ENCLOSURE 2

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

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Report No.:	50-498/98-01; 50-499/98-01
Licensee:	STP Nuclear Operating Company
Facility:	South Texas Project Electric Generating Station, Units 1 and 2
Location:	FM 521 - 8 miles west of Wadsworth Wadsworth, Texas
Dates:	March 23-27, 1998, with inoffice inspection continuing until June 10, 1998
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ATTACHMENT: Supplemental Information

EXECUTIVE SUMMARY

South Texas Project Electric Generating Station, Units 1 and 2
NRC Inspection Report 50-498/98-01; 50-499/98-01

The licensee had developed and implemented an appropriate program in accordance with 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." However, two violations of the Maintenance Rule were identified.

Operations

- Senior reactor operators demonstrated a strong knowledge of their responsibility for recording equipment functional and nonfunctional time for risk profile evaluations and unavailability tracking (Section O4.1).

Maintenance

- The licensee's program scoping was conservative and thorough, with some exceptions. The failure to include in the scope of the Maintenance Rule program the digital rod position indication system and the function of the electrical auxiliary building heating, ventilating, and air conditioning system to automatically and manually transfer control room envelope ventilation to the recirculation operating mode was a violation of 10 CFR 50.65(b). A noncited violation consistent with Section VII.B.1 of the NRC Enforcement Policy related to the licensee's identification of not including the instrumentation air compressors, containment building cranes, fuel handling building cranes, and the 138/13.8kV emergency transformers in the scope of the Maintenance Rule program (Section M1.1).

- The licensee's overall, approach to performing risk significance determination of structures, systems, and components for the Maintenance Rule program was appropriate with no deficiencies identified by the team (Section M1.2).

- The process for establishing performance criteria was appropriate. The expert panel members had an effective understanding of their responsibilities with respect to the Maintenance Rule program implementation (Section M1.2).

- The procedures for performing periodic evaluations met the requirements of 10 CFR 50.65. The monthly assessments and a summary report were comprehensive and were useful tools for evaluating structures, systems, and components performance (Section M1.3).

- The licensee's approach to balancing reliability and unavailability was appropriate (Section M1.4).

- A programmatic strength involved: (1) the practice of updating the risk assessment calculator software program to reflect results from the most current probablistic risk assessment model, (2) the process for assessing plant risk resulting from equipment out-of-service, and (3) the process for evaluating plant risk during various modes (Section M1.5).

- In general, the licensee properly established goals and performance criteria, performed appropriate monitoring and trending, and had implemented appropriate corrective actions when required (Section M1.6).

- The failures to appropriately identify Maintenance Rule functional failures associated with the essential cooling water, electrical auxiliary building heating, ventilation, and air conditioning, and instrument air systems were a weakness in the licensee's implementation of the Maintenance Rule program (Section M1.6).

- The failure to establish measures to evaluate the unavailability of the solid state protection system was a violation of 10 CFR 50.65(a)(2) (Section M1.6).

- Material condition of the plant systems walked down was excellent (Section M2).

- The reviewed self assessments were thorough, comprehensive, detailed, and addressed appropriate areas of Maintenance Rule implementation. The licensee's corrective actions were appropriate for the problems identified, with one exception for corrective action for the licensee-identified failure to establish an unavailability measure for the solid state protection system (Section M7).

- The failure to include the responsible system engineers in the review determinations of nonfunctional failures was a program weakness (Section E4).

Engineering

- The system engineers' knowledge of the Maintenance Rule was appropriate for the tasks required of them. System engineers demonstrated an in-depth and sound knowledge of their respective systems (Section E4).

Report Details

Summary of Plant Status

During the inspection week, Units 1 and 2 operated at or near full power.

Background

The licensee had implemented a Maintenance Rule program that endorsed the guidance of Regulatory Guide 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," and NUMARC 93-01 "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," with some exceptions noted. The licensee's staff submitted additional information, documented in Letter NOC-AE-000132, dated April 14, 1998, to address the concerns and their position regarding the NRC-identified violations.

I. Operations

O4 Operator Knowledge and Performance

O4.1 Operator Knowledge of the Maintenance Rule

a. Inspection Scope (62706)

During the inspection, the team interviewed a shift supervisor, reactor operator, and a unit supervisor to determine if they were familiar with the general requirements of the Maintenance Rule, aware of probabilistic risk assessment (PRA) insights, and understood their particular duties and responsibilities for Maintenance Rule implementation.

b. Observations and Findings

Operator tasks associated with the Maintenance Rule were focused primarily on the operators being cognizant of the current, planned, and actual risk profiles for the individual units, and determining when structures, systems, and components (SSCs) become functional or nonfunctional. The operators' responsibilities were documented in Procedures 0PGP03-ZA-0091, "Configuration Risk Management Program," Revision 0, and 0PGP03-ZA-0101, "Shutdown Risk Assessment," Revision 2. The on-shift senior reactor operator was responsible for ensuring the weekly risk profile was updated with actual out-of-service times and actual back-in-service times for SSCs modeled in the risk assessment calculator (RAsCal) software program. The on-shift senior reactor operator was responsible for updating RAsCal with actual times when equipment was determined to be nonfunctional and functional, for unavailability tracking. Senior reactor operators demonstrated a strong knowledge of their responsibility for recording equipment functional and nonfunctional time for risk profile evaluation and unavailability tracking. Reactor operators normally provided feedback to the senior reactor operator on the status of equipment.

The senior reactor operators and reactor operators interviewed generally understood the purpose of the Maintenance Rule and their respective duties required for Maintenance Rule implementation.

The senior reactor operators and reactor operators also indicated that training on the South Texas Project PRA had been provided by the risk and reliability analysis group. The operators had a general knowledge of the SSCs within the scope of the rule that were risk significant.

c. Conclusions

Licensed operators understood their specific responsibilities for implementation of the Maintenance Rule program. Senior reactor operators demonstrated a strong knowledge of their responsibility for recording equipment functional and nonfunctional time for risk profile evaluations and unavailability tracking.

II. Maintenance

M1 Conduct of Maintenance

M1.1 Scope of the System, Structure, and Component Functions Included Within the Maintenance Rule

a. Inspection Scope (62706)

The team reviewed the licensee's procedure for initial scoping, the updated final safety analysis report, and emergency operating instructions. The team developed an independent list of SSCs that they determined should be included in the scope of the licensee's Maintenance Rule program. The team used this list to determine if the licensee's staff had adequately identified the scope of SSCs or functions that should have been included in the scope of the Maintenance Rule program.

b. Observations and Findings

b.1 Structures

The team found that nonsafety-related and safety-related structures, tanks, equipment supports (pads), and equipment partitions were appropriately scoped into the licensee's monitoring program. The team did not identify any structures that belonged in the program scope, but were not already included in it.

b.2 Systems and Components

The team found that overall, the licensee's scoping effort of systems and components was conservative and thorough, with some exceptions. The team identified that the licensee failed to include the digital rod position indication system within the licensee's 10 CFR 50.65 monitoring program scope. The failure to include digital rod position indication in the scope of the Maintenance Rule was a concern because it is an indication used by reactor operators during use of emergency operating procedures to verify that the reactor is adequately shutdown following a reactor trip. It is also a visual indication by used by operators during use of emergency operating procedures to verify rod position to prevent boration of the reactor coolant system unnecessarily. The licensee's view of the digital rod position indication system was that the system served as an assessment function and had minimal significance in mitigating a transient or reactor trip; therefore, it was not scoped into the Maintenance Rule program. The team disagreed with the licensee's position.

The failure to include the digital rod position indication system in the scope of the Maintenance Rule program did not meet the requirements of 10 CFR 50.65(b), and was an example of a violation (50-498;-499/9801-01).

The function of the electrical auxiliary building heating, ventilating, and air-conditioning system to automatically and manually transfer control room envelope ventilation to the recirculation operating mode upon smoke detection at the heating, ventilating, and air-conditioning inlet was not in the scope of the Maintenance Rule program. The failure to include the control room envelope ventilation transfer function in the scope of the Maintenance Rule program was a concern because of the licensee's definition of "safety system actuation." The licensee identified the isolation of the control room ventilation upon smoke in the South Texas Project Electric Generating Station Updated Final Safety Analysis, Section 6.4.1.6 as a safety system actuation. The licensee chose to deviate from NUMARC 93-01 definition of "safety system actuation," and used in their Maintenance Rule Basis Document Guideline, Section 2.37, the INPO definition.

NUMARC 93-01, Section 8.2.1.5 lists an example of a nonsafety-related SSC whose failure can cause an actuation of a safety system (e.g., failure of a radiation monitor for which the control room ventilation is isolated). The INPO definition is the actuation of the emergency core cooling system (e.g., high pressure injection pumps, low pressure injection pumps, or cold-leg safety injection accumulator tanks) that results from an actuation setpoint or from a spurious/inadvertent emergency core cooling system signal or actuations of the emergency ac power system that result from a loss-of-power to a safeguards bus. The NRC has not endorsed the INPO definition of "safety system actuation," but instead endorses the broader definition, as given in the NUMARC document.

The failure to include the electrical auxiliary building heating, ventilating, and air conditioning function in the scope of the Maintenance Rule program did not meet the requirements of 10 CFR 50.65(b), and was a second example of a violation (50-498;-499/9801-01).

The licensee staff identified that the instrument air compressors, containment building cranes, fuel handling building cranes, and the 138/13.8kV emergency transformers were not scoped in the Maintenance Rule program on July 10, 1996. The omission of these SSCs from the scope of the program was identified and corrected by the licensee. This nonrepetitive, licensee-identified and corrected violation is being treated as a noncited violation, consistent with Section VII.B.1 of the NRC Enforcement Policy (50-498,-499/9801-02).

c. Conclusions

Overall, the licensee's program scoping was conservative and thorough, but it failed to identify one SSC and a function that should have been in scope. The failure to include in the scope of the Maintenance Rule program the digital rod position indication system and the function of the electrical auxiliary building heating, ventilating, and air-conditioning system to automatically and manually transfer control room envelope ventilation to the recirculation operating mode was a violation of 10 CFR 50.65(b). A noncited violation consistent with Section VII.B.1 of the NRC Enforcement Policy related to the licensee's identification of not including the instrument air compressors, containment building cranes, fuel handling building cranes, and the 138/13.8kV emergency transformers in the Maintenance Rule program scope.

M1.2 Safety or Risk Determination

a. Inspection Scope (62706)

The team reviewed the methods that the licensee established for making the required safety determinations; the safety determinations that were made for the systems that were reviewed in detail during this inspection; the licensee's performance criteria to determine if the licensee had adequately set performance criteria under Category (a)(2) of the Maintenance Rule consistent with the assumptions used to establish the safety significance; the licensee's process for determining performance criteria that was documented in the South Texas Project Maintenance Rule Basis Document Guideline; and the licensee's process for establishment of an expert panel. Also, the team interviewed the expert panel members.

b. Observations and Findings

b.1 Safety or Risk Determination Methodology

The licensee's process for establishing the risk significance of SSCs within the scope of the Maintenance Rule was documented in the South Texas Project Maintenance Rule Basis Document Guideline, Revision 2, dated February 25, 1998. This document was found to have adequately described the process for determining risk significance.

The licensee used a method similar to the suggested guidance in NUMARC 93-01 for the determination of risk significant SSCs modeled in the licensee's PRA. The licensee used the quantitative measures of risk reduction worth (RRW) and risk achievement worth

(RAW) as suggested in NUMARC 93-01. An SSC was appropriately considered to be risk significant if the RRW or RAW criteria for it were exceeded. The PRA (Level 1 and 2 analyses) risk ranking had identified 32 systems as risk-significant.

The licensee did not use the 90 percent core damage frequency contribution, as suggested in NUMARC 93-01, for the determination of risk significant SSCs. The licensee staff stated that this measure would not provide meaningful results due to the type of PRA model (Large Event Tree/Moderate Fault Tree) used for the licensee's PRA. The licensee staff had also stated that this was consistent with the observations and findings from the Maintenance Rule inspection at another facility. During the inspection week, the licensee staff performed an additional importance calculation due to the inspection team's question as to why a third importance measure, as suggested in NUMARC 93-01, had not been used. The additional importance calculation performed was the system-level fractional importance where the system fractional importance was the fraction of sequences with the SSC failed in the overall sequence data base. The fractional importance method identified 18 risk significant systems, and all of these systems had been identified as risk significant by the RRW or RAW importance measure criteria. For those SSCs that did not exceed either the RRW or RAW criteria, their relatively low risk significance was also reflected by the system fractional importance results. The team viewed the system fractional importance analysis as beneficial, since this additional importance analysis assisted in demonstrating that the risk significant SSCs were identified by the RRW and RAW.

The team also reviewed the application of the South Texas Project PRA Maintenance Rule for risk significance determination. The South Texas Project PRA was developed and quantified with the RISKMAN computer code. The PRA model used for the Maintenance Rule application reflected plant-specific data and plant modifications through December 1, 1995. For the risk significance determination, the licensee's staff stated that a truncation level of 1E-12 had been used for quantification and the overall core damage frequency (CDF) was 9E-6, with a total of 82,839 sequences. Based on the review of the PRA, the team determined that the PRA's level of detail, data, truncation limits, and overall quality was adequate to perform the risk significance determination for the Maintenance Rule.

The expert panel used a Delphi method to rank each Maintenance Rule system. Each system was evaluated to determine the system's contribution to reducing risk. The team viewed the licensee's use of the Delphi-method process as good because the expert panel performed their Delphi ranking before being shown the PRA risk ranking results, thus, the potential for biasing their decisionmaking did not occur. The PRA risk ranking results identified 32 risk significant SSCs and the expert panel determined that 10 additional SSCs were also risk significant. Thus, the expert panel had provided final approval for 42 risk significant systems.

The auxiliary closed loop cooling water system was the only SSC downgraded by the expert panel as not risk significant due to the way in which the system function was modeled in the PRA. The auxiliary closed loop cooling water system was originally identified by the PRA as risk significant, but changes in the model and further evaluation of this system demonstrated that it did not exceed the RRW or RAW criteria. This system was also ranked low on the expert panel Delphi list. The team found this downgrade acceptable and did not identify any SSCs that had been misranked.

b.2 Performance Criteria

The team found that performance criteria had been established based on information from the PRA, historical data, and industry experience, if applicable.

For the unavailability performance criteria, an individual SSC sensitivity analysis was performed with a doubling of the unavailability that was used in the PRA. The licensee staff stated that this doubling unavailability approach was a recommended approach presented at a Nuclear Energy Institute (NEI) Maintenance Rule Baseline Workshop. For each SSC sensitivity case, the change in the CDF was compared against the acceptable change in CDF as suggested in the Electric Power Research Institute (EPRI) PSA Applications Guide, which is an acceptable NRC screening criteria. None of the individual SSC unavailability sensitivity cases exceeded the EPRI PSA Applications Guide acceptable value of CDF increase by 33 percent, based on the PRA CDF of 9E-6 per reactor year. The expert panel then evaluated the SSC sensitivity case results and industry operating experience to set the performance criteria for the individual SSCs. The unavailability performance criteria were set by the expert panel between the PRA average unavailability and the average unavailability doubled. With the performance criteria established and approved by the expert panel, the licensee then performed an aggregate unavailability sensitivity analysis. The aggregate SSC performance criteria unavailability sensitivity case resulted in a 25.6 percent increase in the CDF, which was less than the 33 percent CDF increase suggested as acceptable by the EPRI PSA guideline. The team considered the licensee's approach to setting unavailability performance criteria to be acceptable.

The licensee established unavailability and reliability performance criteria to provide a basis for determining satisfactory SSC performance. Reliability performance criteria had been indicated by the licensee by the number of Maintenance Rule functional failures (MRFFs), where an MRFF had been defined by the licensee as a component functional failure in a Maintenance Rule scoped system that prevented, or could have prevented, that system from performing one or more of its Maintenance Rule functions. The MRFF performance criteria had been for the number of MRFFs recorded during an 18-month moving window and had been based on several inputs including the reliability used in the PRA, the number of components, number of Maintenance Rule functions, number of expected demands, and a review of MRFF operational history for the two units. The number of MRFFs had been established and approved by the expert panel at the system level and at the train level, if practical, to ensure poor train performance had not been masked by overall system performance. The licensee had also established performance criteria of no repetitive MRFFs for all Maintenance Rule scoped systems. The PRA had also been used to obtain a PSA functional failure, where a PSA functional failure had been defined by the licensee as an actual component failure as modeled in the PRA. The licensee staff indicated that all MRFF events were evaluated to determine if the failure was also a PSA functional failure.

b.3 Expert Panel

The licensee established the expert panel as recommended in NUMARC 93-01. The expert panel consisted of personnel from maintenance, operations, risk and reliability analysis, systems engineering, and operating experience. The Maintenance Rule coordinator served as a facilitator for the expert panel meetings and the Maintenance Rule project manager or technical lead served as the expert panel chairman.

The expert panel's purpose and responsibilities were covered in the South Texas Project Maintenance Rule Basis Document Guideline. The expert panel's responsibilities included final approval of systems scoped under the Maintenance Rule, changes in the Maintenance Rule functions which could affect scoping or risk significance, changes in risk significant systems including risk ranking, changes in performance criteria, disposition of SSCs into Categories (a)(1) and (a)(2), and any significant changes to the Maintenance Rule Basis Document Guideline.

The team noted that the expert panel had received some training on PRA. Expert panel members indicated that their particular area of expertise supplemented any limitations in the PRA model. The team determined that the expert panel members had an adequate understanding of their responsibilities with respect to the Maintenance Rule implementation.

c. Conclusions

The licensee's overall approach to performing risk significant determination of SSCs for the Maintenance Rule program was appropriate with no deficiencies identified by the team. The process for establishing performance criteria was also appropriate. The expert panel members had an effective understanding and knowledge of their responsibilities with respect to the Maintenance Rule program implementation.

M1.3 Periodic Evaluation

a. Inspection Scope (62706)

The team reviewed the procedural guidelines for the periodic assessments, "Annual Summary Report of Maintenance Rule Activities for the Period 2/29/96 - 7/15/97," and three monthly assessments entitled "Performance Criteria, Goals and Monitoring List & Maintenance Rule (a)(1) Systems," completed in December 1997, January 1998, and February 1998.

b. Observations and Findings

The licensee's instructions for conducting periodic evaluations were contained in Procedures 0PGP04-ZE-0313, "Maintenance Rule Program," Revision 1, Section 5.3, and the Maintenance Rule Basis Document Guideline, Revision 2, Section 12. The procedures were similar to the description in NUMARC 93-01, Revision 2, Section 12.

The Maintenance Rule coordinator evaluated the performance and condition monitoring activities, associated goals, and preventive maintenance activities for both units usually every month except during outages. a summary report of the monthly assessment was scheduled to be performed every 18 months, but not to exceed 24 months between assessments. The first, and only, summary report for both units completed by the licensee covered the period between February 29, 1996, to July 15, 1997. The summary report listed the number of Category (a)(1) SSCs for the 18-month period, referenced internal audits, and displayed graphs of Category (a)(1) information. The monthly assessments and summary report were comprehensive, and were useful tools for the system engineers in evaluating their SSCs, and for management in evaluating the status of Category (a)(1) systems. The monthly assessment's data was on the licensee's computer system that allowed every user to view the information.

c. Conclusions

The procedures for performing periodic evaluations met the requirements of 10 CFR 50.65. The monthly assessments and a summary report were comprehensive and were useful tools for evaluating SSC performance.

M1.4 Balancing Reliability and Unavailability

a. Inspection Scope (62706)

The team reviewed the plans and procedures the licensee established to ensure the balancing of reliability and unavailability, and the results of a recent balancing assessment.

b. Observations and Findings

The requirements for balancing were contained in the South Texas Project Maintenance Rule Basis Document Guideline, Revision 2. The licensee's approach involved monitoring SSC performance criteria and goals on a monthly basis. The licensee staff indicated that monthly monitoring should identify adverse trends prior to exceeding performance criteria or goals and allow adjustments to corrective actions. The licensee's process had focused on optimizing reliability and availability. The licensee staff stated that adjustments to maintenance activities shall be made for risk significant SSCs where necessary to ensure that the objective of preventing failures is appropriately balanced against the objective of assuring acceptable system availability. The licensee's process also included activities, such as, weekly reviews of actual plant risk profiles, daily views of predicted and actual plant risk profiles, and evaluations of the 52-week cumulative risk profiles that were presented by the risk and reliability analysis personnel. The licensee's assumption was that if appropriate performance criteria and goals were set, and if such performance criteria and goals were met, then an appropriate balance between reliability and unavailability would be achieved. The results of the overall process would then be evaluated during the required periodic assessments of maintenance program effectiveness. The team viewed this process used by the licensee staff to be a good method for balancing reliability and unavailability.

c. Conclusions

The licensee's approach for balancing reliability and unavailability was appropriate.

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

a. Inspection Scope (62706)

The team reviewed the licensee's procedures and discussed the process with plant operators, PRA engineers, and work schedulers for assessing the change in overall risk associated with the removal of equipment from service due to failure or to support maintenance activities. The team reviewed a sample of plant configuration changes that resulted from schedule adjustments and equipment failures to evaluate the licensee's assessments of the associated variations in risk.

b. Observations and Findings

The licensee's process for evaluating plant risk before taking SSCs out-of-service was documented in the South Texas Project Maintenance Rule Basis Document Guideline, Revision 2, and Procedures 0PGP03-ZA-0091, "Configuration Risk Management Program," Revision 1, and 0PGP03-ZA-0101, "Shutdown Risk Assessment Procedure," Revision 2.

The RAsCal software program had been developed by the risk and reliability analysis personnel to assess the changes in CDF due to maintenance on or failures of SSCs during power operating modes (Modes 1 and 2). The RAsCal code utilized the current PRA model to evaluate the CDF impact for planned maintenance equipment configurations. The RAsCal program was used by work week planners and senior reactor operators to evaluate the risk from planned maintenance activities and emergent work activities. Risk significant thresholds used by the licensee for equipment out-of-service were consistent with the risk significant levels suggested for temporary risk increases in the EPRI PSA Applications Guide. The licensee staff stated that RAsCal contained approximately 12,500 plant configurations, and also provided a return-to-service priority list. If a nonevaluated plant configuration was entered into RAsCal, the user was prompted to contact the risk and reliability analysis personnel for evaluation of the risk for that particular configuration. The configurations in RAsCal were updated to provide results based on the most current PRA model. This process used by the licensee to evaluate the risk prior to taking equipment out-of-service was considered by the team to be a program strength because of its detail and features.

The licensee's staff stated that risk profiles for planned and actual maintenance configurations during shutdown were evaluated with South Texas Project's outage risk assessment and management tool. The team found that outage risk assessment and management was used to evaluate the plant status for five functional areas: decay heat removal, reactor coolant system inventory control, electric power availability, reactivity control, and containment integrity. The team determined these evaluations were well done.

The licensee's staff stated that a risk assessment of the plant configurations during Modes 3 and 4 would be performed by the risk and reliability personnel, since a risk assessment model applicable to these modes was not directly available. The team determined that the risk assessment performed for these modes were based on a combination of inputs from RAsCal, outage risk assessment and management, and engineering judgement. The team considered these evaluations to also have been well done.

The team also reviewed the operator log books to identify different plant configurations. The different plant configurations were discussed with the licensee staff and no configurations were identified that had not been evaluated with RAsCal.

c. Conclusions

A programmatic strength was also identified with: (1) the practice of updating of the RAsCal to reflect results from the most current PRA model, (2) the process for assessing plant risk resulting from equipment out-of-service, and (3) the process for evaluating plant risk during various modes.

M1.6 Goal Setting and Monitoring and Preventive Maintenance

a. Inspection Scope (62706)

The team reviewed program documents and records in order to evaluate the process that was in place to establish performance criteria, set goals, and monitor under Category (a)(1) to meet goals, or to verify that preventive maintenance was effective under Category (a)(2) of the Maintenance Rule. The team also discussed the program with the Maintenance Rule coordinator, expert panel members, component engineers, system engineers, plant operators, and schedulers.

The team reviewed, in detail, the 15 systems and structures described below to verify: that goals or performance criteria were established with safety taken into consideration, that industry-wide operating experience was considered where practical, that appropriate monitoring and trending were being performed, and that corrective action was taken when an SSC function failed to meet its goal or performance criteria, or when an SSC function experienced a functional failure.

Auxiliary feedwater system
* Chilled water system
* Essential cooling water system
* Electrical auxiliary building heating, ventilation, and air conditioning system
* Turbine electrohydraulic controls system
* Emergency diesel generators
Feedwater system
Instrument air system
* Main steam system
* Post accident monitoring system

* 7300 processor support system
* 120 Vac Class 1E system
  Engineering safety features actuation system
* Safety injection system
  Solid state protection system
  Structures (civil/structural)

(* indicates Category (a)(1) monitoring at the time of the inspection)

b. Observations and Findings

The team determined that the licensee's program activities for monitoring the condition and effectiveness of maintenance on structures was appropriate and met the intent of the Maintenance Rule.

The team determined that the systems' performances were such that the SSCs were being monitored in accordance with 10 CFR 50.65(a)(1) or (a)(2), as appropriate, with the exceptions noted below. Performance criteria were appropriate, in most cases. The team found that appropriate corrective actions had been taken to address the causes of any unacceptable performance, except for the deficiencies identified below. The team noted that the licensee was very proactive in utilizing industry-wide operating experience, where practical.

b.1 Essential Cooling Water System

The essential cooling water system provided cooling water to the chilled water, component cooling water and standby diesel generator heat exchanger systems. It was a standby, risk-significant system in Category (a)(1) status because of failures of the annubar flow elements. Goals were to have no more repetitive failures of the annubars. As corrective actions, the licensee staff planned to replace the annubars with elements that had more structural support.

The reliability performance criteria for this system were less than five MRFFs per unit, three MRFFs per train, no repetitive MRFFs, and less than one PSA functional failure, all within 18 months. The availability performance criterion was less than 320 hours of unavailability per train within 18 months.

The team found the goals and corrective actions established for this system were reasonable, and the monitoring appeared to measure the effectiveness of maintenance, with the exception noted below. The licensee identified six MRFFs in the history of this system and the current unavailability was about 120 hours per train. The team reviewed these MRFFs in detail and a computer listing of work authorizations since the implementation of the Maintenance Rule. The team reviewed the unavailability data for this system and verified its accuracy.

The team found that Licensee Event Report 95-05, dated May 11, 1995, identified that the component cooling water pumps started because of an essential cooling water system valve misalignment, which was caused by an operator during a maintenance activity. The licensee did not identify this event as an MRFF because the licensee did not consider a safety system actuation to have occurred. (Section M1.1 of this report discusses the definition problem with "safety system actuation.") Upon further review, the licensee agreed that this was a MRFF. The team determined that this missed MRFF would not have changed the program status of the system. (This licensee event report was addressed in NRC Inspection Reports 50-498/95-06; 50-499/95-06 and 50-498/95-09; 50-499/95-09 and the valve mispositioning was dispositioned as a noncited violation.)

b.2 Electrical Auxiliary Building Heating, Ventilating, and Air Conditioning Systems

The electrical auxiliary building heating, ventilating, and air-conditioning systems provided control room envelope, electrical auxiliary building main area, and technical support center heating, ventilating, and air conditioning. These were standby, risk significant systems in Category (a)(1) because of repetitive transmitter (C2HEFT9589) failures. The goal was to have no more repetitive failures.

As corrective actions, the licensee installed new instruments. The performance criteria for these systems were less than 12 MRFFs per unit, less than 4 MRFFs per train, no repetitive MRFFs, and no more than 9 PSA functional failures, all within 18 months. The availability performance criterion was less than 320 hours of unavailability per train within 18 months.

The team found the goal and corrective actions established for these systems to be reasonable, and the monitoring appeared to measure the effectiveness of maintenance, with one exception noted below. The licensee identified 23 MRFFs in the history of these systems and the current unavailability was about 350 hours per train. The team reviewed these MRFFs in detail and a computer listing of work authorizations since the implementation of the Maintenance Rule. The team reviewed the unavailability data for these systems and verified its accuracy.

The team identified two events that were not identified as MRFFs. The first event the team found was identified in Work Authorization 95000576 (work completion date of May 16, 1995). This document identified that an electrical auxiliary building air handling unit filtration inlet damper failed due to bearing seizure that resulted in the damper not working. The team considered this an MRFF. Upon further review by the team, it was determined that this missed MRFF call would not have changed the program status of the system. The licensee did not identify this as an MRFF; however, on review with the team, the licensee's staff then considered this an MRFF and issued Condition Report 98-974 to correct the disposition.

The second event the team found was in Licensee Event Report 94-18, dated November 30, 1994. The licensee event report identified that the technical specification-required 0.125 inches of water (positive pressure) was not maintained for the control room. The failure to maintain the prescribed positive pressure was the result of implementing an inadequate surveillance procedure that did not ensure a positive pressure greater than 0.125 inches of water. Specifically, the procedure failed to test all the areas required to assure compliance with the technical specification. (This licensee event report was addressed in NRC Inspection Report 50-498/94-37; 50-499/94-37 and the failure to fully meet the requirements of Technical Specifications regarding the control room envelope heating, ventilation and air conditioning system boundary was dispositioned as a noncited violation.) The team considered this failure to maintain the pressure differential an MRFF. Upon further review by the team, it was determined that this missed MRFF call would not have changed the program status of the system. The licensee did not identify this as an MRFF; however, on review with the team, the licensee then considered this an MRFF and issued Condition Report 98-4978 to correct the disposition.

b.3 Instrument Air System

The instrument air system provided air pressure for reactor building, containment isolation, and other control requirements. It was a standby, risk significant system in Category (a)(2) and monitored with reliability and unavailability performance criteria on the system, train, and component levels. Reliability performance criteria were: less than five MRFFs per unit, and no repetitive MRFFs, both within 18 months. The unavailability performance criterion was less than 450 hours for each backup compressor within 18 months. The licensee staff also monitored this system at the plant level.

Performance criteria for this system were reasonable, and the monitoring appeared to measure the effectiveness of maintenance, with the exception noted below. The licensee identified six MRFFs in the history of this system and a current unavailability of about 170 hours for each backup compressor. The team reviewed these MRFFs in detail and a computer listing of work authorizations since the implementation of the Maintenance Rule. The team also reviewed the unavailability data for this system and verified its accuracy.

The team identified that Work Authorization 87568 (work completion date of June 27, 1996) identified that an instrument air receiver pressure switch failed, the header pressure dropped, and the backup compressor started. The team considered the pressure switch failure to be an MRFF. The pressure switch failure was not identified as an MRFF by the licensee, however, on review with the team, the licensee staff then considered this an MRFF and issued Condition Report 98-4974 to correct the disposition. The pressure switch failure did not result in a change of the status of the system to Category a(1), and no Maintenance Rule violation occurred.

b.4 Post-Accident Monitoring, 7300 Processor Support, 120 Vac Class 1E, and Engineered Safety Features Actuation System (Sequencing)

The team noted that the post-accident monitoring, 7300 processor support, 120 Vac Class 1E, and engineered safety features actuation systems were classified as risk significant, standby, safety systems. The team observed that these safety systems were being monitored as Category (a)(1) systems, except for the engineered safety features actuation system, which was monitored as a Category (a)(2) system.

The team noted that performance criteria for monitoring unavailability for these risk significant, standby, safety systems had not been established. The licensee had determined that unavailability would not be tracked for post-accident monitoring, 7300 processor support, 120 Vac Class 1E, and engineered safety features actuation systems, and most other risk-significant electrical, and instrumentation and control SSCs. The licensee's decision was due to the system complexity involving the number and variety of different trains and channels, and that reliability performance criteria or plant level performance criteria would monitor system performance for those systems, which usually don't have planned maintenance activities that render them unavailable. The licensee's staff informed the team that even though most of the electrical, and instrumentation and control SSCs fell into this category, all had been reviewed and evaluated, and determined not to be necessary for monitoring unavailability.

The team did not agree with the licensee's position on not monitoring unavailability for the solid state protection system, and this is discussed further below in Section b.5.

b.5 Solid State Protection System

The team determined that the solid state protection system was monitored in Category (a)(2). The licensee established performance criteria associated with system reliability as no more than three MRFFs per unit per 18 months that are not due to "whisker" induced failures of input control relays, no more than four MRFFs per unit per 18 months for "whisker" induced failures of input control relays, and no repetitive MRFFs. (The team was informed that during the electroplating of the relay, whiskers of single crystal filaments grow outward from the surface of the tin plating.)

The team noted that unavailability was not monitored for this system, and that the testing at the train level was required and performed at quarterly intervals. The team noted that these quarterly surveillances would render the affected train under test unavailable to perform its automatic function without human action, and would require several steps to restore the functionality, if needed. These surveillance tests included, but are not limited to the following: OPSP03-SP-0008B, "SSPS Train B Slave Relay Test (Outputs Blocked)," Revision 4; OPSP03-SP-0006R, "Train a Reactor Trip Breaker TADOT," Revision 5; and OPSP03-SP-0005R, "SSPS Logic Train R Functional Test," Revision 7.

As stated in NUMARC 93-01, to the maximum extent possible, both availability and reliability should be used to provide the maximum assurance that performance is being monitored. The definitions as found in Appendix B of NUMARC 93-01 are provided to promote consistent interpretation of the Maintenance Rule. The term unavailability is defined as "an SSC that is required to be available for automatic operation must be available and respond without human action." Section 12.2.4 of NUMARC 93-01 stated, in part, that, adjustments shall be made for risk significant SSCs, where necessary, to maintenance activities to ensure that the objective of preventing failures is appropriately balanced against the objective of assuring acceptable SSC availability and that 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.

The team noted that performance should be trended against established performance criteria so that adverse trends can be identified, and appropriate corrective actions promptly initiated. The team considered the licensee's historical data, when combined with industry operating experience, operating logs and records, and station performance monitoring data, as useful in analyzing trends as well as failures in equipment performance and making adjustments to the preventive maintenance program. The team determined that the licensee's approach for monitoring the unavailability through identified functional failures narrowly focused on capturing corrective maintenance issues as opposed to monitoring the effectiveness of overall (preventive and corrective) activities. The licensee's staff informed the team that South Texas Project did not use unavailability performance criteria for the solid state protection system because it did not provide a meaningful measure of performance. The licensee's staff position was documented in their Letter NOC-AE-000132. The team found that having had no performance measure established for unavailability for the solid state protection system was a violation of 10 CFR 50.65 (a)(2) (50-498;-499/9801-04).

c. Conclusions

In general, the licensee properly established goals and performance criteria, performed appropriate monitoring and trending, and had implemented appropriate corrective actions when required, with some exceptions. The failures to appropriately identify MRFFs associated with the essential cooling water, electrical auxiliary building heating, ventilation, and air conditioning, and instrument air systems were a weakness in the licensee's implementation of the Maintenance Rule program. The failure to establish measures to evaluate the unavailability of the solid state protection system was a violation of 10 CFR 50.65(1)(2).

M2 Maintenance and Material Condition of Facilities and Equipment

a. Inspection Scope (62706)

In the course of verifying the implementation of the Maintenance Rule program, the team performed in-plant walkdowns to examine the material condition of the following systems:

- Auxiliary feedwater system (Unit 1 and 2)
- Emergency diesel generators (Unit 1)
- Chilled water system (Unit 1 and 2)
- Feedwater system (Unit 1 and 2)

- Safety injection system (Unit 1 and 2)
- Turbine electrohydraulic controls system (Unit 1)
- Essential cooling water system (Unit 1)
- Electrical auxiliary building heating, ventilating, and air conditioning (Unit 2)
- Instrument air system (Unit 2)
- 7300 processor support system (Unit 1)
- Engineered safety features actuation system (Unit 1)
- 120 Vac Class 1E vital power system (Unit 2)

b. Observations and Findings

The team walked down the Unit 1 emergency diesel generators (Trains 12 and 13). The emergency diesel generators appeared to be in excellent material condition. System engineers identified minor material condition deficiencies during the walkdown. The material condition of Unit 1 turbine electrohydraulic control, Units 1 and 2 auxiliary feedwater, chilled water, feedwater, safety injection and essential cooling water systems, and Unit 2 electrical auxiliary building heating ventilation and air conditioning and instrument air systems were observed to be very good, in that the equipment was free of water, air, or oil leaks, corrosion, and external damage. In addition, supports, insulation, and coatings appeared acceptable.

The team generally found that the Unit 1 7300 processor support system, engineered safety features actuation system, and the Unit 2 120 Vac Class 1E vital power system to be free of corroded or dirty contacts and terminals, with no indications of crimped or frayed wiring. The team found the associated instrumentation system cabinets to be appropriately locked and controlled, with the various equipment spaces being maintained in a clean environment free of oil or water leaks and trash. Based on their external condition, they appeared to be well maintained.

c. Conclusions

Material condition of the plant systems walked down was excellent.

M7 Quality Assurance in Maintenance Activities

a. Inspection Scope (62706)

The team reviewed a total of five self-assessments, listed in the attachment, that had been performed on the licensee's Maintenance Rule program between February 1995 and February 1998.

b. Observations and Findings

The first four assessments were performed during the initial phases of Maintenance Rule implementation. The last audit was conducted between January 19-29, 1998, with onsite personnel and personnel from other nuclear plants that supplemented the audit team. The team observed that the most recent audit report was thorough, comprehensive, and detailed. This audit was conducted in order to review the Maintenance Rule program in areas identified as weaknesses during NRC inspections at other nuclear facilities. The audit reviewed the program scope, monitoring program knowledge, balancing reliability and unavailability, program performance criteria and goals, and probabilistic safety analysis.

The audit concluded that implementation and documentation of unavailability determinations were the licensee's greatest vulnerability. The reports states, "10 CFR 50.65(a)(3) requires balancing reliability and unavailability. Currently unavailability data is not being tracked on 19 risk significant systems. Without this data the required balancing cannot be performed." The licensee's staff documented this item in Condition Report 98-1108. The licensee performed the appropriate corrective actions for most of the 19 risk significant systems; however, at the time of this inspection, there was one example of a risk significant system (solid state protection) that was not monitored for unavailability which was discussed in Section M1.6.b.5. The audit also documented several other deficiencies and made corrective action recommendations.

c. Conclusions

The reviewed self-assessments were thorough, comprehensive, detailed, and addressed areas of Maintenance Rule implementation. The self assessments identified concerns and recommendations. The licensee's corrective actions were appropriate for the problems identified, with one exception with the identified failure to establish an unavailability measure for the solid state protection system.

M8 Miscellaneous Maintenance Issues

M8.1 (Closed) Licensee Event Report 50-498/95-002: Excessive degradation of boraflex neutron poison in the Unit 1 spent fuel pool Region 1 storage racks. The team verified that the licensee staff had placed usage restrictions on the degraded region, developed a long-term boraflex management plan, and developed a dose-to-degradation correlation to assure that restrictions in the future will maintain the design basis.

M8.2 (Closed) Inspection Followup Item 50-498/9517-01: Ineffective controls in place to prevent the issue and installation of failure prone Rosemount transmitters. The licensee determined that the improper transmitters were issued and installed because warehouse and procurement personnel were confused by a revised material control and issue process. The inspectors verified that corrective action was implemented to improve the material control and issue process and provide training to personnel involved in material control and issue.

M8.3 (Closed) Inspection Followup Item 50-498/9431-01: Appropriate PM tasks were not developed or included in the PM program for some important equipment in the standby diesel generator and support systems. The licensee has developed a PM optimization program which was documented in Procedure OPG PO3-2M-0002, "Preventive Maintenance Program," Revision 30. The licensee developed a PM identification guide which provides instructions for maintaining the Master PM index and for performing PM optimization reviews.

E4 Engineering Staff Knowledge and Performance

E4.1 Engineer Knowledge of Maintenance Rule

a. Inspection Scope (62706)

The team interviewed engineering personnel to assess their understanding of the Maintenance Rule program and associated responsibilities. The team also reviewed the training that had been administered to system engineering personnel.

b. Observations and Findings

The team identified that system engineering personnel had numerous responsibilities associated with the Maintenance Rule program activities. The system engineers developed performance criteria, established goals, performed evaluations, and made functional failure determinations for their systems.

All system engineers interviewed, demonstrated an in-depth and sound knowledge of their respective systems. Although not having received formal training in probabilistic risk analysis, the system engineers understood the relationship and bases between it and the safety functions and performance criteria of their respective systems. The team noted that a strong reliance existed on reliability engineering personnel for initial functional failure determinations. The team noted that the responsible system engineer was included in functional failure determinations, but was not included in determinations that were initially identified as nonfunctional failures. The team considered this to be a program weakness since nonfunctional failures were not required to be independently reviewed.

The system engineers' knowledge and understanding of the Maintenance Rule were appropriate for the tasks required of them.

c. Conclusions

The system engineers knowledge of the Maintenance Rule was appropriate for the tasks required of them, and they demonstrated an in-depth and sound knowledge of their respective systems. The failure to include the responsible engineers in the review determination of nonfunctional failures was a program weakness.

V. Management Meetings

X1 Exit Meeting Summary

The team discussed the progress of the inspection on a daily basis and presented the inspection results to members of licensee management at the conclusion of the inspection on March 27, 1998. In addition, a supplemental telephonic exit was held on June 10, 1998 to discuss the enforcement findings from the inspection.

The team also reviewed the additional information Letter NOC-AE-000132, dated April 4, 1998, submitted by the licensee documenting their position on NRC-identified examples of potential violations of the Maintenance Rule.

The team asked the licensee staff and management whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

ATTACHMENT

SUPPLEMENTAL INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee

T. Cloninger, Vice President, Nuclear Engineering
W. Cottle, President and Chief Executive Officer
J. Crenshaw, Manager, Mechanical Fluids
T. Frawley, Shift Supervisor
R. Grantom, Administrator, Probabilistic Risk Assessment
J. Groth, Vice President, Nuclear Generation
T. Jordan, Manager, Systems Engineering
L. Martin, Vice President, Nuclear Assurance and Licensing
B. Mookhoek, Licensing Engineer
G. Parkey, Unit 1, Plant Manager
T. Stroschein, Supervisor, Component Reliability
J. Winters, Coordinator, Maintenance Rule

NRC

D. Powers, Chief, Maintenance Branch
W. Sifre, Resident Inspector

INSPECTION PROCEDURES USED

IP 62706	Maintenance Rule

ITEMS OPENED AND CLOSED

Opened

50-498;-499/9801-01 NOV	Failure to include the digital rod position indication and a control room HVAC function within the Maintenance Rule Program scope
50-498;-499/9801-02 NCV	Failure to include the instrument air compressors, containment building cranes, fuel handling building cranes, and 138/13.8 KV emergency transformers within the Maintenance Rule Program scope
50-498;-499/9801-03 NOV	Failure to adequately monitor the solid state protection system

Closed

50-498/95-002	LER	Degradation of Unit 1 Spent Fuel Pool Region 1 Storage Racks Boraflex Coating
50-498;-499/9801-02	NCV	Failure to include the instrument air compressors, containment building cranes, fuel handling building cranes, and 138/13.8 KV emergency transformers within the Maintenance Rule Program scope
50-498/9517-01	IFI	Ineffective controls in place to prevent the issue and installation of failure prone Rosemont transmitters
50-498/9431-01	IFI	Appropriate PM tasks were not developed or included in the PM program for some important equipment in the standby diesel generator and support systems

LIST OF PROCEDURES REVIEWED

OPGP03-ZA-0091	Configuration Risk Management Program	Revision 0
OPGP04-ZE-0313	Maintenance Rule Program	Revision 1
OPSP03-SP-0008B	SSPS Train B Slave Relay Test (Outputs Blocked)	Revision 4
OPSP03-SP-0006R	Train a Reactor Trip Breaker TADOT	Revision 5
OPSP03-SP-0005R	SSPS Logic Train R Functional Test	Revision 7

LIST OF DOCUMENTS REVIEWED

Maintenance Rule Basis Document Guideline, Revision 2

System Engineering Department Guidelines, Revision 6

5Q119MB1046, "Instrument/Service Air System," Revision 1

5R289MB1006, "Essential Cooling Water System," Revision 3

5V119VB1022, "HE/HE(CRE) System," Revision 2

9G019MB0117, "Turbine Generator System," Revision 3

South Texas Project Electric Generating Station Updated Final Safety Analysis Report

Risk Assessment Calculator User Manual, Version 2.2

Memorandum from Allen C. Moldenhauer to J. P. Winters, "Update to System Risk Significance Determination for Maintenance Rule," ST-NOC-NOC-000303, November 24, 1997

Memorandum from Allen C. Moldenhauer to RMS, "PSA System Risk Ranking Study PSA-97-003," ST-NOC-NOC-000289, November 20, 1997

Memorandum from Allen C. Moldenhauer to cc:Mail, "Resolving Comments from the MR Self Assessment CR97-174-6," April 15, 1997

Memorandum from C. R. Grantom to M. S. Lashley, "Risk-Based Sensitivity Study on Maintenance Rule Unavailability Performance Criteria, CR 96-5928-19," ST-HS-HS-036069, March 20, 1997

Memorandum from Allen C. Moldenhauer to File, "Input for Maintenance Rule Performance Criteria as Analyzed with the Probabilistic Safety Assessment," ST-HS-HS-034675, July 9, 1996

PSA-98-002, "*Maintenance Rule Unavailability Performance Criteria Study*," Revision 0, February 16, 1998

0PGP03-ZA-0101, "Shutdown Risk Assessment Procedure," Revision 2, November 16, 1994

Condition Reports/Condition Report Engineering Evaluations

96-4859	97-6062	97-9171	97-15357	97-18945	98-4978
97-653	97-8479	97-12173	97-15459	97-19369	98-4979
97-1492	97-8496	97-13779	97-17780	97-19596	98-4980
97-2501	97-8779	97-15261	97-17736	98-4974	
97-3022	97-8793	97-15278	97-17856	98-4976	

Work Authorization Numbers (WAN)

44445	87568	110818	94033763	95012170
59415	88704	111588	94035287	95015079
60358	89285	113050	94036656	95015905
66160	92533	123502	94037750	95016652
67578	93228	125017	95000576	95016664
69890	96254	126476	95001086	95018255
72265	96315	94006454	95003608	95019967
73919	100579	94012267	95005702	95021046
79942	103201	94013637	95006508	96063514
80166	103816	94015077	95006688	96069748
80822	106321	94015078	95007326	96076721
80990	106804	94031327	95007361	
83290	106968	94031744	95011304	
86205	110012	94033123	95012160	

LERs

498/94-18	499/97-04
499/95-05	

List of Acronyms Used

CDF	-	Core Damage Frequency
EPRI	-	Electric Power Research Institute
LERF	-	Large Early Release Frequency
MRFF	-	Maintenance Rule Functional Failure
NEI	-	Nuclear Energy Institute
NUMARC	-	Nuclear Management and Resources Council, Inc.
PRA	-	Probabilistic Risk Assessment
PSA	-	Probabilistic Safety Assessment
RAsCal	-	Risk Assessment Calculator
RAW	-	Risk Achievement Worth
RRW	-	Risk Reduction Worth
SSC	-	Structure, System, or Component