U.S. NUCLEAR REGULATORY COMMISSION

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Licensee:	Illinois Power Company
Facility:	Clinton Power Station
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EXECUTIVE SUMMARY

Clinton Power Station
NRC Inspection Report 50-461/98028(DRS)

This inspection included a follow-up review of the licensee's program for implementing 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." The report covers a one-week, on-site inspection by regional, resident, and Office of Nuclear Reactor Regulation inspectors, and a contractor from Brookhaven National Laboratory. The NRC's maintenance rule baseline inspection was documented in Inspection Report 50-461/98005.

Although the licensee established an adequate maintenance rule program, due to quality assurance concern with the ineffective implementation of the maintenance rule program, the inspectors concluded that the requirements of the maintenance rule were not met. The remaining aspect of the maintenance rule program that needed to be addressed to meet the requirements of the maintenance rule was to ensure acceptable program implementation throughout the plant restart and subsequent plant operations. As such, plant staff needs to continue to take ownership of their portion of the maintenance rule program to ensure effective implementation. Based on the results of the inspection, NRC Manual Chapter 0350 Case Specific Checklist Item V.3, "Establish Maintenance Rule Program," was closed. No violations or open items were identified during this inspection.

Maintenance

- Although the risk ranking process continued to rely on a probabilistic risk analysis based predominantly on generic data, the risk ranking of structures, systems and components was acceptable. (Section M1.2.)

- In general, the guidance for performing periodic evaluations met the requirements of the maintenance rule and the intent of the industry implementing guidance. The Cycle 6 assessment report provided good evaluations of system performance over the period by documenting changes to maintenance activities and changes to various maintenance rule program aspects. (Section M1.3)

- The inspectors concluded that the process for balancing the unavailability and reliability of structures, systems and components was acceptable, however, based on the Cycle 6 periodic assessment, the licensee concluded that implementation of this process was ineffective. In response to this self-identified concern, the licensee took action to ensure a proper balance existed between the reliability and availability for structures, systems and components. (Section M1.4)

- The inspectors concluded the licensee had adequate on-line and outage risk assessment processes and had established acceptable thresholds for contingency planning. Training of personnel on the on-line risk procedures, however, needed to be completed prior to restart as part of NRC Manual Chapter 0350, Case Specific Checklist Item II.4. (Section M1.5)

- Based on the sensitivity study performed for the availability criteria, and the use of the statistical approach as defined in the Electric Power Research Institute technical bulletins, the inspectors considered the licensee's performance criteria for both availability and reliability to be consistent with the assumptions in the updated probabilistic risk assessment and therefore acceptable. (Section M1.6)

- Appropriate goals and corrective action plans were developed for systems classified as (a)(1) per the maintenance rule. (Section M1.6)

- In general, structures, systems and components were being properly classified under categories (a)(1) and (a)(2) of the MR. Performance criteria, goals, and corrective actions, both in progress and planned, for structures, systems and components in (a)(1) status appeared adequate. The structure, system and component functions for the systems reviewed were properly scoped under the MR. The inspectors reviewed condition reports, maintenance work requests, and the periodic assessment and did not identify any maintenance preventable functional failures not previously classified or unavailability time not properly tracked. (Section M2.1)

Quality Assurance

- The 1998 quality assurance audit was thorough and probing. Based on individual issues, the auditors were able to identify significant underlying causes (lack of ownership and inadequate communications) for the ineffective implementation of the maintenance rule program. Although actions have been identified and were being implemented to correct the weaknesses, it was too soon to determine their effectiveness. The use of outside personnel in the audit provided independent insights into the maintenance rule program and added to the overall quality of the program assessments. (Section M7.1)

Engineering

- The system engineers were experienced and knowledgeable about their systems and understood their responsibilities with respect to the maintenance rule. (Section E4.1)

Report Details

Summary of Plant Status

Clinton Power Station (CPS) was in an extended shutdown during the inspection.

Introduction

This inspection included a follow-up review of the licensee's program for implementing 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," (commonly referred to as the maintenance rule).

II. Maintenance

M1 Conduct of Maintenance (62706)

M1.2 Safety (Risk) Determination and Risk Ranking

a. Inspection Scope

Paragraph (a)(1) of the maintenance rule (MR) requires that licensees monitor the performance or condition of structures, systems, or components (SSCs), against licensee-established goals, in a manner sufficient to provide reasonable assurance that the SSCs are capable of fulfilling their intended functions. The MR also requires that "these goals be established commensurate with safety." In order to implement this requirement, NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," established two safety categories: "high safety significance" and "low safety significance." Criteria for placing SSCs in either of these two safety (also referred to as risk) categories are described in NUMARC 93-01. This safety determination (high safety significance or low safety significance) was to be used to determine if the SSCs should be monitored at the system, train, or plant level.

The inspectors reviewed the methods and calculations that the licensee established for making these safety (or risk) determinations. The use of an expert panel was recommended by NUMARC 93-01 to establish safety significance of SSCs by combining probabilistic risk assessment (PRA) insights with operations and maintenance experience, to compensate for the limitations of PRA modeling and importance measures. In addition, the inspectors reviewed issues identified in the April 1998, MR baseline inspection concerning the adequacy of the risk ranking process, the use of generic data, and the importance ranking of the turbine driven feedwater pumps.

b. Observations and Findings on Risk Determinations

The risk ranking of systems and functions was based on importance measure calculation, "Clinton Nuclear Power Station - Calculation of System and Component Importance Measures." The calculation was based on the December 1995 PRA update,

which was in place at the time of the baseline inspection. The baseline core damage frequency (CDF) for the PRA update was 6E-6 per reactor year with a truncation point of 2E-10, or approximately four orders of magnitude below the baseline CDF. The PRA update was, however, based predominantly on generic industry data. The licensee stated that the PRA was being further updated to improve the modeling of SSCs in the PRA and to incorporate plant specific data. However, this PRA update was not expected to be completed until sometime after plant restart.

Due to its recent completion, the importance measure calculation had not been presented to the expert panel for consideration. The calculation was based on the four-quadrant plot approach considering the Fussell-Vesely (≥ 0.005) and risk achievement worth (≥ 2) importance measures. In addition, the 90 percent of CDF importance measure (an SSC would meet this importance measure if it was included in PRA accident sequence failure combinations that, when ranked in decreasing order, cumulatively accounted for 90 percent of the CDF) was considered separately. Systems that met one or more of the importance measure criteria were considered high safety significant, unless the licensee had sufficient justification for downgrading the significance classification. For example, the turbine building closed cooling water system, which only met the 90 percent of CDF importance measure, was downgraded by the licensee to low safety significance because it had been given a very conservative high probability of failure to run in the PRA of 10 percent. This was considered acceptable by the inspectors.

With respect to the concern with the risk ranking process for the turbine-driven feedwater pumps identified during the MR baseline inspection, the licensee presented an analysis entitled "Risk Significance for the Loss of Feedwater Initiator." The analysis pointed to ten different categories of causes for loss of feedwater. This included the loss of either of the two turbine-driven feedwater pumps, the tripping of any of the three operating condensate booster pumps, the loss of the turbine lube oil system, and the failure of the startup level controller loop when in startup mode. The licensee concluded based on the analysis that the contribution of the two turbine-driven feedwater pumps to the overall CDF was only 1 percent compared with the 7 percent identified during the baseline inspection. This additional analysis justified the low safety significance conclusion for the turbine-driven feedwater pumps.

c. Conclusions on Risk Determinations

Although the risk ranking process continued to rely on a probabilistic risk analysis based predominantly on generic data, the risk ranking of SSCs was acceptable.

M1.3 (a)(3) Periodic Evaluations

a. Inspection Scope

Paragraph (a)(3) of the MR requires that SSC performance and condition monitoring activities, associated goals, and preventive maintenance (PM) activities be periodically evaluated, taking into account where practical, industry-wide operating experience (IOE).

Additional guidance for conducting these periodic evaluations is provided in NUMARC 93-01, which states, "The periodic assessment is intended to evaluate the effectiveness of (a)(1) and (a)(2) activities [the maintenance rule (10 CFR 50.65) defines criteria for assigning SSCs to categories (a)(1) and (a)(2)] including goals that have been established, monitoring of those established goals, cause determinations and corrective actions [for SSC failures], and the effectiveness of preventive maintenance (including [SSC] performance criteria)." This periodic evaluation (or assessment) was required to be performed at least one time during each refueling cycle, not to exceed 24 months between evaluations. The inspectors reviewed the licensee's procedural guidelines for these evaluations, the licensee's Cycle 6 periodic assessment report, and the licensee's October 1998 Monthly Maintenance Rule Performance Report.

b. Observations and Findings

The guidance for conducting periodic evaluations was contained in Nuclear Station Engineering Department (NSED) Procedure M.07, "NSED Maintenance Rule Activities," Section 4.12 and Attachment 4. The procedure addressed the areas to be reviewed as recommended by NUMARC 93-01, and included guidance for conducting overall effectiveness evaluations for the various areas of the MR program. The system assessment guidance in procedure M.07 addressed the following areas: overall performance, balance of reliability and availability, recommended changes to performance criteria, significant improvements, problems and concerns, and planned improvements.

The Cycle 6 assessment report was the licensee's documentation of the subject periodic evaluation. The Cycle 6 assessment report met the requirements of the MR section (a)(3); however, not all of the areas requiring an overall effectiveness evaluation per the M.07 procedure were addressed in the report, such as scope changes. A similar issue was also identified in the 1998 quality assurance (QA) audit. Since there was basically a complete scoping revision during Cycle 6, the lack of an assessment in this area was not significant. However, the inspectors commented that subsequent assessment reports should address scope changes in accordance with the licensee's procedure M.07. The Cycle 6 assessment report was critical of the licensee's performance relative to several areas of the MR program, which included effectiveness of removal of equipment from service, the use of industry operating experience, the effectiveness of balancing reliability and availability, and the effectiveness of corrective actions. Based on the concerns identified in these areas, actions were initiated to improve program implementation. The system performance assessments were comprehensive evaluations of the performance for each system, and included changes to maintenance activities and changes to various MR program aspects. The licensee also issued monthly reports which contained unavailability and functional failure data for each system to provide management with a continual overview of SSC performance with respect to their specific performance criteria.

c. Conclusions

In general, the guidance for performing periodic evaluations met the requirements of the MR and the intent of the NUMARC implementing guidance. The Cycle 6 assessment report provided good evaluations of system performance over the period by documenting changes to maintenance activities and changes to various MR program aspects.

M1.4 (a)(3) Balancing Reliability and Unavailability

a. Inspection Scope

Paragraph (a)(3) of the MR requires that adjustments be made to planned maintenance and monitoring activities where necessary to ensure that the objective of preventing failures of SSCs through maintenance is appropriately balanced against the objective of minimizing unavailability of SSCs due to monitoring or preventive maintenance. As stated in NUMARC 93-01, "the intent is to optimize availability and reliability of the safety functions by properly managing the occurrence of SSCs being out of service for preventive maintenance activities. This optimization could be achieved by any of the following:

- Ensuring that appropriate preventive maintenance is performed to meet availability objectives as stated in plant risk analysis, FSAR [Final Safety Analysis Report], or other reliability approaches to maintenance;

- Allocating preventive maintenance to applicable tasks commensurate with anticipated performance improvement (e.g., pump vibration analysis instead of tear down);

- Reviewing to determine that availability of SSCs has been acceptable;

- Focusing maintenance resources on preventing those failure modes that affect a safety function; or

- Scheduling, as necessary, the amount, type, or frequency of preventive maintenance to appropriately limit the time out of service."

b. Observations and Findings

Procedure M.07 provided guidance for balancing unavailability and reliability for high safety significance SSCs. The procedure required evaluating the balance between unavailability and reliability and recommending changes to maintenance activities to optimize SSC performance. The procedure stated that performance criteria should be set such that staying within their limits was considered achieving a balance between reliability and availability. An SSC's reliability was defined in NUMARC 93-01 as "a measure of the expectation (assuming that the SSC is available) that the SSC will perform its function upon demand at any future instant in time." While an SSC's availability was defined in NUMARC 93-01 as "the time that a SSC is capable of

performing its intended function as a fraction of the total time that the intended function may be demanded. The numerical complement of unavailability." The inspectors concluded that the method for balancing unavailability and reliability described in procedure M.07 was an acceptable method for complying with this aspect of the MR. The licensee also reviewed this balancing concept when an SSC was assigned to MR category (a)(1) and during the periodic assessments.

The licensee concluded in the Cycle 6 periodic assessment that the overall balancing of reliability and availability was not effectively implemented. Based on a review of recent action plans for SSCs assigned to the (a)(1) MR category and the system assessments conducted for the Cycle 6 periodic assessment, the inspectors concluded that the licensee was evaluating the concept of balancing unavailability and reliability more effectively.

c. Conclusions

The inspectors concluded that the process for balancing the unavailability and reliability of SSCs was acceptable, however, based on the Cycle 6 periodic assessment, the licensee concluded that implementation of this process was ineffective. In response to this self-identified concern, the licensee took action to ensure a proper balance existed between an SSC's reliability and availability. Improvement has been recently noted.

M1.5 (a)(3) On-line Maintenance Risk Assessments

a. Inspection Scope

Paragraph (a)(3) of the MR states, "in performing monitoring and preventive maintenance activities, an assessment of the total plant equipment that is out of service should be taken into account to determine the overall effect on performance of safety functions." As stated in NUMARC 93-01, "on-line maintenance is a planned and scheduled activity to perform preventive or corrective maintenance, with the reactor at power, while properly controlling out-of-service time of systems or equipment. The benefits of well-managed maintenance conducted during power operations include increased system and unit availability, reduction of equipment and system deficiencies that could impact operations, more focused attention during periods when fewer activities are competing for specialized resources, and reduction of work scope during outages. On-line maintenance should be carefully managed to achieve a balance between the benefits and potential impacts on safety, reliability, or availability. For example, the margin of safety could be adversely impacted if maintenance is performed on multiple equipment or systems simultaneously without proper consideration of risk, or operators are not fully cognizant of the limitations placed on the plant due to out of service equipment. On-line maintenance should be carefully evaluated, planned, and executed to avoid undesirable conditions or transients, and to thereby ensure a conservative margin of core safety." The inspectors reviewed the procedures and discussed the process for conducting on-line maintenance with the PRA engineers, operations personnel, and the work control group.

The inspectors reviewed the licensee's actions to address NRC Manual Chapter 0350 Case Specific Checklist Item II.4, "Establish and Implement an Effective Risk Assessment Program." The three items identified as part of the NRC internal checklist item were:

1. Development of a risk assessment process for outage and on-line maintenance activities.

2. Training provided to operations and work management personnel involved in risk assessment.

3. Establishment of thresholds for contingency planning.

b. Observations and Findings

The inspectors reviewed the licensee's procedures governing on-line risk management. These procedures were: (1) CPS 1151.12, "On-Line Risk Assessment," including checklists CPS 1151.12F001, "Determination of On-Line Risk Levels," and CPS 1151.12F002, "Contingency Planning;" and (2) CPS 1151.01, "On-Line Work Management Process." Several minor issues were identified with how the procedures interrelate when used to perform risk assessments and with personnel responsibilities with respect to the risk assessment process. The licensee agreed to revise the procedures to clearly define the risk assessment process and personnel responsibilities.

Risk Meter was a licensee-developed software program that converted the full-scope PRA into a spreadsheet, with the exception that internal flooding events were omitted. The process of using Risk Meter involved having station personnel review the current work schedule and then manually enter the systems and components actually or potentially out-of-service into Risk Meter. Four color conditions were established in Risk Meter (green, yellow, orange, and red) to represent risk levels. Green meant a low risk configuration; red meant a high risk configuration. The transition from green to yellow occurred when the on-line risk was 1.5 times the baseline CDF. A transition from yellow to orange occurred at 5 times the baseline CDF, and the transition from orange to red occurred when the on-line risk reached 1E-4 per reactor year. As with similar on-line risk programs that are being used in the industry, SSC functions deemed to be of high safety significance by the expert panel and important balance-of-plant components that were not modeled explicitly in the PRA, were not included in Risk Meter. As a result, operator and engineering judgement would have to be relied upon, as allowed by the procedure, to recognize potentially risky plant configurations, whether pre-scheduled or emergent. Procedure CPS 1151.01 specified that an on-line risk assessment be performed for the work management plan 2 weeks prior to the scheduled work. Despite its limitations, the inspectors concluded that the Risk Meter software was adequate for the licensee to perform on-line risk assessments.

Since the licensee's program for shutdown risk assessment had been evaluated in the MR baseline inspection, the inspectors performed only a limited review of the licensee's

shutdown risk assessment program during this follow-up MR inspection. The inspectors reviewed, procedure CPS 1151.02, "Planned, Maintenance and Forced Outage Preparation," procedure CPS 1151.04, "Outage Planning and Preparation," and procedure CPS 1151.09, "Methodology for Outage Safety Reviews and Maintenance of Acceptable Shutdown Risk." Step 8.4 of procedure CPS 1151.09 identified the steps the licensee was to follow after an outage and prior to startup to ensure the risk of expected SSC configurations was evaluated during the transition period. The procedure did not include guidance on including important balance-of-plant equipment which was not addressed in Technical Specifications, but was within the scope of the MR in these risk evaluations of SSC configurations. Including this equipment in the evaluations would assure that the equipment was available before transitioning to startup. Nevertheless, the inspectors concluded that the procedure was adequate to control shutdown risk and to make the transition from shutdown to startup and vice versa. Based on the results of the baseline inspection and the additional review during this inspection, the inspectors concluded that the licensee had developed an adequate risk assessment process for outage activities.

Guidance for establishment of thresholds for contingency planning was contained in procedure CPS 1151.12F001, and consisted of a checklist which stated that orange risk conditions were considered to be high risk, such that written and pre-planned guidance/contingency plans shall be developed before entering this risk condition in a controlled manner. For unplanned entry into this risk condition, the procedure required that contingencies be developed and implemented until the risk condition was exited. Procedure CPS 1151.12F002 was to be used by the licensee for the actual contingency planning. These controls for contingency planning were considered acceptable.

c. Conclusions

The inspectors concluded the licensee had adequate on-line and outage risk assessment processes and had established acceptable thresholds for contingency planning. Training of personnel on the on-line risk procedures, however, needed to be completed prior to restart.

M1.6 (a)(1) Goal Setting and Monitoring and (a)(2) Preventive Maintenance

a. Inspection Scope

The inspectors reviewed program documents in order to evaluate the process established by the licensee to set goals and monitor under (a)(1) and to verify that PM was effective under (a)(2) of the MR. Monitoring is defined in NUMARC 93-01 as "continuous or periodic tests, inspections, measurement or trending of the performance or physical characteristics of an SSC to indicate current or future performance and the potential for failure. Monitoring is frequently conducted on a non-intrusive basis. Examples of preventive maintenance actions may include operator rounds, engineering walk downs, and management inspections." The inspectors also discussed the MR program with appropriate plant personnel and reviewed the following systems:

(a)(1) systems	(a)(2) systems
Control Room Heating, Ventilation, and Air Conditioning (HVAC)	Actuation Trip Signal Monitoring (pseudo)
Instrument Air	Residual Heat Removal
	Shutdown Service Water

The inspectors reviewed each of these systems to verify that goals or performance criteria (that is criteria established to provide a basis for determining satisfactory SSC/system performance) were established in accordance with the safety significance of the SSC/system, that IOE was taken into consideration where practical, that appropriate monitoring and trending were being performed, and that corrective actions were taken when an SSC/system failed to meet its goal or performance criteria or experienced a maintenance preventable functional failure (MPFF).

b. Observations and Findings

The inspectors reviewed the performance criteria to determine if the licensee had adequately set performance criteria consistent with the assumptions used to establish the safety significance of SSCs/systems. Section 9.3.2 of NUMARC 93-01 recommended that performance criteria for SSCs whose functions were considered to be of high safety significance (high safety significant SSCs) be set to ensure that the availability and reliability assumptions used in the risk determining analysis (i.e., PRA) were maintained.

b.1 Observations and Findings for Reliability and Unavailability Performance Criteria

The recently completed calculation, "Clinton Power Station Maintenance Rule Quantitative Evaluation of Performance Criteria," addressed SSCs that were both in the scope of the MR and also modeled in the PRA update, whether or not those systems were of high or low safety significance. The licensee's MR program was based on defining "parent" functions and "child" functions for SSCs, which were subsets of the parent function. The monitoring period was 18 months, which was assumed to be a fuel cycle. There were four functions which were monitored over two fuel cycles based on the limited number of demands placed on the equipment.

Availability criteria developed for the MR differed from the out-of-service assumptions in the PRA. Therefore, the availability criteria were confirmed by substituting bounding SSC unavailability values directly into the PRA to demonstrate that the increase in CDF was acceptable. Unavailability values were assigned to basic events in the PRA by identifying a major component in each equipment train, such as a pump, and assigning the sum of the unavailability values for that train to that component. A truncation limit of 1E-10 was established as compared to a baseline CDF of 6E-06 per reactor year. Substituting the unavailability values into the PRA resulted in a CDF of 1.6E-05 or a 66 percent increase in CDF. The inspectors considered this an acceptable increase when compared to guidance in the Electric Power Research Institute (EPRI) PSA [probabilistic safety analysis] Applications Guide on the use of availability criteria.

Reliability performance criteria were identified in a document titled "Systems/Structures Scoping and Performance Criteria - Clinton Power Station." This document also identified, for each high safety significant function and for all functions modeled in the PRA, the number of demands for standby systems or the number of running hours for operating systems, the PRA failure rate, and the assigned performance criterion for each function. From this information, the inspectors were able to compare on a sample basis the reliability performance criteria to the number of failures expected at a 95 percent confidence level using the binomial theorem for standby functions and the Poisson distribution for normally operating functions, as described in EPRI Technical Bulletins 96-11, "Monitoring Reliability for the Maintenance Rule," and 97-03 "Monitoring Reliability for the Maintenance Rule - Failures to Run." If the probability of having the number of failures specified by a particular performance criterion was greater than 95 percent, then the performance criterion was considered to allow too many failures and the criterion was adjusted to be more conservative. In addition to the EPRI methodology, the reliability criteria for all functions were also substituted into the PRA and resulted in a CDF of 3.6E-05 per reactor year. The established performance criteria and the resulting CDF were considered acceptable.

b.2 Observations and Findings for Goals Established for (a)(1) SSCs

The inspectors determined that for the majority of SSCs monitored under category (a)(1) of the MR, the licensee had established adequate goals and corrective action plans to address the performance problems that formed the basis for the licensee placing the SSC in category (a)(1). This included establishing adequate goals and corrective actions for the emergency lighting and the leak detection systems, for which adequate goals and corrective actions had not been developed at the time of the MR baseline inspection. Two SSCs placed into category (a)(1) were past their due dates for establishing goals and corrective action plans. However, an extension request, as allowed by the licensee's corrective action program, was approved to ensure root causes were identified for the hydramotor failures on HVAC systems and for reactor water cleanup pump shaft failures, such that adequate goals and corrective actions for these SSCs could be put in place prior to plant start-up. The inspectors determined that the licensee's corrective action program was being used to address these equipment performance problems in an acceptable manner.

c. Conclusions

Based on the sensitivity study performed for the availability criteria, and the use of the statistical approach as defined in the EPRI technical bulletins, the inspectors considered the licensee's performance criteria for both availability and reliability to be consistent with the assumptions in the updated PRA and therefore acceptable. Appropriate goals and corrective action plans were developed for SSCs assigned to category (a)(1) of the MR.

M1.7 Use of Industry-wide Operating Experience

a. Inspection Scope

Paragraph (a)(1) of the MR states that "goals shall be established commensurate with safety and, where practical, taking into account industry-wide operating experience." Paragraph (a)(3) of the MR states that "performance and condition monitoring activities and associated goals and PM activities shall be evaluated at least every refueling cycle. The evaluations shall be conducted taking into account, where practical, industry-wide operating experience." The inspectors reviewed the program to integrate IOE into the MR monitoring program. The MR coordinator, system engineers (SEs), and an operating experience assessment department representative were interviewed to learn the extent to which they understood the application of IOE information to MR processes.

b. Observations and Findings on Use of Industry-wide Operating Experience

Procedures CPS 1016.07, "Industry Operating Experience Report Assessment Program," and CPS 1016.09, "Conduct of Experience Assessment," delineate how the licensee gathered, evaluated, and acted on IOE; however, the procedures did not specifically link IOE use to MR activities. Procedure M.07 had been revised to require using IOE and listed numerous sources of IOE available to the SEs. The SEs also have access on their computers to IOE listings. Condition reports (CRs) were generated by the licensee for any IOE that could be applicable to the station and the CR status was actively tracked.

The licensee's Cycle 6 periodic assessment determined that IOE had not been consistently used with respect to the MR during the assessment period, although the inspectors concluded recent improvements in the process for using IOE were being implemented and that the licensee was now effectively using IOE in developing goals and corrective action plans. The inspectors also noted that the MR program was formally linked to the station's IOE program and that the SEs were actively using the resources provided for IOE.

c. Conclusions for Use of Industry-wide Operating Experience

The inspectors determined that the use of the station IOE program in MR activities was acceptable. The (a)(1) goals and corrective action plans appropriately considered IOE.

M2 Maintenance of Facilities and Equipment (62706)

M2.1 General System Review

a. Inspection Scope

The inspectors conducted a detailed examination of several systems from a MR perspective to assess the effectiveness of the MR program when it was applied to individual systems.

b.1 Observations and Findings for the Control Room HVAC System

As defined by the licensee, the control room HVAC system has 2 "parent" functions, consisting of 12 "child" functions considered to be of low safety significance. The performance of the HVAC system in being able to fulfill it's functions was monitored using appropriate reliability and/or unavailability performance criteria. The system was placed in category (a)(1) for repetitive MPFFs on hydramotors. Associated corrective action plans and goals were not yet established as discussed in Section M1.6.2 of this report.

b.2 Observations and Findings for the Instrument Air System

The instrument air system has 3 "parent" functions, consisting of 5 high safety significance and 5 low safety significance "child" functions. The scoping and boundaries for the system established by the licensee were considered acceptable. The system remained in category (a)(1) due to repetitive MPFFs associated with the automatic depressurization system pressure regulating valves. The associated corrective actions, performance criteria, and goals were considered acceptable.

b.3 Observations and Findings for Actuation Trip Signal Monitoring System (96)

Pseudo-system 96 was developed to monitor the performance of actuation trip signals in numerous systems. The system has 3 "parent" functions, consisting of 29 high safety significance and 1 low safety significance "child" function. The licensee established acceptable performance criteria for this system. The system had recently been returned to category (a)(2) status based on a thorough review of MPFFs from which the licensee determined that there were no repetitive MPFFs which were not being addressed by the licensee in classifying the individual systems, i.e., category (a)(1) or (a)(2). The reclassification of the pseudo-system 96 was considered appropriate by the inspectors.

b.4 Observations and Findings for the Residual Heat Removal System

The residual heat removal system has 1 "parent" function, consisting of 13 high safety significance and 20 low safety significance "child" functions. The inspectors concluded that the licensee had established appropriate reliability and availability performance criteria for functions which could be linked to the assumptions in the licensee's PRA. The residual heat removal system's performance satisfied the licensee's criteria for monitoring the system under category (a)(2) of the MR program.

b.5 Observations and Findings for the Shutdown Service Water System

The shutdown service water system has 3 "parent" functions, consisting of 4 high safety significance and 10 low safety significance "child" functions. The performance of the system in being able to fulfill its functions was monitored using appropriate reliability and/or unavailability performance criteria. The shutdown service water system's performance satisfied the licensee's criteria for monitoring the system under category (a)(2) of the MR program.

c. Conclusions for General System Review

In general, SSCs were being properly classified under categories (a)(1) and (a)(2) of the MR. Performance criteria, goals, and corrective actions, both in progress and planned, for SSCs in (a)(1) status appeared adequate. The SSC functions for the systems reviewed were properly scoped under the MR. The inspectors reviewed CRs, maintenance work requests, and the periodic assessment and did not identify any MPFFs not previously classified or unavailability time not properly tracked.

M7 Quality Assurance (QA) in Maintenance Activities (40500)

M7.1 Licensee Self-Assessments of the Maintenance Rule Program

a. Inspection Scope

The inspectors reviewed three licensee evaluations of the MR program, including the October 1998 QA audit, the June 1998, independent assessment, and the September 1998, engineering self-assessment.

b. Observations and Findings

The recent QA audit of the MR program was broad-based and involved the use of technical experts, which provided additional insights and improved the effectiveness of the audit. The audit resulted in the identification of a number of items and some underlying significant issues. Specifically, when the identified issues were evaluated in total, the audit team's conclusion was that an adequate MR program was in place, but it was not being effectively implemented by the licensee. The licensee subsequently conducted root cause evaluations to identify underlying problems with implementation of the MR program. This resulted in the initiation of a number of corrective actions to address the identified concerns. Some of the underlying causes for the identified concerns were ineffective communications between organizations and between the staff and senior management and the failure of organizations to take ownership for their roles and responsibilities with respect to the MR program.

For example, new or revised procedures were implemented which did not specify roles and responsibilities for the individuals tasked with implementing portions of the MR program and these individuals were not adequately trained to ensure the associated processes would work as intended. The inspectors, based on their observations during this inspection, concluded that this was still an issue, albeit to a lesser extent, and further concluded that the licensee's implementation of the MR program had improved. Based on the QA organization's audit finding, the licensee plans on conducting a follow-up audit before plant restart.

An independent assessment was conducted by a MR coordinator from another utility to determine what improvements could be made to the MR program to ensure that the licensee was in compliance with 10 CFR 50.65. A number of observations and recommendations were identified and responded to by the licensee. The

self-assessment conducted by engineering personnel was an effort to ensure the MR program was sufficiently ready for restart. Engineering personnel involved in the assessment concluded that the program was ready; however, some additional implementation concerns were identified through the QA audit as previously stated, that required resolution.

c. Conclusions

The 1998 QA audit was thorough and probing. Based on individual issues, the auditors were able to identify significant underlying causes (lack of ownership and inadequate communications) for the ineffective implementation of the MR program. Although actions have been identified and were being implemented to correct the weaknesses, it was too soon to determine their effectiveness. The use of outside personnel in the audit provided independent insights into the MR program and added to the overall quality of the program assessments.

M8 Miscellaneous Maintenance Issues (92902)

M8.1 (Closed) Violation 50-461/98005-01(DRS): This was a violation for which enforcement discretion was exercised and involved not properly including SSCs in the scope of the MR. In the October 1997 QA audit, the independent assessment, and the subsequent re-scoping effort, the licensee identified SSCs and functions that required inclusion in the MR scope. In the recent QA audit, the audit team identified questionable scoping decisions for several SSC functions. From the investigation for the resulting CR 1-98-10-170, the licensee determined that an existing scoping document had been recently converted into a large database resulting in a number of errors. The licensee was in the process of re-evaluating and strengthening the information contained in the database to clarify the existing scoping. The inspectors evaluated the licensee's resolution of the scoping issues against the requirements of the MR and concluded that scoping concerns had been properly addressed. This issue is closed.

M8.2 (Closed) Inspection Follow-up Item 50-461/98005-02(DRS): This issue concerned the adequacy of the risk determination process, which was under revision at the time of the baseline inspection. Based on the discussion in Section M1.2 of this report, this issue is closed.

M8.3 (Closed) Inspection Follow-up Item 50-461/98005-03(DRS): This issue concerned completion of the Cycle 6 periodic assessment review. Based on the discussion in Sections M1.3 and M1.4 of this report, this issue is closed.

M8.4 (Closed) Inspection Follow-up Item 50-461/98005-04(DRS): This issue concerned adequacy of the on-line risk assessment process. Based on the discussion in Section M1.5 of this report, this issue is closed.

M8.5 (Closed) Violation 50-461/98005-05(DRS): This was a violation for which enforcement discretion was exercised and involved establishing inadequate performance criteria. Based on the discussion in Section M1.6 of this report, this issue is closed.

M8.6 (Closed) Violation 50-461/98005-06(DRS): This was a violation for which enforcement discretion was exercised and involved establishing inadequate goals. Based on the discussion in Section M1.6 of this report, this issue is closed.

M8.7 (Open) Violation 50-461/98005-07(DRS): This was a violation for which enforcement discretion was exercised and involved the failure to monitor goals for (a)(1) SSCs. Specifically, the licensee was not identifying MPFFs, not identifying and tracking unavailability, and not monitoring unavailability for SSCs which required monitoring and which were required to be available during shutdown. During this inspection, the inspectors verified that the licensee was tracking MPFFs and unavailability for SSCs needed for shutdown operations. The inspectors also evaluated the licensee's activities for tracking MPFFs and monitoring unavailability while shutdown for key safety functions as well as for other SSCs required during the shutdown mode of operations. Based on these evaluations, the inspectors determined that the licensee's monitoring activities were acceptable. This portion of the violation is closed. Due to recent issues identified in the QA audit concerning the inadequate implementation of the MR program, the other two issues will remain open pending further review by QA personnel and the NRC as to the effectiveness of the MR implementation and monitoring of availability and reliability.

M8.8 (Open) Case Specific Checklist Item II.4: Establish and implement an effective risk assessment program. As discussed in Section M1.5 of this report, the licensee has established a risk assessment process for outage and on-line maintenance activities, and established thresholds for contingency planning. However, this issue will remain open pending completion of the required training on the recently issued on-line risk assessment procedures.

M8.9 (Closed) Case Specific Checklist Item V.3: Establish MR program. Based on the results of this inspection as documented in this report, the license has developed an acceptable MR program, although the effectiveness of its implementation will be further reviewed as follow-up to Non-Cited Violation 50-461/98005-07. This issue is closed.

III. Engineering

E4 Engineering Staff Knowledge and Performance (62706)

E4.1 System Engineers' Knowledge of the Maintenance Rule

a. Inspection Scope (62706)

The inspectors interviewed SEs to assess their understanding of PRA, the MR, and associated responsibilities.

b. Observations and Findings

The SEs were experienced and knowledgeable about their systems and MR requirements. Responsibilities included tracking the performance of their assigned

systems, MPFF determinations, and the preparation of goals and corrective action. The SEs were familiar with the MR databases set up to track SSC failures and unavailability. Industry-wide operating experience data was easily retrieved from their work station computers and used to make adjustments to goals, performance criteria, and maintenance activities on their systems. The timeliness concerns with MR activities identified in the QA audit appeared to be resolved and performance indicators were identified and implemented by the licensee to ensure that MR activities were conducted in a timely manner.

The guidance provided to SEs in Procedure M.07, step 4.6.3.5.4, for tracking system unavailability of support and supported systems, was potentially confusing. The guidance could lead SEs to not properly track system unavailability when certain system support components fail. However, based on discussions with two SEs, the inspectors determined that the SEs were familiar with proper methods of tracking unavailability for support and supported systems and no specific cases were identified where unavailability was not being properly tracked. Nevertheless, the licensee stated that procedure M.07 would be revised to clarify the guidance.

c. Conclusions

The SEs were experienced and knowledgeable about their systems and understood their responsibilities with respect to the MR.

V. Management Meetings

X1 Exit Meeting Summary

The inspectors discussed the progress of the inspection with licensee representatives on a daily basis and presented the inspection results to members of licensee management at the conclusion of the inspection on December 18, 1998. The licensee acknowledged the findings presented. The inspectors asked the licensee whether any materials examined during the inspection should be considered proprietary; none was identified.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

J. Barron, Director, Plant Engineering
M. Bridges, System Engineer
V. Cwietniewicz, Manager, Maintenance
T. Devore, System Engineer
M. Dodds, Experience Assessment
A. Hable, PRA Engineer
G. Hunger, Manager, CPS
T. Husted, System Engineer
J. Jansen, PRA Engineer
K. Johnson, Manager, Nuclear Training and Support
G. Krampholz, Plant Engineering
J. Logan, System Engineer
W. Maguire, Director Operations
D. Majeras, System Engineer
G. Mosely, Work Management Unit Coordinator
R. Nilsson, Quality Assurance
M. Norris, Supervisor, Engineering Assurance
T. Parrent, Quality Assurance
R. Phares, Manager, Nuclear Safety and Performance Improvement
W. Romberg, Manager, Nuclear Station Engineering Department
B. Stalter, Work Management
M. Stookey, Licensing
D. Szymkiewicz, Maintenance Rule Coordinator
M. Tacelosky, Operations Services Manager
E. Tiedemann, Shift Technical Advisor
G. Vandre, Nuclear Station Engineering Department
J. Waddell, Independent Analysis Group
P. Walberg, PRA Supervisor

LIST OF INSPECTION PROCEDURES USED

IP 62706:	Maintenance Rule
IP 40500:	Effectiveness of Licensee Controls in Identifying, Resolving, and Preventing Problems
IP 92902	Follow-up - Maintenance

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Closed

50-461/98005-01(DRS)	NCV	Scoping Errors
50-461/98005-02(DRS)	IFI	Risk determination Process
50-461/98005-03(DRS)	IFI	Cycle 6 Periodic Assessment Review
50-461/98005-04(DRS)	IFI	On-line Risk Assessment
50-461/98005-05(DRS)	NCV	Inadequate Performance Criteria
50-461/98005-06(DRS)	NCV	Inadequate Goals
Case Specific Checklist Item V.3		Establish Maintenance Rule Program

Discussed

50-461/98005-07(DRS)	NCV	Failure to Monitor Goals
Case Specific Checklist Item II.4		Establish and Implement an Effective Risk Assessment Program

LIST OF ACRONYMS USED

BNL	Brookhaven National Laboratory
CDF	Core Damage Frequency
CFR	Code of Federal Regulations
CPS	Clinton Power Station
CR	Condition Report
DRS	Division of Reactor Safety
EPRI	Electric Power Research Institute
HVAC	Heating, Ventilation, and Air Conditioning
IFI	Inspection Follow-up Item
IOE	Industry-wide Operating Experience
IP	Inspection Procedure
MPFF	Maintenance Preventable Functional Failure
MR	Maintenance Rule
NCV	Non-Cited Violation
NRC	Nuclear Regulatory Commission
NRR	Nuclear Reactor Regulation
NSED	Nuclear Station Engineering Department
NUMARC	Nuclear Management Resource Council
PM	Preventive Maintenance
PRA	Probabilistic Risk Assessment
PSA	Probabilistic Safety Assessment
QA	Quality Assurance
SE	System Engineer
SSC	Structure, System, or Component

LIST OF DOCUMENTS REVIEWED

*NSED Procedure M.07, "NSED Maintenance Rule Activities," Revision 6, 12/3/98
*CPS No. 1029.05, "Implementation of the Maintenance Rule at CPS," Revision 2, 3/1/98
*CPS No. 1016.07, "Industry Operating Experience Report Assessment Program," Revision 2, 7/16/98
*CPS No. 1016.09, "Conduct of Experience Assessment," Revision 0, 7/1/98
*CPS No. 1014.10, "Availability Tracking of Systems, Structures, and Components," Revision 3, 12/10/98
*CPS No. 1141.01, "Work Control Program," Revision 1, 6/25/97
*CPS No. 1151.01, "On-Line Work Management Process," Revision 4, 9/11/98 with Change No. PAC 0493-98, 12/3/98
*CPS No. 1151.02, "Planned, Maintenance and Forced Outage Preparation," Revision 4, 8/7/98 with Change No. PAC 0494-98, 12/3/98
*CPS No. 1151.04, "Outage Planning and Preparation," Revision 4, 6/26/98 with Change No. 2, 12/3/98
*CPS No. 1151.09, "Methodology for Outage Safety Reviews and Maintenance of Acceptable Shutdown Risk," Revision 3, 12/10/98
*CPS No. 1151.12, "On-Line Risk Assessment," Revision 1, 12/11/98
*CPS No. 1151.12F001, "Determination of On-Line Risk Levels," Revision 0, 12/11/98
*CPS No. 1151.12F002, "Contingency Planning," Revision 0, 12/11/98
*CPS No. 1016.01, "CPS Condition Reports," Revision 29, 4/11/97
* "Clinton Power Station - Calculation of System and Component Importance Measures," 12/11/98
*CPS analysis, "Risk Significance for the Loss of Feedwater Initiator"
*CPS Calculation, "Clinton Power Station Maintenance Rule Quantitative Evaluation of Performance Criteria"
*CPS, "Systems/Structures Scoping and Performance Criteria - Clinton Power Station," 12/14/98
*Assessment of Maintenance Effectiveness at Clinton Power Station for Cycle 6, 7/10/98
*October 1998 Monthly Maintenance Rule Performance Report
*NE-98-45, NSED Self Assessment of Maintenance Rule, 9/30/98
*Program Readiness Restart Review Report, Maintenance Rule, 8/12/98
*Q38-98-18, Quality Assurance Audit Report on Maintenance Rule, 10/26/98
*Q38-97-14, Quality Assurance Audit Report on Maintenance Rule, 10/97
*Self-Assessment No. 98-150, "Assessment of Experience Assessment Department"
*Y-108295, Independent Assessment of the CPS Maintenance Rule Program, 9/9/98
*Y-108496 Letter, "Expectations: Communications up the Chain of Command," 12/4/98
*Y-108266, "Support of Maintenance Rule Expert Panel," 8/21/98
*Y-107193, "Reclassification of Pseudosystem 96-00 to Maintenance Rule Status of a(2), 11/4/98
*Nuclear Policy Statement #21, "Implementation of the Maintenance Rule at CPS," Revision 0, 12/3/98
*Clinton Power Station Individual Plant Examination, 9/92
*Probability Risk Assessment Update Report, 12/95
*Condition Reports: Q-98-10-094, 1-98-09-350, 1-98-07-125, Q-98-10-167, Q-98-10-168, 1-98-10-169, 1-98-10-170, 1-98-09-246, 1-97-10-506, 1-97-10-427, 1-97-09-233, 1-98-06-125, 1-98-03-083-00, 1-98-04-194-0, 1-98-04-445-0