, there were repeated problems with unexpected changes in reactor vessel water level during reduced inventory operations, repeated problems with dropped rods, and biofouling problems. On the other hand, some of the licensee problem-reporting mechanisms, such as the Third Quarter 1995 Station Deviation Trend Report, were strengths, identifying important trends to management.

During the onsite phase of the assessment the team examined the licensee's mechanisms for identifying and resolving problems in operations. Additionally, the team examined the deviation reports written by operations in 1995. The team did not find any hardware problems that had not already been noted by the licensee, and control room observations did not identify any performance issues during a startup or during normal operations.

The team examined some of the licensee's mechanisms for problem identification and resolution.

- The team attended a meeting of the Operations Review Board (ORB). The board's standing membership includes the operations superintendent and representatives from the operators, the procedure writers, training, and the Nuclear Oversight group. The ORB charter is to identify and resolve problems in the operations area. The group appeared to function well with detailed discussions of problems and recommendations for resolution.

- The team reviewed the Nuclear Oversight group's assessment of operations and interviewed the operations member. The group was new, formed in October 1995 and staffed with an operations member in December 1995. The oversight program was being formulated and did not have much in the way of procedures or other infrastructure. The individual assigned to operations was a former licensed senior reactor operator. His findings were reported to management weekly and the more important findings were issued as deficiency reports. The team considered the oversight group to have good potential to be an important addition to problem identification area.

- Site-wide standdown is a recently implemented quarterly program in which the licensee holds periodic four-hour site-wide department meetings to discuss problems, resolutions, and evolving issues. The team attended the operations meeting. Personnel interacted positively and the focus was safety. The team concluded that the meetings were another effective way of identifying problems and their resolutions.

- Operations had initiated a self-assessment program in the beginning of 1996. The program was being formulated but had certain aspects underway such as a tagging performance improvement program with clearly defined actions. The tagging improvement program actions included establishing a tagging mentor for each shift, weekly training, and field observations and feedback by the mentor. The team concluded that the self-assessment program could be another effective way of identifying problems and resolving them.

The team reviewed data on the deviation reports (DRs) generated by the site in 1995. Operations had generated about 1000 of the approximate 3000 DRs written in 1995. This numerical fact indicated that operations was not reluctant to write DRs. A review of a sample of the DRs written by operations showed that the subjects included procedure problems, errors, and hardware problems. The team concluded that operations was properly identifying problems.

The team noted that training had developed a special simulator for self-checking training. The device was challenging and was well received by operators. The training simulator was initiated to help resolve human errors caused by poor self-checking techniques. The device was an innovative method of resolving self-checking problems.

Conclusion

Reduced inspection effort is recommended in the area of problem identification. Normal inspection effort is recommended in the area of problem resolution. Inspections should monitor the effectiveness of actions taken to resolve repetitive problems.

2.3 Quality of Operations

During the in-office review, the team concluded that licensee performance in the area of quality of operations was good. Generally the inspection reports stated that operating crews responded promptly and effectively to operational events. On one occasion, however, an operations manager took command and control of ongoing plant evolutions and acted improperly. The event represented a significant but isolated case. Also, a negative trend in operator performance at the end of 1995 was indicated by recurring personnel errors. The reports also noted that unexpected plant equipment failures challenged operators during startups and shutdowns and during normal operation.

During the onsite phase of the assessment the team toured the plant, observed operations in control room, including startup and back shift, observed non-licensed operator rounds, observed training on the simulator, interviewed operators and shift supervisors, reviewed procedures, attended various daily meetings to assess operations involvement, and observed tagging and lineup activities.

Shift turnovers, annunciator response, attentiveness at the controls, procedure adherence, communication, and log keeping all appeared to be professionally performed. Annunciator boards were maintained black during most of the inspection duration. Operators performed well at the simulator. An excellent debrief of the exercise scenario was conducted by the training observer. There was also good interaction between the operations crew and the trainer; meaningful observations regarding the potential for improved communication were made.

During a reactor startup, the team noted that operators stationed at the valves manually adjusted the feedwater bypass control valves in response to telephoned commands from the control room. The lack of automatic feedwater bypass valves controls, appeared to be an operator challenge which was satisfactorily handled using the plant telephone.

The team reviewed other operator challenges such as workarounds, temporary modifications, and compensatory actions. The licensee maintained lists of these items and management kept the number of such items low.

Conclusion

Normal inspection effort is recommended in the area of quality of operations.

2.4 Programs and Procedures

During the in-office review, the team concluded that licensee performance in the area of programs and procedures was good. Reports noted that procedures were generally followed. During the reviewed period, three violations had been identified for failure to follow procedures, as well as a moderate number of procedure noncompliance instances which were not cited. Also, isolated instances of inadequate procedures were identified.

The control room observations did not reveal any problems with procedure compliance or procedure adequacy. The team did observe one example of a equipment tagout problem, caused, in part, by a lack of instructions in the administrative procedure for tagging. During the tagout of a fire pump for maintenance, the operator found that the tagout did not include a battery charger switch which needed to be placed in the off position. The operator called his shift supervisor and, after agreement, turned the switch to the off position. He also added a handwritten note on the tagout to return the switch back to on at the completion of work. The team discussed this action with plant management since the note did not provide for an accountable initial positioner and an independent verifier, as would have been the case if a change to the tagout had been initiated. The administrative procedure for tagouts did not specify what an operator should have done if a problem was encountered in the field. Management stated the actions taken did not meet their expectations and that they would promulgate their expectations and issue a procedure change. The team noted there had been 28 deviation reports written in 1995 for tagging problems. As noted in Section 2.2 above, the operations department had an initiative underway to improve performance in tagging.

Conclusion

Normal inspection effort is recommended in the area of programs and procedures.

3.0 ENGINEERING

The team assessed the licensee's overall performance in engineering as good, The licensee had in place a sound program for the identifying plant deficiencies, ascertaining their underlying root cause(s), and implementing the required corrective actions. In some instances, however, this program did not appear to be properly implemented. For instance, human error contributed to the delay to identify both the inoperability of battery 2A due to degraded cell voltages in the 1994 event and the degradation of the circuit cards in the rod control system prior to plant transients. In addition, by not fully and promptly invoking the controls offered by the program, engineering burdened itself with operability concerns with both the temperature control valve (TCV) valves for the lube oil systems of the charging pumps because of control loop problems and the Kaman radiation monitors because of systematic problems dating back many years.

3.1 Safety Focus

In the preliminary report, the team concluded that engineering had a conservative safety focus, as demonstrated by the upgrade of emergency diesel generator (EDG) reliability and the elimination of power oscillations obtained by chemical cleaning of degraded steam generators. However, the lack of a good setpoint control program was a weakness and contributed to an overpower event in 1994.

During the onsite assessment period, the team confirmed this conservative safety focus by reviewing operability evaluations (OEs) and safety evaluations

(SEs), interviewing engineering staff, and observing management's direct involvement in engineering activities. The latter involved the prioritizing safety-significant design changes through the Managed Activity Priority System (MAPS) process, communicating its goals and priorities to engineering through daily meetings and directives, and implementing the Level 1 Program, which directs additional attention to safety-significant matters via engineering studies and analyses.

Since the overpower event, the licensee has made marked improvements in the design change process for modifying instrumentation setpoints and associated procedures because of revised scaling or setpoint calculations. A corporate task force is presently upgrading the P250 computer subroutines for the primary calorimetric and resolving related documentation issues. A reactor engineer will oversee all future changes to the software and hardware associated with the primary calorimetric. The licensee has also addressed the adequacy of the change control process for all other setpoint/scaling calculation revisions. The validation of the design change process for setpoint/scaling revisions done prior to the overpower event is being addressed by Region II of the NRC. The team verified that a sample of five recent DCPs correctly updated the specific design reference procedures (DRPs) for setpoint revisions.

The engineering work load of open DCPs, drawing revisions, and pending responses to open Commitment Tracking System (CTS) items and deviation reports (DRs) has been maintained below station-established goals. The timely resolution of such matters is another indicator of the licensee's correct focus on safety issues. The team determined that OEs and SEs are generally comprehensive and provide a sound basis for their final conclusions governing plant safety. The team reviewed ten SEs for justification for continued operations (JCOs), DCPs, engineering transmittals (ETs), and DRs and found that all of them reached the correct conclusions in regard to unreviewed safety questions (USQs) and the continued operability of equipment. During the last two years, the licensee cancelled 67 proposed DCPs. Thirty-one of them are being incorporated into current design changes in process. The other 36 were reviewed and their cancellation was determined to have no effect on plant safety.

Conclusion

Overall, the team determined that engineering had demonstrated a superior safety focus. Management is intimately involved in all engineering activities and provides conservative guidance to the department. A reduced inspection effort is recommended in this area.

3.2 Problem Identification and Problem Resolution

The in-office review concluded that the licensee generally provided prompt assessments and resolution for emerging issues. For example, the cleaning of steam generator tubes to eliminate power oscillations, open-circuited charging of station batteries. and the upgrading of the protective lining of in-plant emergency service water (ESW) piping for hydroids and corrosion. Additional examples noted during the onsite period were the improvements in containment ventilation and the station blackout project.

Weaknesses were also noted by the team. In some cases, engineering failed to recognize promptly the degradation of certain equipment before failures occurred (some resulting in plant transients). For example, engineering did not promptly identify the inoperability of battery 2A due to the degraded state of cell 52 in the 1994 event. The system engineer did not recognize the acceptable range of operation of that cell's voltage because of confusing electrical periodic test (EPT) procedures at that time. A lack of a questioning attitude contributed to the delay in recognition. The EPTs have been subsequently revised to accurately state the specific operating ranges of a battery cell's voltage for operable, alert, and inoperable status. Another example is the rod control system. Engineering failed to recognize prior to 1992 that both the maximum operating temperature and the mean time to failure (MTTF) of the circuit cards that control the operation of the rods had been exceeded for a number of years. Reactor transients in later years can be attributed to the degradation of the original circuit cards because of high ambient temperatures and aging. The measures taken by engineering since the problems were identified seem reasonable and justifiable but slow in developing. This is especially true for the planned upgrade of the chillers cooling the general area surrounding the rod control cabinets and also for the total replacement of all the original circuit cards (not just the firing cards). To date, the licensee's corrective actions do not include a periodic replacement of the circuit cards based solely on their mean time to failure. The common element among these equipment failures is that engineering did not identify the significance of controlled plant parameters until the equipment failure and plant transients had occurred.

The preliminary report stated that engineering uses deviation reports (DRs) to identify, track, and resolve most plant deficiencies identified by or assigned to engineering. The sample of 30 DRs reviewed by the team onsite confirmed that engineering addresses a wide spectrum of problems. The low threshold for initiating deviation reports contributes to prompt identification and resolution of most plant deficiencies as shown by the 267 DRs written by and the 1441 DRs assigned to engineering during 1994 and 1995.

The preliminary report referred to the licensee's inability to properly address some lingering long-term problems. These were further evaluated during the onsite assessment period. The team verified that engineering's corrective actions appear to have resolved some of those problems, including the periodic loss of reactor coolant system (RCS) water in the standpipe level indication system for Unit 1 and the auxiliary feed water (AFW) pump-turbine governor valve problems that resulted in numerous AFW turbine trips for both units during testing. Other problems such as the microfouling of the CCW heat exchangers and the macrofouling of the ESW pumps and piping due to hydroids, appear to have been reasonably curtailed by engineering-recommended corrective actions taken to date.

The team noted two other examples of long-standing equipment problems where several design changes were required over a period of years to resolve both operational and maintenance concerns. The first one was the control loop and material concerns that plagued the lube oil cooling system for each of the six charging pumps over the last 5 years. A temperature control valve (TCV) in each system controls ESW flow to the lube oil coolers and thus the temperature of the charging pumps' lube oil. The temperatures in the lube oil systems of the charging pumps have fluctuated widely in the last 5 years, at times bordering the upper limit. Repeated design changes were required to modify each of the TCVs installed in 1992 before an acceptable operating temperature range was established for each lube oil system. The TCVs had inherent problems that were not discovered until after installation. These included improper packing material and a low operating range that severely hampered stem travel, incorrect overall control loop action altering the failure mode of a TCV, and a too high air input signal from pressure regulator to valve positioner. The complexity of the problem in conjunction with incomplete initial assessment resulted in numerous design changes, hindering the timely resolution of this issue. While the team was onsite, some of the TCVs were still experiencing problems with a feedback arm that assists in the responsiveness of a TCV to system perturbations like fluctuating ESW or lube oil temperatures.

The second example concerns the false alarms of the Kaman monitors over the last 4 years. The engineers assigned to the installation and startup of these monitors were experienced, but did not initially recognize the extent of the external plant problems, which included the lack of ready access to an instrument ground, a less than optimum environment for the monitors, unique internal ground requirements, and the required resolution of the power source. Several design changes and modifications delayed the resolution of this problem over several years.

Conclusion

Overall, the licensee's performance in the area of problem identification and problem resolution was good. Some complex longstanding issues challenged the engineering department's ability to promptly characterize and resolve the problems.

Normal inspection effort in the areas of problem identification and problem resolution is recommended.

3.3 Quality of Engineering

The preliminary report stated that the quality of modifications and design change packages was generally good. While onsite, the team reviewed 20 closed and open DCPs, 4 temporary modifications (TMs), 30 DRs, and 5 setpoint calculations. All of them were thorough and detailed, had the required design inputs and references, and adhered to the appropriate licensee procedures. The design changes typically solved the initial problems identified without initiating any new ones. The licensee has a good program for the review and prioritization of design changes, as illustrated by the MAPS process. The issuance of 96 DCPs from 1994 through 1996 with only 11 of the more involved ones requiring five or more field revisions further demonstrates the ability of engineering to resolve normal issues correctly on the initial attempt.

Also all but 6 of the 33 DCPs required for the Unit 2 outage in May 1996 have been completed, with the 6 outstanding scheduled to be completed by April 1, 1996.

A weakness in the engineering program is the occasional failure to fully explore and characterize a problem before corrective action is initiated. This weakness was shown recently by engineering's failure to foresee that excavation for the burial of the new fiberglass fish spray piping might damage the missile barrier for ESW piping. The licensee attributed the January 17, 1996, incident to improper reviews by the design engineer, system engineer, and the independent reviewer of DC 91-025. The team noted that the failure to define the prerequisites for excavation near the ESW piping was a contributing factor. Another example of not properly defining the scope of an engineering design change is DCP 94-066. It was to implement a new flow measurement system for the MER 3 chillers. The licensee identified the lack of ownership for scaling documents, improper use of factory test results for the new system, and incorrect information conveyed in design documents as the reasons for misstatements in calibration procedures and for the faulty scaling of installed flow indicators.

The overall change control process was considered to be good, as demonstrated by prompt identification of both drawings and documents to be revised. The number of outstanding drawing revisions was not excessive, and the controls for updating and maintaining critical drawings were effective, as stated in the preliminary report and verified during onsite assessment period. The Operational Readiness Review (ORR) process is generally considered a strength because it requires the project engineer to verify the correct implementation of any design change prior to testing and to ensure that all affected priority drawings, including those in the Control Room are updated prior to pre-operability testing. These requirements help prevent any mistakes that could develop because of the redlining of Control Room drawings. The only anomaly noted by the team was that the system engineer is not formally required to be part of that process. The team verified the content of priority drawings for ESW and AFW piping, the electrical distribution for the station blackout (SBO), diesel and station battery 1B, and of the actual installations for the DCPs associated with the new control room chillers and the bromine injection system for the CCWHXs.

Engineering support of operations and maintenance was considered good based on reviews of DCP-process self-assessments and interviews with operations and maintenance personnel. The organizations responsible for implementing design changes and operating plant equipment stated that most engineering design changes resolved the initial problem without invoking any maintenance or operational concerns.

Engineering self-assessments consist of monthly and quarterly audits, primarily of design functions, and with specific audits in targeted areas. The engineering assessments appear to be detailed, comprehensive, and effective in ascertaining the strengths and weaknesses of engineering; the corrective actions are specific and concise. These assessments appear weak in trending human performance for mistakes concerning design changes, equipment failures, and plant events. The Engineering Program Performance Annunciator

Panel Report attempts to accomplish this aim, but its categories, mainly design changes, have lenient requirements for acceptability. Previously, as stated in the preliminary report, the QA audits, engineering self-assessments, and performance monitoring of engineering by management were positive indications of management's efforts to improve overall engineering performance. The realigning of the nuclear oversight group could affect this good previous performance and needs to be monitored in the future.

Based on a sample of training records reviewed, it appears that most engineering personnel have the required training or equivalent experience to perform their work. This is also true for the performance of 10 CFR 50.59 evaluations. Some individuals in engineering have the designated training to participate in root cause evaluation teams.

One negative observation made by the team was that systems engineers are not programmatically required to be involved in implementing or testing design packages. Presently system engineers are encouraged to be involved but it is up to their discretion to become involved.

The quality of the Surry engineering organization is generally good.

Conclusion

The weaknesses associated with the examples of failure to promptly recognize the safety significance of degraded equipment, resulting in delayed corrective actions, are being addressed by the licensee. NRC inspections should continue to assess this area.

Normal inspection is recommended for this area.

3.4 Programs and Procedures

The preliminary report indicated that surveillance activities were appropriately performed and that implementing procedures were being followed. Controls were adequate to ensure that effective updates of procedures were performed for design changes. Surveillance procedures were adequate to support safe operation of the plant. During the onsite period the team verified the high quality of procedures.

As stated in the preliminary reports and verified on site, the licensee instituted programs and conducted several assessments that were effective in evaluating and maintaining plant systems and components. Examples of these programs include the inservice inspection (ISI) program, which had well-written procedures, as demonstrated by the high-quality reactor vessel examinations and evaluation of ultrasonic data; the flow accelerated corrosion program to maintain high energy carbon steel pipe within acceptable wall thickness limits; and the motor-operated valve (MOV) compliance program, in which a high number of valves were tested.

Conclusion

The programs and procedures adopted by licensee at Surry Power Station were considered to be superior.

Reduced inspection in this area is recommended.

4.0 MAINTENANCE

Based on the preliminary assessment, onsite inspection, and final analysis, the area of maintenance was determined to be generally good, with superior performance in the area of problems identification. Human performance deficiencies, some programmatic problems, and maintaining plant material condition represented the greatest challenges in the maintenance area. Overall, normal inspection is recommended.

Maintenance management's safety focus was confirmed to be good. Over the past 3 months, the maintenance backlog appeared to be trending down towards the site goal (previously it had been fairly constant). Problem identification, via the deficiency reporting system, self-assessments, and quality assurance department audits, was a strength. Problem resolution in the maintenance area was focused on minimizing human performance errors, improving the work control process, and improving maintenance programs such as the Maintenance and Test Equipment (M&TE) program. Plant material condition was good and appeared to be slowly improving. The quality of maintenance work was usually good, and rework was not a significant problem. Maintenance and surveillance procedures were generally of good quality.

4.1 Safety Focus

During the preliminary assessment, the area of safety focus was determined to be good. This was based on effective planning and scheduling, supervisory oversight of complex jobs, basic use of risk-informed decision making, and acceptable on-line maintenance practices.

While on site, the team reviewed planning and scheduling of maintenance and surveillances, prioritization of work activities, return of equipment to service, and on-line maintenance practices, including coordination when multiple pieces of equipment were taken out of service. The team also observed morning maintenance meetings, daily management meetings, plan-of-the-day meetings, the monthly as low as reasonably achievable (ALARA) meeting, and the maintenance standdown day presentation. The team interviewed the Superintendent of Maintenance, the Superintendent of Outage and Planning, and members of their staffs.

During the onsite inspection the team was unable to draw new insights into the quality of direct oversight of maintenance activities because of the relatively low significance of maintenance work that was in progress during the 2 weeks the team was onsite. A foreman typically provided oversight for the maintenance activities that the team observed.

Planning and Scheduling/Outage Planning

The team concluded that the licensee was effective in accomplishing most of work scheduled during outages, as well as emergent work that was added to the outage scope. Typically, the outage involved approximately 2000-2300 original-scope work orders and an additional 800-1200 emergent work orders. Approximately 90-95 percent of the scheduled work orders were completed, as were most of the emergent work orders. Deferred work orders were generally of low safety significance, but the number of deferred work orders appeared to have increased with the recent reduction in outage duration.

About 1 year ago, data on work control process effectiveness were limited. Recently, several new maintenance work process indicators (work order trends) were developed and are now being used to monitor the maintenance backlog and help identify any emerging problems in the work control process.

Prioritization of Work Activities

The team reviewed several work orders and determined that they were prioritized in accordance with station procedures (VPAP-2002, "Work Requests and Work Order Tasks") and that the prioritization appeared to be reasonable. The licensee's work order priorities range from priority 1 (urgent work) to priority 4 (cosmetic work). The team observed maintenance workers perform a priority 1 work order that involved replacement of a leaking air release (auto vent) valve on the diesel-driven fire pump. The team also observed maintenance and surveillance activities involving Technical Specification (TS) Limiting Conditions for Operation (LCO) allowed outage times. Maintenance foremen ensured that the work was performed in an expeditious manner and that associated paperwork was quickly processed to minimize equipment out of service time.

The team viewed the use of the daily Operating Critical Parameters report as a effective method for communicating the significance of having multiple pieces of equipment out of service. This report evaluates five major categories (fission product barriers, safety systems, reactivity, monitoring and assessment, and plant availability), which are further broken down into 17 elements. Each day the major categories and elements are color-coded to indicate components, equipment, and systems that are out of service. For example, on March 7, 1996, the Unit 1 Operating Critical Parameters report contained items such as increased reactor coolant system (RCS) iodine and activity levels due to fuel cladding defects, tagouts for charging pump seal cooler maintenance and transformer tap changer maintenance, and a pressurizer spray valve in manual (because it did not stroke fully closed on demand). The Unit 2 Operating Critical Parameters report contained items such as an inoperable valve (2-RC-PCV-2455C) and frequent reactor coolant average temperature (T_{ave}) deviation alarms.

The team also observed that the maintenance department Project Tombstone report was useful in identifying and helping to prioritize longstanding and repetitive issues. The fourth quarter 1995 Project Tombstone report identified several issues and associated action items, including station batteries, rod control system, foreign material exclusion (FME) events, high- and low-level structure degrading equipment, instrument process rack upgrades, and the annunciator system.

Return of Equipment to Service

The team reviewed completed post-maintenance test (PMT) procedures and observed PMTs in progress during the site inspection. The PMTs that were reviewed were appropriate. However, licensee deficiency reports occasionally noted that PMTs were inadequate or that no PMT was specified for work orders. Overall, the team viewed the PMT process to be good.

During the PMT (1-OPT-CH-001) for the Unit 1 charging pump A, the licensee identified that the service water temperature control valve was not operating properly and that the charging pump outboard horizontal vibration was in the alert range. The licensee initiated deficiency reports (DRs) for both of these conditions.

On-Line Maintenance

The team reviewed the licensee's use of on-line maintenance. The current practice essentially has three components. The first two parts involve minimizing the unavailability of safety equipment and operating within TS LCOs. The licensee sets goals and attempts to meet them for safety equipment cumulative unavailability. When performing on-line maintenance, the licensee also attempts to perform the maintenance in one-half the TS LCO time limit. The third part of the on-line maintenance practice involves avoiding certain combinations of out-of-service equipment. The licensee drafted a matrix (using Individual Plant Examination (IPE) insights) that identifies certain combinations of equipment that should not normally be taken out of service at the same time (previously, the licensee used a similar matrix that was developed using operator and engineering expertise). If the licensee wishes to deviate from this guidance, station management approval and compensatory action plans are usually required. While this guidance appears to be adequate, it was not clear how on-line maintenance evaluations are documented. Specifically, the team asked to see the evaluation that justified performing emergency diesel generator (EDG) maintenance on-line. The licensee response was that the EDG on-line maintenance was consistent with the practice described above.

Conclusion

The maintenance safety focus was determined to be good. Normal inspection effort is recommended in this area.

4.2 Problem Identification/Problem Resolution

Problem Identification

In the preliminary assessment, problem identification was determined to be good, as evidenced by the low threshold for identifying problems, the large number of deficiency reports being generated, the quality of maintenance self-assessments, and the quality of QA department audits of maintenance.

While onsite, the team reviewed numerous deficiency reports (DRs) initiated by the maintenance department, the maintenance self-assessment plan for 1996, and corrective actions for identified deficiencies. The team also interviewed several workers regarding their use of the deficiency reporting system.

The team concluded that the DR process was easy to use and was used frequently by the maintenance department. About 1000 out of the approximately 3000 yearly DRs are initiated by the maintenance department. The team reviewed the DRs initiated by the maintenance department since January 1, 1996, and determined that the DRs captured good issues, not just ones in the maintenance area. For example, one DR initiated during a prejob walkdown identified procedure problems, an incorrect setpoint, improperly mounted switches, drawing errors, and unmarked switches. Another DR initiated after disassembly of a valve actuator identified an upside down diaphragm, a galled spring adjustor, a broken pin, and pipe wrench marks on the top threads of the spring rod. Other DRs identified improper thread engagement, out-of-tolerance electrical equipment, incorrect seat ring material, burnt insulation, improper PMT, conflicting pump repacking guidance, and a service water pump exceeding site unavailability goals. The team viewed the maintenance department DR initiation as a strength.

The preliminary report identified QA audits of maintenance as a strength. The team confirmed this during the site inspection and final analysis.

Maintenance assessments, which were formerly performed by QA, will now be performed by the maintenance department. So far only one self-assessment has been completed under the new program and it involved the work control process. The team reviewed the findings and noted that the most significant findings were that work control accountability was improving but that craft, planning, and preventive maintenance group personnel were not providing feedback to improve work packages. A second self-assessment on FME is in progress. The maintenance department has a proposed plan to perform approximately 15 additional self-assessments during 1996, including topics such as human performance, M&TE followup, EDG reliability, preventive maintenance, safety and relief valves, check valves, motor-operated valves, and turbine-driven auxiliary feedwater pumps. It is too early to determine if the maintenance self-assessments will match the very high quality of the assessments that were previously performed by QA.

Problem Resolution

The preliminary assessment report identified several personnel errors during maintenance and surveillance activities that resulted in unnecessary challenges to equipment and personnel. The team interviewed maintenance and site management and found that they viewed the human performance deficiencies as a significant station issue. Corrective actions that were initiated included station wide standdown days, increased use of coaching and job observations, emphasis on self-checking (Stop, Think, Act, and Review) and procedural adherence, and focus on prejob briefings. No significant personnel errors were observed during the 2 week site assessment, but it is too early to determine if the corrective actions will be effective in reducing the number of personnel errors and the resultant plant challenges.

The most significant programmatic concern identified during the preliminary assessment was the M&TE deficiencies. A QA audit of measuring and test equipment (M&TE) concluded that the M&TE program at Surry did not meet regulatory requirements and was not being effectively implemented. The team reviewed the corrective actions, which included making numerous changes to VPAP-1201, "Control of Measuring and Test Equipment," holding supervisors and calibration technicians accountable for implementing the requirements of VPAP-1201, conducting annual assessments of the M&TE program, conducting training, placing certain hydrometers in the M&TE calibration program, reviewing all M&TE data sheets to verify that they are complete and accurate, and incorporating 311 technical manuals in the vendor technical manual program. The licensee has additional M&TE followup assessments planned.

The team noted that corrective actions are in progress for the QA check valve program and for the safety and relief valve program audit findings. Corrective actions included adding check valves to the program and testing and replacing several small relief valves.

In the preliminary assessment report, the team noted that balance-of-plant material condition deficiencies were often self-revealed following reactor trips. While onsite, the team performed system walkdowns, observed surveillance testing, and reviewed plant records to assess the material condition of the plant. It is too early to tell if the balance-of-plant material condition has improved significantly, but as discussed above, the maintenance backlog appears to have declined over the past 3 months.

Conclusion

Maintenance problem identification was determined to be superior. Reduced inspection effort is recommended in this area.

Maintenance problem resolution was determined to be good. Normal inspection effort is recommended in this area.

4.3 Equipment Performance and Material Condition

During the preliminary assessment, the area of equipment performance and material condition was determined to need improvement. Approximately 16 out of 18 plant perturbations were the result of either plant material condition (primarily in the balance of plant) or maintenance and surveillance errors. In addition, occasional equipment failures during post-trip recoveries challenged site personnel.

Material condition issues identified in the preliminary assessment included multiple rod control system failures, station battery problems, balance-of-plant equipment failures, control room annunciator system failures, a rod position indication system deficiency, component cooling water and emergency service water system degradations (macrofouling and hydroids), charging pump lube oil temperature control valve failures (service water), Kaman radiation monitor problems, and turbine-driven auxiliary feedwater pump problems. Additional material condition issues highlighted during the site inspection and final analysis included a power range nuclear instrument problem, high- and low-level structure equipment degradations, a pressurizer spray valve problem, a thermal barrier heat exchanger leak, and frequent T_{ave} deviation alarms.

No major equipment performance problems were noted during the team's observations of maintenance and surveillance activities. The only equipment performance issue of note during these observations was that the service water temperature control valve (mentioned above) did not operate properly during the PMT for the Unit 1 charging pump A. The team noted that the fourth quarter 1995 System Engineering Quarterly Report identified that during 1995, 60 percent of the technical specification LCO entries associated with inoperable charging pumps due to equipment failure were caused by the failure of these valves.

Team walkdowns of several plant systems indicated good overall material condition (few water, steam, or oil leaks) and superior housekeeping. The team reviewed the latest vibration, oil, and bearing inspection results for safety-related and non-safety-related pumps. Safety-related pump vibration inspection results were identified as "good" and only seven non-safety-related components were identified with a vibration severity code of "rough." During the final analysis the team concluded that the current performance of safety systems was generally good. For example, no turbine-driven auxiliary feedwater pump governor valve problems were noted during the last 12 months.

Corrective actions were complete or in progress for most of the material condition issues discussed above. Long-term corrective actions that were not yet complete included increasing room cooling for the rod control system cabinets, replacing the entire 2A station battery in the second quarter of 1996 (Unit 2 refueling outage), coating the other two emergency service water pump suction bells with an antifouling material, modifying the turbine-driven auxiliary feedwater pump governor valve linkage, and replacing existing screen structures with a new stainless steel design.

The licensee placed a high priority on minimizing the number of temporary modifications (4) and operator workarounds (21) so that they did not significantly impact operator performance. The temporary modifications involved gagging relief valves and providing spot cooling to the rod control power cabinets. The most significant operator workarounds involved venting safety injection header piping to prevent gas accumulation (low-head safety injection pump), lack of automatic control of the steam dumps in the steam pressure mode (since 1986), failed pressurizer heaters, and the inoperable pressurizer spray valve. The licensee also placed a high priority on minimizing the number of lighted annunciators in the control room.

Conclusion

Equipment performance and material condition were determined to be good. Inspection focus should be on balance-of-plant equipment performance and on long-term corrective actions for material condition deficiencies. Normal inspection in this area is recommended.

4.4 Quality of Maintenance Work

During the preliminary assessment, the area of quality of maintenance work was determined to be good. This was based on NRC inspector observations and evaluations of maintenance work. However, the preliminary assessment noted that several personnel errors during maintenance and surveillance activities resulted in plant perturbations and minor events.

While onsite, the team observed an EDG surveillance, turbine-driven auxiliary feedwater pump preventive maintenance, emergency service water pump suction cleaning and PMT, the station battery discharge test, and portions of the Unit 1 charging pump A preventative maintenance (including Limitorque operator lubrication and inspection of five valves), and also spent 1 day with the weekend maintenance crew observing relief valve bench testing and air release valve replacement on the diesel-driven fire pump. Few problems were noted during the maintenance observations. Equipment was properly tagged out, foremen verified the tagouts prior to releasing the work to the craft, prejob briefings were conducted, the craft had all necessary work orders and procedures at the job site, and the craft followed procedural guidance.

The one exception was during the performance of the Unit 1 station battery discharge test personnel failed to follow the procedure, which directed initiation of a work request if charging current exceeded 350 amps. Initially, a work request was not initiated because of additional guidance provided at the job site by the system engineer. After discussions with the team, the workers decided to initiate a work request. In addition, the test on station battery 1B was completed in 8 minutes versus the 15 specified in the procedure. The maintenance department initiated a DR that addressed these and other concerns with the station battery discharge test procedure. The licensee concluded that the procedure was not written to accurately reflect the objectives of the test.

In the preliminary assessment, the team noted that foreign material exclusion problems were identified as a long-standing and recurring problem by both the NRC and the licensee. During the site visit the team determined that this problem was largely a control-of-contractor issue. The licensee initiated corrective actions and plans to audit this area prior to the 1996 Unit 2 refueling outage. Corrective actions include placing increased emphasis on ensuring contractors meet site standards during the next outage.

Corrective actions for human performance deficiencies are discussed above under problem resolution. No significant personnel errors were identified during the team's observations of maintenance and surveillance activities.

Conclusion

The quality of maintenance work was determined to be good. Inspection focus should continue to be on the effectiveness of corrective actions for human performance deficiencies. Normal inspection effort is recommended in this area.

4.5 Programs and Procedures

During the preliminary assessment, the area of programs and procedures was determined to be good and to warrant normal inspection. This was based on NRC assessments of the licensee's technical procedure upgrade program, maintenance program effectiveness, and NRC inspector observations of maintenance activities.

During the onsite assessment the quality of maintenance and surveillance procedures was determined to be generally good, with the exception of the problems with the station battery discharge test procedure. The team viewed the fact that procedures frequently specify real-time engineering assessment of test results as a strength. Procedural usage by maintenance personnel was observed to be consistent with licensee management expectations.

The team noted that about 1 month prior to the site inspection the licensee implemented the Fix It Now (FIN) team concept. The FIN team's primary goals are to walk down and validate work requests, make minor repairs, and provide resolutions to maintenance problems, whenever possible. The FIN team was implemented to help streamline the process for accomplishing minor maintenance and to reduce the number of minor maintenance items in the normal work control process. The IPAP team reviewed the FIN charter and a list of completed FIN team work activities. The FIN team appeared to be working within the guidance of the new program.

The large number of material condition deficiencies identified (or self-revealed) over the past 2 years (all of low safety significance) suggests that more effective preventive maintenance may be able to prevent some of these deficiencies and the resultant plant perturbations. The team noted that certain equipment, such as single-point-failure relays that could cause a turbine trip or reactor trip and EDG auxiliary lube oil pumps, are replaced periodically as a preventive maintenance activity because of high failure rates. It appears that the corrective action system was the mechanism used to identify these generic problems and that the reliability-centered maintenance program primarily focused on individual components.

Conclusion

The programs and procedures were determined to be good. Inspection focus should be on the long-term effectiveness of corrective actions for M&TE deficiencies. Inspection focus should also be on the effectiveness of the preventive maintenance program in preventing repetitive plant equipment failures. Normal inspection effort is recommended in this area.

5.0 PLANT SUPPORT: RADIOLOGICAL CONTROLS

This section addresses only Radiological Controls, which was inspected at the site. The recommended inspection for Security and Emergency Preparedness as indicated in Appendix A, is based on the preliminary report.

5.1 Safety Focus

The preliminary report concluded that the licensee's performance was superior in this area. The overall radiation protection safety focus was strong and well directed.

During the onsite assessment, the team determined that the preliminary conclusion was valid. Station management and all work groups provided strong support and were actively involved with the station's radiation protection (RP) program. Evidence that RP was effectively integrated into all work groups included observing the excellent monthly Station ALARA Committee Meeting, work group dose goal development, and the maintenance group's support of the video information management system (VIMS) project for improving job planning and preparation. Outage planning appeared very effective. The impact of the ongoing fuel leakage in Unit 1 has been factored into possible emergent maintenance shutdowns and the refueling outage. The Unit Two 1995 refueling/10-year outage report, documenting the record low outage exposure for a Virginia Power unit, was excellent.

The general plant contamination controls program was good, with "street clothes" accessibility for greater than about 95% of the auxiliary buildings. The material condition of the Radwaste building and equipment storage buildings was very good.

Communication between the RP group and other crafts was outstanding from the superintendent level down to the individual worker. This was observed at meetings, during tours of the plant, worker prejob briefings/debriefs, and by direct observation of ongoing work.

Conclusion

Overall performance in this area was superior. Reduced inspection effort is recommended.

5.2 Problem Identification and Resolution

The preliminary report stated that the Quality Assurance audit, surveillance programs, and the RP self-assessment program were well organized and provided effective oversight of the RP program. Some weakness was noted in problem resolution; the inspector identified a failure to take a broad, programmatic view in response to two similar noncompliances.

During the onsite inspection, by discussion, review of documents, and observation, the inspector determined that the licensee had taken proper programmatic action and corrected the problem of using forms outside the framework of approved procedures. This action was completed in November 1995 by the RP department as part of a global Level 1 records retention improvement plan, part of which focused on procedures and regulatory requirements.

Several root cause evaluations (RCEs) in response to identified problems in the RP area were reviewed (discussed further in Section 5.4.1). The RCEs were comprehensive, well focused on the specific event, technically and programmatically astute with appropriate event-related recommendations for corrective actions. As an area for improvement, the inspector noted that taking a broader, more generic view in the recommendation/corrective action area would benefit the RCE process. For example, if the RP group had noted that its technicians were using administrative forms outside the approved plant procedures structure, station management should look for similar problems in other work groups.

The inspector examined the RP self-assessment-surveillance program by reviewing a sampling of the program's implementing procedures and completed assessments and, evaluation scheduling, and by having discussions with the management and staff involved. Based on the program's technical breadth, the number and kinds of problems self-identified, and the resultant recommendations/corrective actions, this program is viewed as a strength.

Conclusion

Overall performance in this area was superior. Reduced inspection effort is recommended.

5.3 Quality of Plant Support

The preliminary report concluded that the licensee's performance was average in this area, with some problems of failure to follow radiations controls procedures governing access to the incore sump rooms.

By reviewing procedures and interviewing RP management and technicians, the team verified that the corrective actions put in place to strengthen the controls over the incore sump room remained effective. Additionally, the team discussed with the licensee the controls in place for areas adjacent to the spent fuel transfer canal, where, during spent fuel movement, transient high-radiation areas are created in accessible areas. Based on that discussion and a review the implementing operating procedure, the team determined the licensee has a good program in place to control access to these high and very high radiation areas. While touring the refueling building with RP management, the team verified that no irradiated components were suspended on lines from the side of the pool.

The team made the following observations on the backshift during reactor power ascension. Onshift chemistry staff were knowledgeable of plant conditions and overall plant operations related to secondary chemistry. After reviewing the health physics (HP) shift supervisor's (HPSS's) log, night order book, and required reading book, and discussing the shift's work load, the inspector accompanied the HP technician inside the radiological controlled area (RCA). The technician was knowledgeable in general and, when questioned about some of the potential impacts of the ongoing fuel leak, was aware of likely changes in the plant relative to his area of responsibility. The HPSS was very knowledgeable and demonstrated excellent awareness of hazards and proper controls around plant systems, including the incore sump areas. A formal meeting served as an excellent vehicle for a comprehensive turnover to the day shift.

The inspector observed an at-power containment entry for snubber maintenance. The HPT designated as team leader and the maintenance worker both were knowledgeable of the HP and containment entry procedural controls. They thoroughly checked their radiation survey and respiratory equipment prior to entry, and the evolution went according to plans. The required post-job briefing with Operations was professionally conducted.

The inspector toured the auxiliary building, noting effective radiation, high radiation, and contamination postings. The licensee had installed additional shielding on numerous systems to effectively reduce auxiliary building dose rates. The team entered several high radiation areas and found excellent, conspicuously posted supplementary precautions and reminders for entry requirements.

An area for improvement identified and discussed with RP management was the control and oversight of 8 small, sealed, less-than-10 microcurie cesium-137 sources used by workers to response-check survey instruments before entering the RCA. These sources were located on the counter containing the clean protective clothing (PC) and respirators ready for issue in the clean dressout. In the past, a RP individual was stationed at the counter to assist workers and provide oversight of the sources. Although the inspector did not identify any regulatory compliance issues (given the physical layout and the close proximity of the HP office), the licensee agreed to examine ways to improve the surveillance and accountability of these sources now that RP PC counter service is no longer provided (at least during normal plant operations).

Since no formal HPT training was going on during the week of the onsite inspection, the inspector interviewed HPTs and HP shift supervisors (first line supervisors), observed HPTs working in the field, and reviewed portions of the nuclear employee training manual and selected HPT lesson plans. The inspector determined that the materials reviewed were of high quality and that the HPTs were more than adequately qualified to perform their assigned tasks.

Conclusion

Overall performance in this area was superior. Reduced inspection effort is recommended.

5.4 Programs and Procedures

The preliminary report concluded that the licensee's performance was average in this area, with some problems (for which a noncited violation was issued) with workers not following RP controls procedures (not wearing assigned dosimetry) during outage work in September 1995. After completion of the preliminary report and part of the preinspection preparation, the inspector reviewed the circumstances of the December 14, 1995, Unit 2 RCS letdown system leak repair event. This event resulted in a notice of violation (NOV) issued February 5, 1996, with multiple examples of procedural (RWP) noncompliance.

During the onsite inspection, the inspector confirmed that the licensee's corrective actions were appropriate as a result of the worker dosimetry problems in the September outage. The inspector then reviewed the licensee's corrective actions for the Unit 2 leak repair event, documented in RCE 95-2970, and discussed these actions with RP management and technicians. The RCE was properly focused, targeting appropriate casual factors with definitive, global corrective actions. The inspector observed the event case study training for the HPTs; this training focused on the human factors aspect and provided excellent insights and feedback on the lessons learned from the event. All other corrective actions have been completed or on track for completion.

The inspector reviewed the event in which the radwaste wet oxidation reaction tank was overpressurized during an attempt to chemically clean the tank. Based on a tour of the radwaste facility, a review of the documents (RCE 94-24 and related documents), discussions with cognizant RP management and staff, appropriate corrective actions were taken and completed by the licensee, and the controls currently in place are adequate to prevent reoccurrence.

As a result of fuel leak problems in fuel cycle 14 of Unit 1, station management formed a reactor coolant system (RCS) activity task team to focus on the impact of the fuel failures on plant operations. Based on a review of the team's actions to date and the scope and depth of its findings and actions already taken (e.g., input to outage planning, leak checking in auxiliary building, waste gas/effluent management), this team's actions are an excellent example of the station's team approach to handling problems. This effort is a licensee strength.

Conclusion

Overall performance in this area was average. Normal inspection effort is recommended.

6.0 REVIEW OF UFSAR COMMITMENTS

While performing the inspection discussed in this report, the team reviewed applicable portions of the updated final safety evaluation report (UFSAR) that related to the residual heat removal and service water systems. No inconsistencies were noted between the installed equipment and the system descriptions in the UFSAR.

7.0 EXIT MEETING

At the conclusion of the inspection, the team conducted an exit meeting that was open to the public. During the meeting, the team's findings were presented. The following people were in attendance:

Virginia Electric and Power Company

Viki Armentrout, Licensing
R. Blount, Maintenance
M.L. Bowling, Manager, Nuclear Licensing & Operations Support
B.L. Bryce, Assistant Station Manager, Nuclear Safety and Licensing
S.R. Burgoco, Maintenance Supervisor
David A. Christian, Station Manager
M.D. Crist, Superintendent, Operations
Terry W. Gillespie, Site Services
Candee G. Lovett, Licensing Supervisor
Robert S. Lynch, Administrative Services
J.H. McCarthy, Assistant Station Manager, Operations and Maintenance
Fred McConnell, Superintendent, Nuclear Materials
Gary D. Miller, Corporate Licensing
J.W. Norvelle, Nuclear Public Affairs Director
R.F. Saunders, Vice President, Nuclear Operations
Russell Savedge, Security Supervisor
T.B. Sowers, Superintendent, Engineering
B.L. Stanley, Director, Nuclear Oversight
E. Turko, Engineering Supervisor
N. Urquhiart, Training Supervisor
H.H. Blake, Superintendent, Site Services

U.S. Nuclear Regulatory Commission

Al Belisle, Reactor Projects, Region II
Morris Branch, Senior Resident Inspector
Jon Johnson, Reactor Projects, Region II
Peter S. Koltay, Special Inspection Branch
Keith Portner, Resident Inspector

SURRY POWER STATION UNITS 1 AND 2

FINAL PERFORMANCE ASSESSMENT/INSPECTION PLANNING TREE

- 1.0 SAFETY ASSESSMENT/ CORRECTIVE ACTION — N
  - 1.1 PROBLEM IDENTIFICATION — N
  - 1.2 PROBLEM ANALYSIS AND EVALUATION — G
  - 1.3 PROBLEM RESOLUTION — N
- 2.0 OPERATIONS — N
  - 2.1 SAFETY FOCUS — N
  - 2.2 PROBLEM IDENTIFICATION — G; PROBLEM RESOLUTION — N
  - 2.3 QUALITY OF OPERATIONS — N
  - 2.4 PROGRAMS AND PROCEDURES — N
- 3.0 ENGINEERING — N
  - 3.1 SAFETY FOCUS — G
  - 3.2 PROBLEM IDENTIFICATION — N; PROBLEM RESOLUTION — N
  - 3.3 QUALITY OF ENGINEERING WORK — N
  - 3.4 PROGRAMS AND PROCEDURES — G
- 4.0 MAINTENANCE — N
  - 4.1 SAFETY FOCUS — N
  - 4.2 PROBLEM IDENTIFICATION — G; PROBLEM RESOLUTION — N
  - 4.3 EQUIP PERF/ MATL COND — N
  - 4.4 QUALITY OF MAINTENANCE WORK — N
  - 4.5 PROGRAMS AND PROCEDURES — N
- 5.0 PLANT SUPPORT — G
  - 5.1 SAFETY FOCUS — RC G; SEC G; EP G
  - 5.2 PROBLEM IDENTIFICATION / PROBLEM RESOLUTION — G; RC G; SEC G; EP G
  - 5.3 QUALITY OF — RC G; SEC G; EP G
  - 5.4 PROG & PROC — RC N; SEC G; EP G

G	REDUCED INSPECTION	B	INCREASED INSPECTION
N	MAINTAIN INSPECTION	Y	INDETERMINATE-MORE INSPECTION REQUIRED