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EXECUTIVE SUMMARY

Turkey Point Nuclear Plant, Units 3 and 4
NRC Inspection Report 50-250/98-01 and 50-251/98-01

This inspection included a review of the licensee's implementation of 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants" [the Maintenance Rule]. The report covers a one-week period of inspection by inspectors from Region II.

Overall, the inspection team concluded that the licensee had a comprehensive Maintenance Rule program and the program was being effectively implemented. The team found only minor deficiencies in program implementation which were immediately addressed by the licensee.

Operations

- Licensed operators, in general, understood their specific duties and responsibilities for implementing the Maintenance Rule. Training of operations personnel in Probabilistic Safety Assessment (PSA) and the Maintenance Rule was considered good (Section O4.1 and M1.5).

- Licensed operators' and schedulers' understanding of the use of the risk-assessment tools for removal of equipment from service was good (Section O4.1 and M1.5).

Maintenance

- Required structures, systems, and components (SSCs) were included within the scope of the Rule (Section M1.1).

- The licensee had considered safety in establishing goals and monitoring for systems and components in (a)(1) status (Section M1.6).

- In general, industry-wide operating experience was used for both (a)(1) and (a)(2) systems and components (Section M1.6 and M1.7).

- In general, review of SSCs in (a)(2) status determined that performance criteria were adequately established commensurate with safety. However, the performance criteria for the isolation function for the containment purge radiation monitors (R11 & R12) were not appropriate for monitoring the function (Section M1.2 and M1.7).

- The (a)(3) periodic assessments performed by the licensee met the requirements of the Rule (Section M1.3).

- The approach to balancing reliability and unavailability was reasonable (Section M1.4).

- The structures program met the requirements of the Rule. All accessible structures had been inspected. A weakness was identified concerning adequate documentation of inspection deficiencies. Additionally, responsibility for condition monitoring of foundations and baseplates for systems and components was not clearly defined (Section M1.7).

- In general, walkdown of systems determined that the systems were being appropriately maintained. Minor deficiencies observed by the team were immediately addressed by the licensee. (Section M1.7 and M2.1)

- There were neither fire detection nor automatic suppression in the switchyard relay building (Section M1.7).

- Audits and self-assessments of the Maintenance Rule program were thorough. Corrective actions sampled by the team were appropriately implemented (Section M7.1).

<u>Engineering</u>

- The licensee's overall approach to performing risk-ranking for SSCs within the scope of the Maintenance Rule using the PSA and the expert panel was adequate (Section M1.2).

- The licensee's process for evaluation of risk for on-line removal of equipment from service was both comprehensive and effectively implemented. The process and involvement of the PSA organization in the process was considered good. Two minor weaknesses were identified: There were inconsistencies concerning the inclusion of all risk-significant SSCs in the lists of risk-significant components and inconsistencies in the classification of SSCs on sheets in the equipment out-of-service logbooks. The licensee's implementation of an on-line risk-monitor should significantly strengthen the program. The licensee's process for assessing shutdown-risk was comprehensive. (Section O4.1 and M1.5).

- Review of expert panel activities concluded that the panel was a benefit to the implementation of the Maintenance Rule program (Section M1.2).

- In general, systems engineers' technical knowledge of systems was sound. Recent assignments and turnovers caused some lack of system specific knowledge. Some systems engineers' understanding of the Rule and it's implementation needed improvement. The lack of formal training for some systems engineers was identified as a weakness (Section E4.1).

Report Details

Summary of Plant Status

Units 3 and 4 operated at power during the inspection period.

Introduction

The primary focus of this inspection was to verify that the licensee had implemented a maintenance monitoring program which met the requirements of 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," (the Maintenance Rule). The inspection was performed by a team of inspectors that included a team leader and three Region II-based inspectors, and an NRC PSA contractor. An operations engineer from NRR observed the process to ensure inspection uniformity. A senior resident and two residents from Region II participated primarily for training purposes. The licensee provided an overview presentation of their program to the team on the first day of the inspection. The overview handout is included as an attachment to this report.

I. OPERATIONS

04 Operator Knowledge and Performance

04.1 Operator Knowledge of Maintenance Rule

a. Inspection Scope (62706)

Operations and work control scheduling personnel responsible for minimizing on-line and shutdown-risk and for recording component outage times were interviewed for their knowledge and implementation of the Maintenance Rule. The team interviewed applicable personnel, including expert panel members, an off-shift nuclear plant supervisor, an on-shift nuclear plant supervisor, an assistant nuclear plant supervisor, a quarterly scheduling supervisor, a plan of the day supervisor, an outage scheduling supervisor, the PSA risk and reliability group supervisor, an engineering supervisor, and the Maintenance Rule coordinator.

b. Observations and Findings

All of the licensed plant operators (supervisors) and schedulers who were interviewed demonstrated a very good working knowledge of the on-line risk assessment program and of the process to identify risk-significant components which may require a PSA evaluation if taken out-of-service. The operators were knowledgeable of the importance of the logging of equipment unavailability times to the system engineers who were responsible for tracking the unavailabilities for their respective systems. They considered the process, which required each system engineer to review the clearance requests and the out-of-service logbook for his or her system, to be cumbersome. The system engineers had to retrieve the logs from the quality assurance (QA) records system. Also, there were no formal process for notifying system engineers of emergent work. However, the system engineers did interface with the plan of the day supervisor as necessary. To resolve this issue, the licensee was in the process of implementing a computerized program called Nuclear Operations Management System. The team also interviewed the outage scheduling supervisor and an assistant nuclear plant supervisor who was a member of the risk-assessment team (RAT). In particular, the RAT member was especially knowledgeable in the shutdown-risk program, as well as in the on-line program. He displayed a great deal of confidence and enthusiasm for the workings of the RAT.

c. Conclusions

Licensed operators, in general, understood their specific duties and responsibilities for implementing the Maintenance Rule. Training of operations personnel in PSA and the Maintenance Rule was considered good. Licensed operators' and schedulers' understanding of the use of the risk-assessment tools for removal of equipment from service was good.

II. MAINTENANCE

M1 Conduct of Maintenance

M1.1 Scope of Structures, Systems, and Components Included Within the Rule

a. Inspection Scope (62706)

Prior to the onsite inspection, the team reviewed the updated final safety analysis report (UFSAR), licensee event reports, the emergency operating procedures, previous NRC inspection reports, and other information provided by the licensee. During this review, the team selected a sample of SSCs that had not been classified in the scope of the Rule, but that appeared to the team to be SSCs that should be in the scope. During the onsite portion of the inspection, the team used this list to verify that the licensee had adequately identified the SSCs that should be included in the scope of the Rule in accordance with 10 CFR 50.65(b).

b. Observations and Findings

The licensee appointed an expert panel to perform several Maintenance Rule implementation functions including establishing the scope of the Maintenance Rule. The panel reviewed 142 systems and structures for Units 3 and 4. One hundred eight (108) were determined to be in the scope of the Rule.

The team reviewed the licensee's Maintenance Rule database in an effort to verify that all required SSCs were included within the scope of the Maintenance Rule. The team's review was performed to assure the scoping process included:

- all safety-related SSCs that were relied upon to remain functional during and following design basis events and ensure the integrity of the reactor coolant pressure boundary, the capability to shutdown the reactor and maintain it in a safe shutdown condition, and the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the 10 CFR Part 100 guidelines;

- non-safety SSCs that were relied upon to mitigate accidents or transients;

- non-safety SSCs which were used in the plant emergency operating procedures;

- non-safety SSCs whose failure could prevent safety-related SSCs from fulfilling their safety-related function, and

- non-safety SSCs whose failure could cause a reactor trip or actuation of a safety-related system.

The team reviewed the licensee's database and verified that all required SSCs were included in the Rule.

c. Conclusions

Required SSCs were included within the scope of the Rule.

M1.2 Safety or Risk Determination

a. Inspection Scope (62706)

Paragraph (a)(1) of the Rule requires that goals be commensurate with safety. Additionally, implementation of the Rule using the guidance contained in NUMARC 93-01, requires that safety be taken into account when setting performance criteria and monitoring under paragraph (a)(2) of the Rule. This safety consideration is to be used to determine if the SSC should be monitored at the system, train, or plant level. The team reviewed the methods and calculations that the licensee established for making these risk-determinations. The team also reviewed the risk-determinations that were made for the specific SSCs reviewed during this inspection. NUMARC 93-01 recommends the use of an expert panel to establish safety significance of SSCs by combining probabilistic risk-assessments (PRA) insights with operations and maintenance experience, and to compensate for the limitations of PRA modeling and importance measures. The team reviewed the composition of the expert panel and the experience and qualifications of its members. The team reviewed the licensee's expert panel process and the information available which documented the decisions made by the expert panel. The team interviewed several members of the expert panel to determine their knowledge of the Maintenance Rule and to understand the functioning of the panel.

b. Observations and Findings

b.1 Background

The process for determining the risk-significance of SSCs within the scope of the Maintenance Rule was documented in Procedure 0-ADM-728, "Maintenance Rule Implementation." The risk-significance determination process was based on the PSA developed for the individual plant examination (IPE) of severe accident vulnerabilities in response to NRC Generic Letter 88-20. The PSA model was based on the small event tree, large fault tree approach using the EPRI-developed, computer assisted, fault tree application code. In the initial version of the PSA dated June 1991 that was submitted to the NRC, the plant core damage frequency (CDF) due to internal events was stated to be 3.7E-04/ per reactor year, of which 83% was attributable to transient induced loss of coolant accidents (LOCA). A modification was identified which could reduce the CDF to 1.0E-04/per reactor year. This modification consisted of allowing the service water system to directly cool the "B" charging pump, thereby bypassing the component cooling water (CCW) system.

This modification formed the basis for the response to Generic Letter 88-20 as Revision 0 of the IPE, submitted in June 1991. Plant-specific failure and unavailability data dating from January 1984 for Unit 3 and June 1984 for Unit 4 to December 1989 for both units were used in the calculation of the CDF. In response to the NRC review of the submittal and questions concerning the human error failure rates, the licensee had resubmitted the IPE in June 1992.

In May 1993, the licensee issued an update to the PSA ("Turkey Point Plant Probabilistic Risk Assessment Update Summary Report April 26, 1993.") This update incorporated primarily modeling changes to the PSA; in particular, the modeling of human error recovery actions was "hardwired" to ensure that recovery actions were applied only to those cutsets which involved equipment for which recovery was possible. For the 1993 update, the total CDF was reduced to 6.6E-05/ reactor year. The small LOCA, loss of grid, and loss of CCW were the dominant initiators and transient induced LOCAs with either failure of long-term cooling or of secondary cooling were the dominant contributors to risk. This update provided the first ranking of SSC importance based on the top 90% of CDF cutsets measure, the Fussell-Vesely, the Risk Achievement Worth, and the Risk Reduction Worth measures. In November 1995, the licensee issued another PSA update ["Turkey Point Units 3 & 4 Probabilistic Risk Assessment Update (1995)"]. The actual data window included five years of operating experience for both units for the period January 1990 to December 1994. The model included changes made to the instrument air system and the standby steam generator feed pumps so that two of the four motor driven compressors were now driven by diesels and one of the two standby feed pumps was now also driven by a diesel. The total CDF was revised to 6.3E-05/ reactor year.

b.2 Risk-ranking

The licensee identified 105 systems, of which 82 were identified as within the scope of the Maintenance Rule. The risk-ranking was performed by Calculation No. PTN-BFJR-93-012, "Risk Significance Determination of PTN Systems." The truncation point was 1.0E-10 as compared to a baseline CDF of 6.6E-05/reactor year. The team considered the truncation level within the NRC guidelines to perform the risk-ranking. SSCs were ranked by the Fussell-Vesely measure (F-V > 0.005), the risk reduction worth measure (RRW > 1.005), the risk-achievement worth measure (RAW ≥ 2.0), and the top 90% of CDF measure. If the SSC satisfied any one of the measures, it was considered to be risk-significant. The licensee noted that all PSA basic events were in the top 90% of cutsets. The licensee then considered all 31 PSA systems to be risk-significant. These important measures were then reconfirmed based on the 1995 PSA update. No changes were made to the risk-ranking.

The expert panel upgraded the new and spent fuel system, the containment building, containment isolation, emergency containment filters, and the nuclear instrumentation system to the risk-significant level. The panel downgraded the motor driven instrument air compressors, the main feedwater pumps, the steam generator blowdown flow control valves and the motor driven service water pumps to the non-risk-significant level. Two of the four air compressors are diesel driven, one of the two standby steam generator feed pumps is diesel driven, and two of the four service water pumps are diesel driven. All of the diesel driven equipment was considered risk-significant. The team considered the panel's justifications for downgrading to be appropriate based on the fact that the motor driven equipment could not be connected to emergency busses. In addition, the expert panel determined that the portions of the reactor protection system (RPS) and the engineered safeguards features actuation system (ESFAS), which provided indication only, were not risk-significant. The expert panel's decision was based on the PSA, the level of redundancy of instrumentation, the degree to which instrumentation failure is detectable, and the effect of failed instrumentation within the emergency operating procedures network. The expert panel determined that the containment wide-range water level and refueling water storage tank (RWST) level instrumentation are risk-significant because of their importance in realigning the emergency core cooling systems for cold leg recirculation.

The team considered the licensee's risk-significance ranking process to be based on updated PSA information and data with appropriate actions taken by the expert panel. Therefore, the risk-ranking process was acceptable.

b.3 Performance Criteria

The process for establishing the performance criteria of SSCs was also documented in Procedure 0-ADM-728, "Maintenance Rule Implementation." In establishing the criteria for unavailability, the licensee performed Calculation PTN-BFJR-96-005, "Risk Evaluation of Increasing Equipment Unavailability to the Maximum Allowed Under the Maintenance Rule." This calculation was a bounding analysis in that it determined the increase in CDF if the length of time required to perform maintenance was extended to the unavailability performance criteria established for the

Maintenance Rule program. The baseline CDF was 5.54E-05/ reactor year based on a revised PSA model. The CDF increase was determined to be 0.56E-05/reactor year, resulting in a CDF of 6.10E-05/ reactor year. The licensee referenced the allowable permanent increase in CDF as given by the EPRI PSA Applications Guide, August 1995, Section 4.2.1 and Figure 4-1. The allowable increase in CDF per the EPRI guide is 13.4% for a baseline CDF of 5.54E-05/ reactor year. The licensee determined a 10.1% increase in CDF for the bounding unavailability calculation and concluded that this increase was not risk-significant. The team considered the licensee's calculated increase in CDF to be reasonable.

The two EPRI Technical Bulletins, 96-11-01, "Monitoring Reliability for the Maintenance Rule," and 97-3-01, "Monitoring Reliability for the Maintenance Rule - Failures to Run," were applied to the demand failure rates of standby systems and to the run failure rates of normally operating systems. The licensee performed Calculation PTN-BFJR-97-003, "Evaluation of the Impact of the Proposed Maintenance Rule Reliability Criteria on the Baseline CDF for Units 3 & 4." The reliability criteria for the risk-significant components ranged from zero functional failures (maintenance preventable functional failures (MPFFs)) for systems such as the reactor coolant system (RCS) pressurizer power operated relief valves (PORVs), the RCS accumulators, and vital switchgear and breakers, to three functional failures for the emergency containment coolers. The change in CDF was estimated assuming the cumulative impact of having all applicable SSCs at the proposed Maintenance Rule reliability criteria values. Based on input provided by the system engineers concerning the estimated number of demands per 18-month cycle, the licensee compared the PSA failure rates to the estimated probability of 0, 1, and 2 demand failures based on the binomial theorem. The change in CDF was also considered together with the increase in CDF due to the bounding unavailability calculation mentioned above. Compared to a baseline CDF of 5.34E-05/reactor year, considering only the change due to the reliability performance criteria, the CDF increased by 39% to 7.43E-05/ reactor year while considering the changes due to both the reliability and availability performance criteria together, the CDF increased by 51% to 8.09E-05/reactor year.

The licensee presented Calculation No. PSL-BFJR-97-001, "Evaluation of the Impact of the Proposed Maintenance Rule Reliability Criteria on the Baseline PSA CDF for Units 1 & 2," (undated computer version of Revision 0) for the St. Lucie plant. This calculation demonstrated that the licensee adapted the methodology of EPRI Bulletin 97-3-1 summary wherein it stated: "If a utility does not wish to develop and monitor a separate standby criterion as well as a run time criterion, the two criteria can be combined by addition to a single overall criterion wherein no distinction is made between standby and runtime failures...." The licensee therefore combined the running time failures into a single standby criterion using the binomial theorem only, not the Poison distribution which would be applicable for running failures. The team reviewed Calculation PTN-BFJR-97-003 for Turkey Point and considered the setting of the reliability criteria to be reasonable.

The expert panel reviewed the performance criteria for each system on a system by system basis; there was no single overview of all the performance criteria simultaneously. As part of the periodic assessments recently performed (PTN-ENG-98-0025, "Unit 4 Maintenance Rule Periodic Assessment"), the licensee also made adjustments in availability or reliability for several systems as required by comparison to the actual system operating experience considering the number of failures and/or unavailability. For example, the availability criteria of the diesel driven instrument air compressors were increased from 93.8% to 96%. The availability criteria of the A, B, and C CCW heat exchangers (HX) was increased from 92.8% to 95%. The normally operating, non-risk-significant, qualified safety parameter display system, was monitored at the plant level, but, based on a functional failure, the expert panel decided that a reliability performance criterion of ≤ 1 MPFF per 18-month cycle should be established for this system. Analyses were performed for each system, and comments and conclusions by the expert panel were documented for each system as necessary.

b.4 Expert Panel

Procedure 0-ADM-728 defined the structure and responsibilities of the expert panel. The chairman of the expert panel was procedurally identified as the engineering manager. The panel consisted of personnel from the engineering, reliability and risk-assessment, maintenance, operations, and work controls departments.

The team interviewed some members of the expert panel. The panel consisted of experienced supervisory level staff ranging in experience from 10 years to 34 years, many of whom had either been past or certified as senior reactor operators. The panel met as required but typically on a frequency ranging from twice per week to once per month. The panel members indicated that both the system engineers and the expert panel members had been trained in both PSA and the Maintenance

Rule. The team reviewed the training in PSA and found it to be acceptable. An expert in PSA was a member of the panel. During the course of the inspection, to modify the requirements for a quorum identified in Procedure 0-ADM-728, the licensee issued a procedural change notice to specify that a PSA expert from the reliability and risk-assessment department shall participate in all meetings of the expert panel.

The team reviewed the expert panel meeting minutes from the period of January 1997 to January 1998. The meeting minutes adequately described the decisions reached. In many cases, extensive condition reports (CRs) were part of the meeting minutes. The members used these reports to decide whether components should be moved to or from the (a)(1) category of the Maintenance Rule. During the interviews with the team, the panel members exhibited a thorough knowledge of both the on-line and shutdown maintenance risk-assessment programs and the plant's procedures to minimize on-line and shutdown-risk.

The team considered the expert panel membership and process to be appropriate to implement the requirements of the Maintenance Rule.

c. <u>Conclusions</u>

The licensee's overall approach to performing risk-ranking for SSCs within the scope of the Maintenance Rule using the PSA and the expert panel was adequate. Performance criteria were adequately established commensurate with safety. Review of expert panel activities concluded that the panel was a benefit to the implementation of the Maintenance Rule program.

M1.3 <u>Periodic Assessment</u>

a. <u>Inspection Scope (62706)</u>

Paragraph (a)(3) of the Rule requires that performance and condition monitoring activities and associated goals and preventive maintenance activities be evaluated taking into account, where practical, industry-wide operating experience. This assessment is required to be performed at least one time during each refueling cycle, not to exceed 24 months between evaluations. The team reviewed the procedure the licensee had established to ensure this assessment would be completed as required.

The team reviewed the licensee's periodic assessments for both units. In addition, the team discussed the requirements with the Maintenance Rule coordinator who is responsible for this activity.

b. Observations and Findings

The licensee has performed a periodic assessment, for fuel cycle 16 of both units (Unit 3 - October 8, 1995, to April 16, 1997, Unit 4 - April 8, 1996, to October 13, 1997). Procedurally, the periodic assessment was addressed in licensee Procedure 0-ADM-728, "Maintenance Rule Implementation." Team review of the periodic assessments determined that they were in compliance with NUMARC 93-01. Three minor weaknesses were noted and identified to the licensee as follows.

- The guidance for NUMARC 93-01 topic "12.2.2, Review of S.C. Performance (a)(2)" was not completely addressed. Because of the licensee's process, optimization of availability and reliability for SSCs was not discussed in either units Periodic Maintenance Assessment. The licensee indicated that optimization of availability and reliability was conducted on a case by case basis as a need surfaces.

- In the Unit 3 assessment, the corrective actions taken to assure that performance of Valve 3-20-218, feedwater discharge check valve, met the goals established by requirements of (a)(1) as recommended by NUMARC 93-01 topic "12.2.3, Review of Effectiveness of Corrective Actions" were not specifically addressed or referenced. The licensee indicated that those actions should have been specifically addressed in the Unit 3 assessment; however, they were discussed in other documents.

- In the Unit 4 assessment, the team noted that although the 4B residual heat removal pump failed to meet the availability performance criteria, the licensee established only a reliability goal. After discussions with the team, the licensee indicated that it would have been more appropriate to establish both reliability and availability goals.

c. Conclusions

The (a)(3) periodic assessments performed by the licensee met the requirements of the Rule.

M1.4 Balancing Reliability and Unavailability

a. Inspection Scope (62706)

Paragraph (a)(3) of the Rule requires that adjustments be made where necessary to assure that the objective of preventing failures through the performance of preventive maintenance is appropriately balanced against the objective of minimizing unavailability due to monitoring or preventive maintenance. The team met with the Maintenance Rule coordinator, system engineers, and representatives of the expert panel to discuss the licensee's methodology for balancing reliability and unavailability.

b. Observations and Findings

The team reviewed the licensee's approach to balancing system reliability and unavailability for risk-significant systems to achieve an optimum condition. The licensee had scheduled balancing reviews during periodic assessments, not to exceed 24 months. The requirements for balancing reliability and unavailability were discussed in the licensee's Procedures 0-ADM-728, "Maintenance Rule Implementation" and EDI-SE-008, "Monitoring Maintenance Effectiveness". The system engineers were required to perform a balancing review on a monthly basis for risk-significant systems and during the periodic system evaluations.

The team reviewed the licensee's process for balancing a function's reliability and unavailability. The licensee's approach consisted of monitoring SSC performance against the established SSC performance criteria. The process considered a function balanced if the performance criteria were met. The licensee recently performed periodic assessments for both units, in which the licensee made adjustments in availability or reliability performance criteria for several systems as required by comparison to the actual system operating experience considering the number of failures and/or unavailability. This method was in compliance with NUMARC 93-01.

c. Conclusions

The approach to balancing reliability and unavailability was reasonable.

M1.5 Plant Safety Assessments Before Taking Equipment Out-of-service

a. Inspection Scope (62706)

Paragraph (a)(3) of the Maintenance Rule states that the total impact on plant safety should be taken into account before taking equipment out-of-service for monitoring or preventive maintenance. The team reviewed the licensee's procedures and discussed the process with applicable personnel, including expert panel members, an off-shift nuclear plant supervisor, an on-shift nuclear plant supervisor, an assistant nuclear plant supervisor, a quarterly scheduling supervisor, a plan of the day supervisor, an outage scheduling supervisor, the PSA risk and reliability group supervisor, an engineering supervisor, and the Maintenance Rule coordinator. In addition, a sample of clearance requests and logsheets from the "Tech Spec Related Equipment and Risk-significant SSC Out-of-Service Logbook" for the period November 1997 to January 1998 was reviewed to evaluate the effectiveness of licensee assessment of changes in risk that resulted from plant configuration changes.

b. Observations and Findings

The licensee's on-line maintenance program was described in Procedure 0-ADM-210, "On-Line Maintenance/Work Coordination." The procedure contained several attachments, including a "Hot Items Checklist" (Attachment 2), a "Risk-significant Equipment List" (Attachment 5), a Dual Components On-Line Maintenance Matrix" (Attachment 6), and "Components Included in Risk-significant Equipment List" (Attachment 7). The on-line maintenance program consisted of quarterly scheduled system assignments. For weeks 1 to 13, for each unit, different systems were scheduled for maintenance. The scheduling of work orders for the particular week in question usually began approximately six weeks prior to that week. If work items are added to the schedule prior to the work week, the quarterly schedule supervisor reviews the items to determine if a PSA evaluation is required. For emergent work, the plan of the day supervisor reviews the schedule for impact on the plant with respect to safety, particularly to determine if a PSA evaluation is required. The on-line maintenance matrix, Attachment 6, contains a list of equipment that, when removed from service either individually or in combination, might increase the core damage probability by greater than 1.0E-06 assuming both components are out-of-service for 72 hours simultaneously. The licensee considered increases in CDF below this amount to be non-risk-significant.

The PSA group supervisor provided several examples of documented risk-assessments for combinations of equipment out-of-service. Although the assessments did not indicate whether they were performed in response to emergent conditions, the supervisor did state that he had been called at home approximately 10 times in the last year to perform such assessments. The risk-assessments calculated the change in CDF, and large early release probability (LERP) for an assumed outage period as anticipated to be required by the operators.

All of the licensed plant operators (supervisors) and schedulers who were interviewed demonstrated a very good working knowledge of the on-line risk-assessment program and of the process to identify risk-significant components which may require a PSA evaluation if taken out-of-service. However, the team noted that Attachments 5, 6, and 7 to Procedure 0-ADM-210 were inconsistent in identifying all risk-significant components. Some of the valves included in the attachments were normally closed valves in the safety injection system which were required to open following a safety injection signal. However, there were other normally closed valves which were also required to open such as the auxiliary feedwater (AFW) flow control valves and the containment recirculation motor-operated valves, which were considered risk-significant and yet were not included in Attachments 5, 6, or 7.

In addition, during the review of the logsheets from the "Tech Spec Related Equipment and Risk-significant SSC Out-of-Service Logbook," the team noted that the logsheets contained a box to be checked if the equipment taken out of service was considered risk-significant. Some of the items taken out-of-service, which were not checked as risk-significant, included the pressurizer level and pressure transmitters. The licensee staff indicated that such components would only be identified as risk-significant if they were taken out-of-service to the extent that a train or channel was out-of-service and that individual inputs to the train or channel were not considered risk-significant. However, they could not identify any steps in Procedure 0-ADM-210 which provided any guidance to the user as to when to check the "risk-significant" box.

The lack in Procedure 0-ADM-210 of a complete listing of risk-significant components in the on-line matrix and in the lists of risk-significant components and, also in Procedure 0-ADM-210, the lack of adequate guidance in identifying components as risk-significant in the out-of-service logbooks were considered weaknesses in the licensee's on-line risk assessment program. The licensee acknowledged these weaknesses.

In preparation for adaptation of the EPRI-developed equipment out-of-service (EOOS) computer program for on-line maintenance, the licensee developed a "one top event" model of the PSA ("Turkey Point Units 3 & 4 Equipment Out of Service (EOOS) Development Project Report"). The PSA plant model that was evaluated following the 1995 PSA update was modified to create a master file with EOOS master plant models. This process also served to enhance the primary PSA model. During the inspection, the licensee issued Engineering Instruction EDI-STA-003, "On-line Risk Monitor," which was intended to initiate usage of the EOOS on-line risk-monitor. The instruction indicated that configuration-specific risk levels (CDF) in excess of 5.0E-04/year should not be allowed. The EOOS model also had provisions to measure LERP. The baseline CDF for the EOOS model was 5.0E-05/ reactor year compared to a truncation point of 1.0E-08. The licensee's implementation of the EOOS on-line maintenance risk assessment program was considered a strength in the implementation of the Maintenance Rule.

For maintenance occurring during shutdown or refueling outages, the licensee had in effect Procedure 0-ADM-051, "Outage Risk Assessment and Control." Since the licensee did not have a shutdown PSA, the strategy to minimize risk during outages was based on qualitative measures depending on what phase in the outage the plant is in when equipment is to be taken out-of-service. This strategy was based on NUMARC 91-06, "Guidelines for Industry Actions to Assess Shutdown Management." Phase I was defined as the initial portion of an outage in which the decay heat load is high and additional equipment is maintained functional, or the first 240 hours following unit shutdown. Phase II was defined as the later stages of an outage in which the decay heat load is reduced and relaxations of functional equipment requirements are allowed, or more than 240 hours following unit shutdown. The procedure contained eight enclosures, each of which described the minimum required equipment, depending on whether the plant was in Phase I or Phase II, a large decay heat load or a reduced decay heat load, whether the RCS was above or below 200°F, whether there were two RCS loops available, or whether the reactor cavity was flooded greater than 23 feet. For each enclosure, the minimum equipment required to be available was identified for the particular function such as decay heat removal, inventory control, on-site and off-site power, reactivity control, shutdown monitoring instrumentation, or containment closure. The risk-significant required equipment was also identified. The "time to boil" was implicitly considered in the identification of the required equipment and the phases of the shutdown.

The outage activities are overseen by the RAT, whose charter was to review the outage plan, revisions to the outage plan, and higher risk activities to ensure that key safe shutdown functions were being maintained at the highest practical levels. The team was composed of managers or senior designees from work controls, operations, maintenance, projects, fire protection, engineering, licensing, and quarterly scheduling. The team reviewed the "97 Unit 4 Refueling Outage (Cycle 17)" which indicated the differences in scheduling various components to be out of service. The team also interviewed the outage scheduling supervisor and an assistant nuclear plant supervisor who was a member of the RAT. In particular, the RAT member was especially knowledgeable in the shutdown-risk program, as well as in the on-line program. He displayed a great deal of confidence and enthusiasm for the workings of the RAT. The objective is to try to return equipment to service in one half of the limiting condition of operation time. Operations performs an operability test before returning equipment to service.

c. Conclusions

The licensee's process for evaluation of risk for on-line removal of equipment from service was both comprehensive and effectively implemented. The process and involvement of the PSA organization in the process was considered good. Two minor weaknesses were identified: There were inconsistencies concerning the inclusion of all risk-significant SSCs in the lists of risk-significant components and inconsistencies in the classification of SSCs on sheets in the equipment out-of-service logbooks. The licensee's implementation of an on-line risk-monitor should significantly strengthen the program. The licensee's process for assessing shutdown-risk was comprehensive.

M1.6 Goal Setting and Monitoring for (a)(1) SSCs

a. Inspection Scope (62706)

Paragraph (a)(1) of the Rule requires, in part, that licensees shall monitor the performance or condition of SSCs against licensee established goals, in a manner sufficient to provide reasonable assurance the SSCs are capable of fulfilling their intended functions. The Rule further requires goals to be established commensurate with safety and industry-wide operating experience be taken into account, where practical. Also, when the performance or condition of the SSC does not meet established goals, appropriate corrective action shall be taken.

The team reviewed the systems and components listed below for which the licensee had established goals for monitoring of performance to provide reasonable assurance the system or components were capable of fulfilling their intended function. The team evaluated the use of industry-wide operating experience, monitoring of SSCs against goals, and corrective action taken when SSCs failed to meet goal(s), or when an SSC experienced an MPFF.

The team reviewed program documents and records for the systems or components the licensee had placed in the (a)(1) category in order to evaluate this area. The team also discussed the program with the Maintenance Rule coordinator, system engineers, and other licensee personnel.

b. Observations and Findings

b.1 High Head Safety Injection (HHSI) Pump 4A

HHSI pump 4A had been classified as (a)(1) on June 9, 1997, as the result of a failure to meet performance criteria for reliability. The pump had experienced two unrelated MPFFs within a 18-month period. The first failure involved a casing leak that exceeded allowable UFSAR limits. The second failure involved a failure of the pump motor breaker to close when demanded. The remaining portions of this system had not experienced reliability problems and had remained classified as (a)(2). The team verified that the licensee had implemented goal setting and monitoring as required by paragraph (a)(1) of the Rule for HHSI pump 4A.

b.2 Containment Purge Radiation Monitors

Containment air particulate radiation monitors, R-3-11 and R-4-11, and containment air gaseous radiation monitors, R-3-12 and R-4-12, were classified as (a)(1) on January 31, 1998, due to repetitive failures. The licensee had identified problems with poor performance and frequent periods out-of-service for those radiation monitors. The remaining portions of the radiation monitoring system had not experienced reliability problems and had remained classified as (a)(2). The containment air particulate and gaseous radiation detectors shared a common equipment skid on each unit and monitor the containment atmospheres for RCS leakage. The team determined that these radiation monitors were relatively new equipment and that most of the equipment performance problems were related to frequent need to change filter paper. The team verified that the licensee had implemented goal setting and monitoring as required by paragraph (a)(1) of the Rule for the containment air particulate and gaseous radiation monitors.

b.3 Auxiliary Feedwater Nitrogen Backup Supply

The AFW nitrogen backup supply was classified as (a)(1) on November 3, 1997, due to problems with excess nitrogen consumption during testing. This portion of the AFW system performed a safety-related function to provide a backup to the instrument air system for controlling AFW flow to the steam generators. The remaining portions of this system had not experienced reliability problems and had remained classified as (a)(2). The instrument air system was not safety-related. With loss of instrument air, the AFW nitrogen check valves must seal to prevent loss of nitrogen to provide for operation of the AFW flow control valves. The licensee had identified problems with excessive nitrogen consumption during routine testing of the AFW system. The team reviewed the licensee's evaluation of this issue and concurred with the determination that the most probable cause of the problem was fouling of the check valves by metallic debris or rust from upstream carbon steel instrument air piping. Corrective actions included additional inline filters installed to the instrument air supply lines to limit potential fouling of the check valves. The team verified that the licensee had implemented goal setting and monitoring as required by paragraph (a)(1) of the Rule for the AFW nitrogen backup supply.

b.4 Rod Control System

The Unit 3 rod control system was not classified as risk-significant within the scope of the Maintenance Rule. It was initially identified as (a)(2) with plant level performance criteria for non-risk-significant systems. However, it was placed into the (a)(1) category during Cycle 15 since plant level performance criteria was being approached, but not exceeded. The placement in (a)(1) was voluntary and was considered as a conservative measure by the licensee. The plant level performance criteria and indicators affected were 1) five functional failures; 2) three unplanned manual trips; and 3) four unplanned/forced outages. The main problem was in the electrical area. With the equipment aging, the functional failures occurred when various printed circuit boards failed, some due to excessive heat in the cabinets.

The corrective actions taken by the licensee were to 1) add cooling fans in the cabinets; 2) relocate printed circuit cards away from heat sources; 3) replace the firing circuit cards with an improved type; 4) replace several components on the other circuit cards with components having a higher rating; and 5) testing of printed circuit cards by the vendor.

The team verified that the licensee had implemented goal setting and monitoring as required by paragraph (a)(1) of the Rule for the rod control system.

b.5 3A and 3B Component Cooling Water Heat Exchangers

November 20, 1996, the licensee identified by CR 96-1466 that the 3B CCW HX failed to meet the availability performance criteria of 92.78% availability (18-month rolling average), as a result of extensive cleaning and plugging activities and was placed in (a)(1) status. The corrective action, re-tubing the 3B HX, was completed in January 1997. The licensee's established goal was to improve availability to greater than 94.00% each month after re-tubing, with monthly monitoring. The expert panel determined that the goal had been met and returned the 3B HX to (a)(2) status August 20, 1997.

The 3A CCW HX had been in service past its expected service life. Due to extensive severe pitting and general corrosion which reduced the cleaning effectiveness and resultant heat transfer capacity, the 3A HX was re-tubed in May 1997. On June 10, 1997, the licensee identified by CR 97-0976 that the 3A CCW HX failed to meet the availability performance criteria of 92.78% availability (18-month rolling average), as a result of extensive cleaning and plugging activities and the tube replacement activities. The corrective action, re-tubing the HX, had been completed. The licensee's established goal was to improve availability to greater than 94.00% each month and to sustain no tube failures due to pitting or corrosion through December 1997. The expert panel determined that the goal had been met and returned the 3A HX to (a)(2) status February 9, 1998.

The team reviewed the corrective action for these failures and the goals and monitoring under the (a)(1) status, and concluded that the corrective action, goals and monitoring were appropriate. The team also reviewed additional work order data concerning performance of this system for the period June 1995 to the beginning of the inspection. The team compared periods of unavailability identified by a review of operator logs with the unavailability database for the CCW system. No deficiencies were noted.

c. Conclusions

The licensee had considered safety in establishment of goals and monitoring for systems and components in an (a)(1) status. Industry-wide operating experience was used and corrective actions were appropriate.

M1.7 Preventative Maintenance and Trending for (a)(2) SSCs

a. Inspection Scope (62706)

Paragraph (a)(2) of the Rule states that monitoring as required in paragraph (a)(1) is not required where it has been demonstrated that the performance or condition of a SSC is being effectively controlled through the performance of appropriate preventative maintenance, such that the SSC remains capable of performing its intended function.

The team reviewed the selected SCCs listed below for which the licensee had established performance criteria and was trending performance to verify that appropriate preventive maintenance was being performed, such that the SSCs remained capable of performing their intended function. The team evaluated the use of industry-wide operating experience, trending of SSCs against performance criteria, and corrective action taken when SSCs failed to meet performance criteria, or when an SSC experienced an MPFF.

The team reviewed program documents and records for selected SSCs that the licensee had placed in the (a)(2) category in order to evaluate this area. The team also discussed the program with the Maintenance Rule coordinator, system engineers, maintenance supervisors, and other licensee personnel. In addition, the team reviewed specific program areas based on review of operator logs and EOOS logs.

b. Observations and Findings

b.1 Structures

The licensee completed their structural baseline inspections. The team reviewed 0-ADM-728, "Maintenance Rule Implementation," to evaluate the adequacy of the acceptance criteria and performance criteria for evaluation of the concrete and structural steel. The team also reviewed the results of the structural inspection of the cooling canal system documented in "Thermal Performance of the Turkey Point Cooling Canal System in 1997."

The team conducted a walkdown inspection of the following structures: the demineralized water storage tank; Units 3 and 4 4160V C-Bus switchgear enclosures; Units 3 and 4 emergency diesel generator (EDG) buildings; the intake structure; the turbine building; the cask crane A-frames; Units 3 and 4 primary water storage tank and the RWST; and the auxiliary building in order to observe the condition of the concrete and steel structures. The team inspected the cooling canal system to evaluate the canals for settlement, slope stability and slope protection. The team compared their observations with the structural baseline checklists, and 0-ADM-728, "Maintenance Rule Implementation", Attachment 4, "Structural Inspection Attributes for Maintenance Rule Structures". The team noted several conditions which deviated from 0-ADM-728, Attachment 4, that had not been documented by the licensee in the structural baseline checklists.

The licensee indicated that, although the observed conditions existed and did not meet the attributes of 0-ADM-728, Attachment 4, they were minor in nature and did not compromise the integrity of the structures. The team concurred with the licensee, but indicated that without detailed baseline information, trending of minor discrepant conditions was not possible.

During walkdown of the CCW system, the team identified deficiencies on the system foundations and baseplates. Discussion of these deficiencies with the structural engineer and the CCW system engineer determined that responsibility for these structural components was not clearly delineated or understood by the personnel involved. As a result of this interface problem, the noted deficiencies had not been documented. The inadequate documentation of these deficiencies combined with the interface problem which contributed to the documentation issue was noted as a weakness. Subsequently, licensee management indicated that the structural components for a system had been and were currently the responsibility of the system engineer.

b.2 Auxiliary Feedwater System

The licensee had classified the AFW system as a safety-related, standby, and risk-significant system. Review of the AFW system determined that appropriate performance criteria had been established and monitoring was being accomplished against those criteria. Review of the problems associated with the system determined that appropriate corrective actions had been taken for failures. Operating experience was being used in system monitoring. No deficiencies were noted concerning this system.

b.3 Standby Steam Generator Feedwater Pumps

The licensee had classified the standby steam generator feedwater pumps as non-safety related, standby, and risk-significant. These pumps were considered as part of the feedwater system, required manual starting by the operator and served as a backup to the AFW system in the event that the AFW system did not function properly. There were one motor driven the operator and served as a backup to the AFW system in the event that the AFW system did not function properly. There were one motor driven pump and one diesel driven pump which were shared between the two units. Review of the standby steam generator feedwater pumps determined that appropriate performance criteria had been established and monitoring was being accomplished against those criteria. Review of the problems associated with these pumps determined that appropriate corrective actions had been taken for failures. Operating experience was being used in system monitoring. No deficiencies were noted concerning these pumps.

b.4 Radiation Monitoring

The licensee had classified the radiation monitoring system as a non-risk-significant system with certain radiation monitors considered as safety-related. Additionally, the licensee had evaluated the radiation monitoring system as a normal operating system with system performance criteria of no repeat MPFFs per fuel cycle and no more than 5% unavailability for any single radiation monitor. Although this system included several radiation monitors that provided interlock or automatic isolation functions, those standby functions were considered by the licensee to be part of the process system rather than the radiation monitoring system.

The team noted that the licensee's expert panel had recently modified the radiation monitoring system performance criteria to include availability in addition to reliability. In the process of performing the historical review the system engineer had missed some of the availability associated with the containment purge radiation monitors. Those radiation monitors had already been classified as (a)(1) due to repetitive failures. The team determined that the problem with missing unavailability time was an isolated case and did not represent a significant portion of total time in service. As a result of this oversight the licensee issued CR 98-0368. The team reviewed this CR and noted that proposed corrective actions required the system engineer to review all sources of out-of-service information for the system and resolve the data inaccuracy issue.

The team noted that with the exception of containment purge radiation monitors, the interlocks or automatic isolations for each of the radiation monitors were functionally tested by the licensee on a monthly basis. This testing had been accomplished by use of Surveillance Test Procedures, 3-OSP-067.1, "Process Radiation Monitoring Operability

Test," and 0-SMI-067.4, "Control Room HVAC Radiation Monitors RAI-6642 and RAI-6643 Monthly Operability Test". However, the automatic damper isolation function associated with the containment purge radiation monitors was only tested once per refueling cycle. This path had not normally been established except during refueling outages and the interlock was only tested prior to refueling. Containment purge dampers are left closed during normal unit operation. Therefore, failures of that standby automatic isolation function may only have been observed during testing. NUMARC 93-01, Revision 2, Section 9.3.2 recommends that specific performance criteria are established for all risk-significant SSCs and all non-risk-significant SSCs that are in a standby mode. The team discussed with the licensee the concern that the system performance criteria of no repeat MPFFs was inadequate for the standby function associated with the containment purge radiation monitors. As a result of this oversight, the licensee issued CR 98-0367. The team reviewed this CR and noted that proposed corrective actions included development of additional performance criteria for the automatic damper isolation function associated with the containment purge radiation monitors.

Based on the risk-significance of this minor discrepancy, the actual extent of use of subject dampers, the licensee's corrective actions for this isolated issue, and the reasonableness of licensee efforts to implement the Rule, the team concluded that the licensee appropriately addressed the team's concerns.

b.5 High Head Safety Injection System

The licensee had classified the HHSI system as a safety-related, standby, and risk-significant system. Review of the HHSI system determined that appropriate performance criteria had been established and monitoring was being accomplished against those criteria. Review of the problems associated with the system determined that appropriate corrective actions had been taken for failures. Operating experience was being used in system monitoring. No deficiencies were noted concerning this system.

b.6 Startup Transformers

The startup transformers system for each unit had been classified as a risk-significant system with some standby functions. The startup transformers in each unit provide an independent offsite source of power from the switchyard for startup and when the main generator and auxiliary transformer are out-of-service. Review of the system determined that appropriate performance criteria had been established and monitoring was being accomplished against those criteria. Review of the transformers determined there were no problems or failures with the system. The reliability was 100% and the availability was 99.91% over the last rolling 18-month period. Appropriate preventive maintenance was being implemented. Operating experience was being used in system monitoring. No functional failures of deficiencies were noted concerning the startup transformer system in each unit.

During the team's walkdown of the main switchyard that provided offsite power to the startup transformers, a concern with the relay control house was identified. No fire detection equipment or alarms were found. The licensee stated that corrective action would be implemented by the installation of fire detection equipment that would have a remote alarm to the site's main control room. The installation of the fire detection equipment was tentatively scheduled for completion by the end of June 1998.

b.7 125 VDC & 120 VAC Instruments

This system was a common system that provided both vital and non-vital 125 VDC and 120 VAC power to both units. The 125 VDC vital power to safety-related loads was classified as the risk-significant portion of the system. The non-risk-significant parts of the system included the vital 120 VAC, non-vital 125 VDC, and non-vital 120 VAC. The 125 VDC vital power had both reliability and unavailability performance criteria. The non-risk-significant portions or the system used plant level performance criteria. Based on the past failure history review, none of the performance criteria were exceeded. All the vital 125 VDC power was 100% available and there were no functional failures for reliability. None of the plant level performance criteria was exceeded for the non-risk-significant portion of the system. There were no adverse trends, functional failures, over due PMs, major corrective maintenance, or applicable industry trends. The team did not identify any deficiencies or concerns with this system.

b.8 Component Cooling Water System

Review of the CCW system determined that appropriate performance criteria had been established, and monitoring was being accomplished against those criteria. Review of the problems associated with the system indicated that appropriate corrective actions had been taken for failures. Operating experience was being used in system monitoring.

The team compared periods of unavailability identified by a review of operator logs and clearance logs with the unavailability database for the CCW system. No deficiencies were noted.

b.9 Intake Cooling Water (ICW)

Review of the ICW system determined that appropriate performance criteria had been established, and monitoring was being accomplished against those criteria. Review of the problems associated with the system indicated that appropriate corrective actions had been taken for failures. Operating experience was being used in system monitoring. The team compared periods of unavailability identified by a review of operator logs and clearance logs with the unavailability database for the ICW system. No deficiencies were noted.

c. Conclusions

For (a)(2) SSCs, the team concluded that performance criteria were properly established; industry-wide operating experience was considered, where practical; appropriate trending was performed; corrective action was taken when SSCs failed to meet performance criteria or when an SSC experienced a functional failure; and operating data were being properly captured. The structures program met the requirements of the Rule and all accessible structures had been inspected. A weakness was identified concerning adequate documentation of inspection deficiencies for structures. Additionally, responsibility for condition monitoring of foundations and baseplates for systems and components was not clearly defined. The performance criteria for the containment purge radiation monitors were determined to be inappropriate, and it was noted that there was no fire detection or automatic suppression in the switchyard relay building.

M2 Maintenance and Material Condition of Facilities and Equipment

M2.1 Material Condition Walkdowns

a. Inspection Scope (62706)

During the course of the reviews, the team performed walkdowns of the following systems and plant areas, and observed the material condition of these SSCs.

- AFW system

- standby steam generator feedwater pumps
- HHSI system
- radiation monitoring
- other balance of plant areas
- demineralized water storage tank
- Units 3 and 4 4160V C-bus switchgear enclosures
- Units 3 and 4 EDG generator buildings
- intake structure, the turbine building .
- cask crane A-frames .
- Units 3 and 4 primary and refueling water storage tanks
- auxiliary building.
- cooling canal system.
- 125 VDC & 120 VAC Instruments
- startup transformers
- rod control system

b. Observations and Findings

The team performed material condition walkdowns on selected portions of each system that related to the areas inspected. Housekeeping in the general areas around system and components was acceptable. Piping and components were painted, and very few indications of corrosion, oil leaks, or water leaks were evident. The team observed the inside of selected panels and cabinets and no loose debris, damage, or degraded equipment was noted. Minor deficiencies observed by the team were immediately addressed by the licensee.

c. Conclusions

In general, walkdown of systems determined that the systems were being appropriately maintained. Minor deficiencies observed by the team were immediately addressed by the licensee.

M7 Quality Assurance in Maintenance Activities

M7.1 Licensee Self-Assessment

a. Inspection Scope (62706)

The team reviewed the following assessments and audits of the licensee's implementation of the Maintenance Rule:

- "Quality Department Assessment of Maintenance Rule Implementation," dated January 8, 1996.
- "Self-Assessment of Maintenance Rule Implementation," dated February 28, 1996.
- "Quality Department Maintenance Rule Review of the Emergency Diesel Generators," dated March 27, 1996.
- "Independent Assessment of Maintenance Rule Implementation," dated May 21, 1996.
- "Quality Assurance Audit QAO-PTN-97-005, Maintenance Rule Audit," dated June 3, 1997.

b. Observations and Findings

The team reviewed the above listed assessments and audits during the inspection preparation week and while on site. The first four audits or assessments reviewed were conducted prior to the required implementation of the Maintenance Rule (July 10, 1996). These reviews were performed to determine the licensee's readiness to implement the Maintenance Rule. The audits and assessments were comprehensive and thorough.

The final audit (QAO-PTN-97-005) was performed approximately one year following the implementation of the Rule. This audit focused on the lessons learned from the first 10 NRC Maintenance Rule baseline inspections performed at other nuclear power stations. Problem areas identified at other stations were addressed and corrective actions, if required, were incorporated into the licensee's Maintenance Rule program.

Overall, the licensee's audits and self-assessments of the Maintenance Rule program were thorough, and coupled with the overall findings of this baseline inspection, assisted in the establishment of a sound Maintenance Rule program.

c. Conclusions

Audits/self-assessments of the Maintenance Rule program were thorough. Corrective actions sampled by the team were appropriately implemented.

III. ENGINEERING

E2 Engineering Support of Facilities and Equipment

E2.1 Review of Updated Final Safety Analysis Report (UFSAR) Commitments (62706)

A recent discovery of a licensee operating their facility in a manner contrary to the UFSAR description highlighted the need for a special focused review that compares plant practices, procedures and/or parameters to the UFSAR descriptions. While performing the inspections discussed in this report, the team reviewed the applicable portions of the UFSAR that related to the areas inspected. The team verified that the UFSAR wording was consistent with the observed plant practices, procedures and/or parameters.

E4 Engineering Staff Knowledge and Performance

E4.1 Engineer Knowledge of the Maintenance Rule

a. Inspection Scope (62706)

The team interviewed licensee system owners (system engineers) for the SSCs reviewed in paragraphs M1.6 and M1.7 to assess their understanding of the Maintenance Rule and associated responsibilities.

b. Observations/Findings and Conclusions

In general, systems engineers' technical knowledge of systems was sound. Recent assignments and turnovers caused some lack of system specific knowledge. Some systems engineers' understanding of the Rule and it's implementation needed improvement. The lack of formal training for some systems engineers was identified as a weakness.

V. MANAGEMENT MEETINGS

X1 Exit Meeting Summary

The team leader discussed the progress of the inspection with licensee representatives on a daily basis and presented the results to members of licensee management at the conclusion of the inspection on February 27, 1998. The licensee acknowledged the findings presented.

PARTIAL LIST OF PERSONS CONTACTED

LICENSEE:

C. Guey, Risk and Reliability Group Supervisor
R. Hovey, Site Vice President
D. Jernigan, Plant General Manager
E. Lyons, Maintenance Rule Coordinator
E. Thompson, Engineering Manager
D. Tomaszewski, Systems Engineering Manager

NRC:

P. Fredrickson, Chief, Maintenance Branch, RII
R. Gibbs, Maintenance Rule Inspection Team Leader, RII
T. Johnson, Senior Resident, Turkey Point, RII
B. Mallett, Deputy Director, Division of Reactor Safety, RII

LIST OF INSPECTION PROCEDURES USED

IP 62002	Inspection of Structures, Passive Components, and Civil Engineering and Features at Nuclear Power Plants
IP 62706	Maintenance Rule

LIST OF PROCEDURES REVIEWED

Procedure 0-ADM-051, "Outage Risk Assessment and Control," revision dated August 27, 1997.

Procedure 0-ADM-210, "On-Line Maintenance/Work Coordination," revision dated February 10, 1998.

Procedure 0-ADM-728, "Maintenance Rule Implementation," revision dated January 23, 1998.

Calculation No. PTN-BFJR-93-012, "Risk Significance Determination of PTN Systems," Revision 0.

Calculation PTN-BFJR-96-005, "Risk Evaluation of Increasing Equipment Unavailability to the Maximum Allowed Under the Maintenance Rule," Revision 4.

Calculation No. PSL-BFJR-97-001, "Evaluation of the Impact of the Proposed Maintenance Rule Reliability Criteria on the Baseline PSA CDF for Units 1 & 2," (undated computer version of Revision 0) for the St. Lucie plant.

Calculation No. PTN-BFJR-97-003, "Evaluation of the Impact of the Proposed Maintenance Rule Reliability Criteria on the Baseline CDF for Units 3 & 4," Revision 2.

EPRI TR-105396, "PSA Applications Guide," August 1995.

EPRI Technical Bulletin 96-11-01, "Monitoring Reliability for the Maintenance Rule," November 1996.

EPRI Technical Bulletin 97-3-01, "Monitoring Reliability for the Maintenance Rule - Failures to Run," March 1997.

Engineering Department Instruction EDI-SE-008, "Monitoring Maintenance Effectiveness," Revision dated July 28, 1997.

Engineering Department Instruction EDI-STA-003, "On-line Risk Monitor," revision dated February 26, 1998.

NUMARC 91-06, "Guidelines for Industry Actions to Assess Shutdown Management," Original Issue.

Surveillance Test Procedure 3-OSP-067.1, "Process Radiation Monitoring Operability Test," revision dated January 15, 1998.

Surveillance Test Procedure 0-SMI-067.4, "Control Room HVAC Radiation Monitors RAI-6642 and RAI-6643 Monthly Operability Test," revision dated December 9, 1996.

"Turkey Point Plant Units 3 & 4 Probabilistic Risk Assessment Individual Plant Examination Final Report," Volumes 1 and 2, June 1991.

"Turkey Point Plant Probabilistic Risk Assessment Update Summary Report," April 26, 1993.

"Turkey Point Units 3 & 4 Probabilistic Risk Assessment Update (1995)," November 1995.

"Turkey Point Units 3 & 4 Equipment Out-of-Service (EOOS) Development Project Report", September 19, 1997 10, 1997.

PTN-ENG-98-0025, "Unit 4 Maintenance Rule Periodic Assessment," January 27, 1998.

"Maintenance Rule Initial Periodic Assessment Period from March 1995 to July 9, 1996."

"Thermal Performance of The Turkey Point Cooling Canal System in 1997," October 1997.

Turkey Point Nuclear Plant

MAINTENANCE RULE

NRC ENTRANCE

FEBRUARY 23, 1998

ENCLOSURE 2

TURKEY POINT NUCLEAR PLANT
MAINTENANCE RULE

- ORGANIZATION / RESPONSIBILITIES
- PROGRAM DEVELOPMENT
- SCOPING AND RISK SIGNIFICANCE DETERMINATION
- PERFORMANCE CRITERIA, GOAL SETTING, MONITORING
- A(1) SSCs
- EVALUATING RISK WHEN REMOVING SSCs FROM SERVICE
- BALANCING AVAILABILITY AND RELIABILITY
- PERIODIC ASSESSMENTS
- PROGRAM ADJUSTMENTS
- STRUCTURES
- FUTURE IMPROVEMENTS

TURKEY POINT NUCLEAR PLANT MAINTENANCE RULE

ORGANIZATIONS

- R. J. HOVEY SITE VICE PRESIDENT
  - D.E. JERNIGAN PLT GENERAL MANAGER
  - J.R. HARTZOG BUS SYS MANAGER
  - G.E. HOLLINGER LICENSING MANAGER
  - M.L. LACAL TRAINING MANAGER
  - M.P. HUBA NUC MATL MANAGER
  - J.E. KIRKPATRICK PROT SVC MANAGER
  - J.A. MARCO HR MANAGER
  - T.V. ABBATIELLO QA MANAGER
  - E.A. THOMPSON SITE ENG MANAGER

- D.E. JERNIGAN PLANT GENERAL MANAGER
  - M.J. OTTILIGE ASSESS/COMP TECH
  - M.O. PEARCE MAINT MANAGER
  - R.G. WEST OPERATIONS MANAGER
  - R.E. ROSE WORK CNTRL MANAGER

- R.S. KUNDALKAR VP NUC ENG
  - E.A. THOMPSON PTN ENG MGR
    - J. BALAGUERO ENGINEERING OPS SUPPORT
    - S.T. HALE SPECIAL PROJECT MANAGER
    - E. HODGES COST ANALYST
    - W. SKELLEY PLANT ENGINEERING
    - D. TOMASZEWSKI SYSTEMS ENGINEERING
    - A. ZIELONKA SPECIAL PROJECT MANAGER

TURKEY POINT NUCLEAR PLANT MAINTENANCE RULE

PROGRAM RESPONSIBILITIES

- ENGINEERING DEPARTMENT HAS OVERALL MAINTENANCE RULE PROGRAM RESPONSIBILITIES
- SYSTEM ENGINEERS
  - PERFORMANCE MONITORING
  - A(1) GOAL SETTING AND MONITORING
  - CAUSE DETERMINATIONS
  - PERIODIC ASSESSMENTS
- EXPERT PANEL REVIEWS AND APPROVES
  - SCOPE
  - RISK SIGNIFICANCE
  - PERFORMANCE CRITERIA
  - A(1) GOAL SETTING
  - PERIODIC ASSESSMENTS
- WORK CONTROLS REVIEWS SCHEDULED WORK AND ASSESSES OVERALL RISK TO PLANT
- OPERATIONS REVIEWS RISK PRIOR TO REMOVING EQUIPMENT FROM SERVICE
- RELIABILITY AND RISK ASSESSMENT GROUP (RRAG) PROVIDES PSA REQUIRED ANALYSIS

TURKEY POINT NUCLEAR PLANT
MAINTENANCE RULE

PROGRAM DEVELOPMENT

- INITIAL EFFORTS IN 1993
  - SCOPING
  - RISK SIGNIFICANCE REVIEWS
  - PERFORMANCE CRITERIA
- PROGRAM COMPLETION IN 1995 / 1996
  - SYSTEM ENGINEERS PREPARED BASIS DOCUMENTS
  - RISK SIGNIFICANT REVIEW BY EXPERT PANEL
  - PERFORMANCE CRITERIA DEVELOPED / APPROVED
  - 3 YEAR REVIEW PERFORMED BY SYSTEM ENGINEERS
  - INITIAL CLASSIFICATION OF SYSTEMS
- PROGRAM PROCEDURES ISSUED / REVISED EARLY 1996
- INTERNAL PROGRAM ASSESSMENT / QA REVIEW PERFORMED
- OUTSIDE ASSESSMENT PERFORMED MAY 1996

TURKEY POINT NUCLEAR PLANT
MAINTENANCE RULE

SCOPING AND RISK SIGNIFICANCE

- 142 SSCs CONSIDERED
- 108 SSCs IN SCOPE
- 36 SSCs RISK SIGNIFICANT
- ORIGINALLY SCOPED BY SYSTEM OR STRUCTURE
  - DOCUMENTED BY SCOPING MATRIX & SYSTEM ANALYSIS SUMMARIES
  - ENHANCED PROGRAM BY ISSUING FUNCTION MATRIX
- RISK SIGNIFICANCE DETERMINED BY EXPERT PANEL
  - NUMARC 93-01 GUIDANCE FOLLOWED FOR
    - RISK ACHIEVEMENT WORTH
    - RISK REDUCTION WORTH
    - TOP 90%

TURKEY POINT NUCLEAR PLANT
MAINTENANCE RULE

PERFORMANCE CRITERIA, GOAL SETTING, MONITORING

- PERFORMANCE CRITERIA DEVELOPED BY SYSTEM ENGINEERS AND APPROVED BY EXPERT PANEL
- SYSTEM ENGINEERS MONITOR PERFORMANCE AGAINST PERFORMANCE CRITERIA
    - SYSTEM ENGINEER TURNOVER / REASSIGNMENT
    - CHECKLISTS DEVELOPED TO ENSURE TRANSFER OF INFORMATION
    - SUPERVISORY INVOLVEMENT
- RISK SIGNIFICANT PERFORMANCE CRITERIA VALIDATED AGAINST PSA
    - AVAILABILITY
    - RELIABILITY
- SYSTEM ENGINEERS RESPONSIBLE FOR GOAL SETTING AND A(1) MONITORING
    - GOAL SETTING AND A(1) MONITORING DOCUMENTED IN CONDITION REPORT
    - APPROVED BY EXPERT PANEL
- QUARTERLY REPORT SUMMARIZES PERFORMANCE
    - IMPROVING AND STANDARDIZING FORMAT AND CONTENT

TURKEY POINT NUCLEAR PLANT
MAINTENANCE RULE

A(1) SSCs

- SSCs PREVIOUSLY IN A(1) AND RETURNED TO A(2)
  - 3B EMERGENCY DIESEL GENERATOR
  - UNIT 3 AND UNIT 4 CONTAINMENT RADIATION MONITOR
  - UNIT 3 FEEDWATER DISCHARGE CHECK VALVE 3-20-218
  - ICW TO TPCW HX ISOLATION VALVE POV-3-4882
  - UNIT 3 AND 4 EMERGENCY CONTAINMENT COOLERS
  - 3B CHARGING PUMP
  - DIESEL DRIVEN SERVICE WATER PUMP
  - 3B COMPONENT COOLING WATER HEAT EXCHANGER
  - 3B RESIDUAL HEAT REMOVAL PUMP
  - 4B RESIDUAL HEAT REMOVAL PUMP
  - 3A COMPONENT COOLING WATER HEAT EXCHANGER
- SSCs CURRENTLY IN A(1)
  - UNIT 3 ROD CONTROL SYSTEM
  - PASS/PAHM HEAT TRACE CIRCUITS
  - 4A HIGH HEAD SAFETY INJECTION PUMP
  - PASS CHLORIDE ANALYZER
  - AUXILIARY FEEDWATER BACKUP NITROGEN
  - PRMS
- CONCLUSION
  - MAINTENANCE RULE IMPLEMENTATION HAS BEEN EFFECTIVE IN IDENTIFYING AND RESOLVING EQUIPMENT ISSUES

TURKEY POINT NUCLEAR PLANT
MAINTENANCE RULE

EVALUATING RISK WHEN REMOVING EQUIPMENT FROM SERVICE

- ON LINE MAINTENANCE CONTROLLED BY PROCEDURE 0-ADM-210
  - QUARTERLY SCHEDULE
  - PRE-EVALUATED MATRIX FOR TWO RISK SIGNIFICANT COMPONENTS OOS CONCURRENTLY FOR 72 HOURS
  - WORK CONTROLS EVALUATES SCHEDULED ACTIVITIES
  - OPERATIONS EVALUATES PRIOR TO REMOVING FROM SERVICE
  - RISK ASSESSMENT GROUP PROVIDES PSA EVALUATION FOR MORE THAN TWO COMPONENTS OOS CONCURRENTLY
- AVERAGE RISK TO THE PLANT DUE TO ON LINE MAINTENANCE CALCULATED TO BE 5.4 E-5
  - LESS THAN 1995 BASELINE CDF
  - EQUAL TO 1997 BASELINE CDF
- SHUTDOWN RISK CONTROLLED BY PROCEDURE 0-ADM-051
  - FUNCTION BASED REQUIRED EQUIPMENT LIST FOR VARIOUS PLANT CONDITIONS
    - BASED ON NUMARC 91-06
  - OUTAGE SCHEDULE DEVELOPED USING REQUIRED EQUIPMENT LIST AS INPUT
  - RISK ASSESSMENT TEAM IDENTIFIED HIGHER RISK CONDITIONS
  - DEVIATIONS FROM REQUIRED EQUIPMENT LIST APPROVED BY PLANT MANAGEMENT - CONTINGENCIES PLANNED
  - PRE-PLANNED CONTINGENCIES IDENTIFIED FOR UNPLANNED DEVIATIONS FROM REQUIRED EQUIPMENT LIST

TURKEY POINT NUCLEAR PLANT
MAINTENANCE RULE

BALANCING AVAILABILITY AND RELIABILITY

- PERFORMANCE CRITERIA FOR AVAILABILITY AND RELIABILITY VALIDATED BY PSA
- AVAILABILITY VALIDATED PRIOR TO RULE IMPLEMENTATION DATE
- RELIABILITY VALIDATED MID 1997 BASED ON INDUSTRY EXPERIENCE AND NRC IN 97-18
  - DEMANDS ESTIMATED
  - SOME PERFORMANCE CRITERIA ADJUSTED
- OVERALL CONCLUSION - PERFORMANCE CRITERIA ARE APPROPRIATE
- SSC IS DETERMINED TO BE BALANCED IF PERFORMANCE CRITERIA FOR BOTH AVAILABILITY AND RELIABILITY ARE MET
- APPROPRIATE ADJUSTMENTS MADE TO MAINTENANCE PROGRAM IF PERFORMANCE CRITERIA ARE NOT MET
- SUMMARIZED DURING PERIODIC ASSESSMENT

TURKEY POINT NUCLEAR PLANT
MAINTENANCE RULE

PERIODIC ASSESSMENTS

- PERFORMED FOLLOWING EACH REFUELING OUTAGE
  - UNIT 3 COMPLETED AUGUST 1997
  - UNIT 4 COMPLETED JANUARY 1998
- SYSTEM ENGINEERS PERFORM ASSESSMENT FOR EACH SSC
  - SSC PERFORMANCE REVIEWED
  - RELIABILITY VS AVAILABILITY REVIEWED
  - ADJUSTMENTS IDENTIFIED
  - INDUSTRY OPERATING EXPERIENCE SUMMARIZED
- SUMMARY REPORT PREPARED BY MR COORDINATOR
- REVIEW AND APPROVAL BY EXPERT PANEL

PROGRAM ADJUSTMENTS

- FUNCTIONS MATRIX
- PROCEDURE IMPROVEMENTS FOR DOCUMENTATION OF FUNCTIONAL FAILURES AND MPFF
- SCOPING ADJUSTMENTS
  - COMMUNICATIONS
  - EMERGENCY LIGHTING
  - AREA RADIATION MONITORING
  - HVAC SYSTEMS
  - ROD POSITION INDICATION (RPI)
- RISK SIGNIFICANCE REVIEWS
  - INSTRUMENTATION
  - NON-VITAL DC HVAC
  - MOTOR DRIVEN INSTRUMENT AIR COMPRESSORS
- PERFORMANCE CRITERIA ADJUSTMENTS
  - INSTRUMENT AIR
  - INTAKE COOLING WATER (CCW HEAT EXCHANGERS)
  - COMPUTER/CABLE SPREADING ROOM HVAC
  - ROD CONTROL (RPI)
  - COMPONENT COOLING WATER
  - REACTOR PROTECTION SYSTEM
  - NUCLEAR INSTRUMENTATION
  - SAFEGUARDS ACTUATION SYSTEM
  - PROCESS RADIATION MONITORING
  - CONTAINMENT POST ACCIDENT EVALUATION
  - ANNUNCIATORS
- PLAN OF THE DAY IMPROVEMENTS

STRUCTURES

- CONDITION MONITORING PERFORMED BY CIVIL ENGINEERS
  - INSPECTIONS PERFORMED EACH REFUELING CYCLE VS. ATTRIBUTES MATRIX
  - DEFICIENCIES IDENTIFIED
  - DOCUMENT REVIEW PERFORMED
- STRUCTURES CLASSIFIED AS PER REG GUIDE 1.160 REV. 2
  - ACCEPTABLE
  - ACCEPTABLE WITH DEFICIENCIES
  - UNACCEPTABLE
- STRUCTURES PLACE IN A(1) IF:
  - UNACCEPTABLE
  - DEFICIENCIES COULD CAUSE FAILURE TO MEET FUNCTION IF LEFT UNCORRECTED UNTIL NEXT INSPECTION

FUTURE IMPROVEMENTS

- FURTHER STANDARDIZE REPORTS
- REVIEW 1997 PSA UPDATE FOR EFFECT ON RISK RANKING
- EOOS ON LINE RISK MONITOR IN TRIAL IMPLEMENTATION
- SHUTDOWN SAFETY ASSESSMENT TOOL
- IMPROVE EQUIPMENT OUT OF SERVICE BOOK (NOMS)

TURKEY POINT NUCLEAR PLANT
MAINTENANCE RULE

SUMMARY

- MAINTENANCE RULE IMPLEMENTATION HAS RESULTED IN IDENTIFICATION AND CORRECTION OF EQUIPMENT ISSUES
- ON LINE MAINTENANCE HAS NOT RESULTED IN UNDUE RISK TO THE PLANT
- PERIODIC ASSESSMENTS PERFORMED TO CONTINUE IMPROVEMENTS