U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Inspection Report 50-244/94-16 License: DPR-18

Facility: R. E. Ginna Nuclear Power Plant
Rochester Gas and Electric Corporation (RG&E)

Inspection: June 7 through July 25, 1994

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INSPECTION SCOPE

Plant operations, maintenance, engineering, plant support, and safety assessment/quality verification.

INSPECTION EXECUTIVE SUMMARY

Operations

At the beginning of the inspection period the plant was operating at full power (approximately 97 percent). On June 13, 1994, the plant was shut down and an unusual event was declared due to delays in repairing rotor bars of the "B" safety injection pump motor that resulted in a plant shutdown required by technical specifications. Following completion of safety injection system post-maintenance testing, a reactor startup was conducted and the plant returned to full power operation on June 16, 1994. The inspector noted significant management involvement throughout this event. Operators demonstrated strict procedural adherence and good communications during plant mode changes.

Maintenance

Several broken/cracked motor rotor bars were identified in a safety injection pump motor. Repairs were completed by an off-site vendor. Full spectrum vibration analysis techniques are being incorporated into the reliability centered maintenance program to predict such failures. Inspection of the motor rotor in a similar motor did not identify any degradation. As a result of motor repair delays experienced at the off-site facility, surveillance testing of critical safety-related equipment is being scheduled earlier in the work week to facilitate off-site repairs, if required.

New power supplies were installed in the microprocessor rod position indicator system to correct intermittent, spurious system alarms that resulted when both redundant supplies failed.

A mechanical seal on the "B" safety injection pump was replaced due to excessive leakage. Recent material problems with the "B" safety injection pump caused the licensee to initiate an in-depth review of the condition of the other safety injection pumps.

Engineering

Corporate engineering effectively monitored rotor repairs at an off-site facility. A second safety injection pump motor was disassembled and the motor rotor bars were inspected by the electrical engineering staff to assure other motors did not exhibit similar failures. Selection was appropriately based on operating history and vibration spectral frequency analysis. The decision to inspect the "C" SI pump and delay startup demonstrated management's commitment to safe plant operations.

Plant Support

Routine observations in the areas of radiological controls, security, and fire protection indicated that these programs were effectively implemented. An improved x-ray machine with image enhancement capabilities was installed at the main entrance.

(EXECUTIVE SUMMARY CONTINUED)

Safety Assessment/Quality Verification

Management utilized various resources to assure that work met acceptance standards and that the underlying causes of plant incidents were identified and expeditiously corrected. These resources included having comprehensive root cause analyses performed to establish the factors that resulted in failures of a safety injection pump motor and the pump's mechanical seal. The Quality Assurance staff provided effective oversight for various maintenance and testing activities. PORC provided excellent oversight in assessing and directing the course of action following failure of a safety-related motor.

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DETAILS

1.0 OPERATIONS (71707)

1.1 Operational Experiences

At the beginning of the inspection period the plant was operating at full power (approximately 97 percent). On June 13, 1994, the plant was shut down and cooled down to less than 350 degrees F due to delays in repairing the "B" safety injection pump motor that resulted in a plant shutdown required by technical specifications. Following completion of safety injection system post-maintenance testing, a reactor startup was performed, and full power operation was achieved on June 16, 1994. The plant operated at full power for the remainder of the inspection period. There were no other significant operational events or challenges during the inspection period.

1.2 Control of Operations

Control room staffing was as required. Operators exercised control over access to the control room. Shift supervisors maintained authority over activities and provided detailed turnover briefings to relief crews. Operators adhered to approved procedures and were knowledgeable of off-normal plant conditions. The inspectors reviewed control room log books for activities and trends, observed recorder traces for abnormalities, assessed compliance with technical specifications, and verified equipment availability was consistent with the requirements for existing plant conditions. During normal work hours and on backshifts, accessible areas of the plant were toured. No operational inadequacies or concerns were identified.

1.3 Plant Shutdown Required by Technical Specifications

On June 13, 1994, at 11:19 a.m., the licensee commenced a plant shutdown after determining that the "B" safety injection (SI) pump could not be returned to service within the 72 hour limiting condition for operation (LCO) due to delays in repairing the pump's motor. In accordance with the Emergency Plan Implementing Procedures (EPIP 1-0), an Unusual Event was declared at 11:15 a.m. RG&E placed the plant in hot shutdown at 4:14 p.m. Reactor coolant temperature was reduced below 350 degrees F at 9:57 p.m., and the Unusual Event was terminated at 9:59 p.m.

Management involvement during the plant shutdown was excellent. Management, including maintenance and operations managers, was frequently present in the control room during the shutdown. Additional licensed and non-licensed operators augmented the normal shift staffing to assist in the shutdown and minimize administrative distractions. Local officials and the NRC staff were notified of the impending Unusual Event prior to the actual declaration. Management exercised prudent judgement by directing that the auxiliary feedwater pumps be tested prior to the completion of the shutdown. Based on the potential generic concerns identified with the failure of a safety injection pump motor, RG&E determined that a net safety benefit existed by ensuring operability of the auxiliary feedwater pumps before securing the main feedwater pumps.

Operators performed the plant shutdown in a controlled and professional manner, maintaining minimal distractions in the control room. Operator communications, both in the control room and in the field, were formal and used repeat backs. The shutdown was completed without incident.

1.4 Plant Startup

After returning the "B" SI pump to service, a plant startup commenced on June 16, 1994. Operators began a reactor startup at 12:55 a.m., with criticality achieved at 2:27 a.m. The plant was placed on the distribution grid at 6:36 a.m., and full power was achieved on June 16, 1994 at 9:08 p.m.

Overall, operators completed the startup in a deliberate and controlled manner. Communications were formal and operators were closely adhered to procedures. The control room foreman briefed reactor operators before the actual performance of critical steps to anticipate the outcome. The reactor startup was completed without incident. The inspector independently verified the accuracy of the estimated critical position and found it to be within tolerance.

2.0 MAINTENANCE (62703, 61726)

2.1 Preventive/Corrective Maintenance

2.1.1 "B" Safety Injection Pump Motor Failure

Event Overview

On Friday, June 10, 1994, the inspector observed monthly surveillance testing (PT-2.1M) of the SI pumps. When the "B" SI pump was started, both the inspector and a results and test (R&T) technician observed sparks momentarily coming from one of the pump motor vents. The sparking stopped when the pump reached normal operating speed. The R&T technician immediately informed the control room of the condition, and the pump was promptly secured. The Operations staff appropriately declared the pump inoperable and maintenance personnel commenced disassembly of the pump to determine the cause. Upon inspection, one broken motor rotor bar and two cracked rotor bars were identified. Management directed that the rotor be sent off-site to a vendor (Reliance Electric) for repair. Due to being received during the weekend, the repair facility could not immediately begin repairs upon receipt. On Monday, June 13, 1994, RG&E corporate engineers and quality assurance personnel were assigned to oversee activities at the vendor site, while rebarring of the rotor was performed.

The repaired motor was returned on June 14, 1994. Following installation and post-maintenance testing, the "B" SI pump was declared operable on June 15, 1994.

Maintenance Activities

The maintenance activities, supporting the delivery and receipt of the rotor, were performed under Work Order No. 19402393, using Maintenance Procedure (M)-45.0, "Mechanical/ Electrical Inspection and Maintenance of Ginna Station Motors." The inspector observed portions of these activities and the receipt inspection of the rotor upon return from the vendor. The inspector concluded that the maintenance activities and subsequent post-maintenance testing were appropriately performed. A site quality assurance inspector conducted a thorough receipt inspection of the rotor, including verifying certification and inspecting against acceptance criteria and guidance provided in relevant quality assurance procedures.

During these maintenance activities, the inspector noted significant management involvement and oversight. Corporate engineering staff and senior site managers were at the work site, observing installation of the rotor and post-maintenance testing. Activities were conducted around the clock to expedite repair.

Safety Injection System Inservice Testing

The inspector reviewed the inservice test data for the SI pump and motors. RG&E was using displacement measurements to meet inservice testing (IST) requirements for pump vibration. Measurements were taken at four locations on the pump, and none on the motor. Although the data indicated that the pumps were within the alert range, the displacement measurement technique was not the most effective technique to diagnose or predict problems. RG&E was in the process of developing a vibration measurement technique, which would provide data over a spectrum of frequencies. Initial data had been taken on most components, however, a data base was not yet available to allow meaningful trending. RG&E planned to transition into this new vibration spectrum analysis in 1995. The inspector concluded that the development of vibration spectrum analysis would significantly enhance the IST program, including RG&E's diagnostic and predictive capabilities.

Licensee Response To a Related Vendor Bulletin

RG&E received information from the motor vendor concerning rotor bar cracking on April 13, 1994. The information, in the form of a vendor technical bulletin issued March 17, 1994, alerted licensees to the potential rotor bar cracking due to frequent motor starts (in excess of 3,000 start cycles under nominal conditions). The vendor bulletin was based on a single failure of a motor in a nuclear application, reported to the vendor in 1981, and on several motors that had similar failures or conditions in non-nuclear applications.

In response to the vendor bulletin, the Operations Assessment Program coordinator initiated several actions to evaluate the information. The assigned completion date of all actions was July 12, 1994. At the time of receipt of the information, the "B" SI pump had experienced a problem in achieving adequate discharge pressure during a surveillance test on April 9, 1994. Activities to repair the pump to allow startup from the refueling outage were completed on

April 16, 1994. Although the motor was decoupled from the pump at the time RG&E had received the information, the inspector considered that RG&E did not have a reasonable amount of time and basis to assess and take action in response to the vendor bulletin prior to plant startup from the refueling outage. The inspector concluded that RG&E's initial disposition of the bulletin, prioritization, and course of action were appropriate, based of the information provided by the vendor.

Inspection for Common Failures

On June 14, 1994, RG&E management met to determine if they had reasonable assurance that similar rotors used in safety-related applications were not significantly degraded with cracked rotor bars, and that they could proceed with the restart of the plant. At the time of the meeting, the "B" SI pump was expected to be ready to support a plant startup the following day. RG&E management considered several factors, which provided some assurance that other rotors were operable. The motor start cycles of the "A" and "C" SI pump motors were believed to be much less (less than 1200 starts) than the 3,000 starts specified in the vendor bulletin. Of the three SI pumps, the "B" pump was used in recent years to fill SI accumulators, and therefore experienced the greatest number of starting cycles. However, because these pumps had been installed since initial plant operation, RG&E did not have a reliable quantitative estimate of the number of motor starting cycles; and, it was possible that the "C" pump was used to refill accumulators in the plant's early years of operation. Unlike the "B" SI pump motor start, no arcing was noted from the "A" or "C" pump motors during surveillance testing. The vibration spectrum analysis indicated that the "A" pump motor was in good condition, and that the "C" pump motor had no broken rotor bars; however, the data suggested that a cracked rotor bar(s) may exist.

RG&E management determined that, although there was no definitive evidence that the "C" rotor was degraded, inspecting the "C" SI pump motor rotor bars would be prudent. This decision was made, in part, because the vibration spectral analysis was in the initial stages of development and was not yet fully implemented at Ginna. Examination of the "C" SI pump motor would indicate if vibration data could be used to forecast the condition of similar safety-related pump motors, to provide assurance that the other motors were not degraded. Plant start-up was delayed to conduct the inspection of the "C" pump motor. Subsequent inspection results provided confidence in the reliability of similar safety-related motors, since no degraded rotor bars were identified in the "C" rotor.

Assessment

The inspector concluded that RG&E management's decision to inspect the "C" SI pump motor demonstrated excellent safety perspective. RG&E management review and assessment of this issue was thorough. RG&E initiated a root cause analysis (M-94-012) and Corrective Action Report (CAR) No. 2094 to address corrective actions concerning the "B" SI pump. The CAR detailed 27 separate long- and short-term corrective actions. In addition to the establishment of programmatic predictive tools to identify cracked rotor bars, the CAR addressed peripheral

issues, such as the rescheduling of surveillance testing on safety equipment, that have LCOs of 72 hours or less, earlier in the week to permit expedited repairs, if required; and establishing a protocol for locating key spare parts that are not in stock. RG&E's actions to inspect the "C" SI pump and delay startup showed management's priority and commitment to safe plant operations.

2.1.2 Microprocessor Rod Position Indicator System Power Supply Failure

On June 30, 1994, intermittent alarms on annunciator C-29, "MRPI System Failure," along with an error indication on the MRPI screen for rod C-9, began to occur. Troubleshooting led instrument and control (I&C) technicians to replace the detector interface card for rod C-9, however, the problem persisted. Suspecting a card seating problem, the original detector interface card was reinstalled on Friday, July 1, which appeared to correct the problem. However, the intermittent alarms resumed during the holiday weekend, and MRPI for rod C-9 was declared inoperable. In accordance with technical specification 3.10.5.2, operators commenced verification of rod C-9 position using the moveable incore neutron detectors every eight hours. The problem persisted through the remainder of the holiday weekend, but then stopped before additional troubleshooting could be initiated. On July 8, 1994, after several days of operation without recurrence of the MRPI alarm, rod C-9 position was verified in accordance with performance test (PT)-1, "Rod Control System," and MRPI for rod C-9 was declared operable.

On July 10, 1994, the "MRPI System Failure" alarm was again received. The MRPI alarm screen showed primary and secondary status failed for the positive 15 VDC, and intermittent primary and secondary status failed for the negative 15 VDC; intermittent data cabinet temperature alarms were also being displayed. Troubleshooting found both positive 15 VDC power supplies to be passing a 1.3 VAC ripple; the maximum limit for such distortion is ± 0.1 VAC. The negative 15 VDC power supplies were found to be operating normally.

Repair was accomplished by a temporary modification (94-026) that connected two new positive 15 VDC power supplies in parallel with the installed power supplies, using temporary connections to the backplane terminals in the MRPI data cabinet. The installed power supplies were then deenergized by removing the AC supply isolation fuses, and left in place; it was not considered practical to remove the power supplies while the system was operational. The new power supplies were not mounted, but were placed inside the data cabinet. There has been no recurrence of "MRPI System Failure" alarms since this temporary modification was installed. The temporary power supplies will be permanently installed during the 1995 refueling outage.

The inspector assessed that licensee action to declare rod C-9 MRPI inoperable had been a conservative response to an intermittent condition. The decision to return this indication to operable status despite not having established the cause of the intermittent alarms was appropriate and well considered. As a part of this action, management provided guidance to the operators regarding MRPI operability, should alarms for rod C-9 occur in the future. The

inspector reviewed work order 19402728, "Received Spurious Alarms on MRPI Rod C-9," work order 19402792, "MRPI System Failure Alarm," and temporary modification 94-026; no deficiencies were noted. The inspector had no additional concerns on this matter.

2.1.3 "B" Safety Injection Pump Mechanical Seal Failure

On July 13, 1994, during the performance of PT-2.1M, "Safety Injection System Monthly Test," the "B" SI pump outboard mechanical seal was observed to be leaking. An attempt to adjust the seal was not successful, and the pump was declared inoperable. Investigation revealed that the spring that maintains pressure on the mechanical seal seating surfaces had not been welded to form a closed loop at the end of the coil. Without this rigid loop, the spring had worked its way around the edge of the floating seal ring. The combination of reduced spring pressure and misalignment had resulted in excessive seal leakage.

The failed mechanical seal was replaced and the pump was returned to service on July 15, 1994. As a result of this failure, the licensee initiated a root cause analysis (M-94-013) to ensure that any common causes would be identified and that all aspects of the corrective action would be tracked to completion. The inspector had no further questions at this time.

2.2 Surveillance Observations

2.2.1 Routine Observations

Inspectors observed portions of surveillances to verify proper calibration of test instrumentation, use of approved procedures, performance of work by qualified personnel, conformance to limiting conditions for operation (LCOs), and correct system restoration following testing. The following surveillances were observed:

- Performance Test (PT)-2.1M, "Safety Injection System Monthly Test," revision 12, effective date April 8, 1994, observed June 10, 1994

  -- Test was stopped prior to completion due to failure of the "B" SI pump motor

- PT-36Q-C, "Standby Auxiliary Feedwater Pump C - Quarterly," revision 10, effective date April 15, 1994, observed July 20, 1994

- PT-16Q-T, "Auxiliary Feedwater Turbine Pump - Quarterly," revision 12, effective date July 14, 1994, observed July 21, 1994

- PT-CPI-TRIP-TEST-5.20, "Reactor Protection System Trip Test/Calibration For Channel 2 (White) Bistable Alarms," revision 9, effective date June 3, 1994, observed July 25, 1994

The inspector determined through observing this testing that operations and test personnel adhered to procedures, test results and equipment operating parameters met acceptance criteria, and redundant equipment was available for emergency operation.

3.0 ENGINEERING (71707)

3.1 Licensee Action On Previous Inspection Findings

3.1.1 (Closed) Unresolved Item (91-201-02) Reanalyze Service Water System Hydraulic Model Using Actual Plant Data

During the Service Water System (SWS) Operational Performance Inspection, the inspection team concluded that the SWS hydraulic model was relatively accurate, but was limited in the amount of actual plant data used to verify flow. In response to this finding, the licensee checked, modified, and validated the original NUS model. Test data was used to evaluate the specific model inputs, which included:

- Service water pump performance data
- Containment recirculating fan cooler hydraulic data
- Diesel generator cooler hydraulic data
- Containment recirculating fan motor cooler hydraulic data

The final validation, by taking plant data in the two pump configuration, provided for 11 flow measurements and 31 pressure gage readings. This provided confirmation that the model is acceptable for design reviews and evaluations for other system configurations. Additional details regarding the licensee's validation are contained in the licensee's letter to the NRC dated March 30, 1994. The inspector had no additional concerns on this matter.

4.0 PLANT SUPPORT (71707)

4.1 Radiological Controls

4.1.1 Routine Observations

The inspectors periodically confirmed that radiation work permits were effectively implemented, dosimetry was correctly worn in controlled areas and dosimeter readings were accurately recorded, access to high radiation areas was adequately controlled, survey information was kept current, and postings and labeling were in compliance with regulatory requirements. Through observations of ongoing activities and discussions with plant personnel, the inspectors concluded that the licensee's radiological controls were effective.

4.2 Security

4.2.1 Routine Observations

During this inspection period, the inspectors verified that x-ray machines and metal and explosive detectors were operable, protected area and vital area barriers were well maintained, personnel were properly badged for unescorted or escorted access, and compensatory measures were implemented when necessary. During this inspection period, an improved x-ray machine with image enhancement capabilities was installed at the main entrance. No unacceptable conditions were identified.

4.3 Fire Protection

4.3.1 Routine Observations

The inspectors periodically verified the adequacy of combustible material controls and storage in safety-related areas of the plant, monitored transient fire loads, verified the operability of fire detection and suppression systems, assessed the condition of fire barriers, and verified the adequacy of required compensatory measures. No discrepancies were noted.

5.0 SAFETY ASSESSMENT/QUALITY VERIFICATION (71707)

5.1 Periodic Reports

Periodic reports submitted by the licensee pursuant to Technical Specification 6.9.1 were reviewed. Inspectors verified that the reports contained information required by the NRC, that test results and/or supporting information were consistent with design predictions and performance specifications, and that reported information was accurate. The following reports were reviewed:

-- Monthly Operating Report for May 1994
-- Monthly Operating Report for June 1994

No unacceptable conditions were identified.

5.2 Licensee Event Reports

A Licensee Event Report (LER) submitted to the NRC was reviewed to determine whether details were clearly reported, causes were properly identified, and corrective actions were appropriate. The inspectors also assessed whether potential safety consequences were properly evaluated, generic implications were indicated, events warranted additional onsite follow-up, and applicable requirements of 10 CFR 50.73 were met.

The following LER was reviewed (Note: date indicated is event date):

- 94-008, "B" SI Pump Declared Inoperable Due To Broken Motor Rotor Bar, Causes Completion of Plant Shutdown as Required By Technical Specifications (June 13, 1994)

The inspector concluded that the LER was accurate, met regulatory requirements, and appropriately identified the root cause.

5.3 Corporate Management Changes

In June of 1993, Mr. Will McCoy relinquished his responsibilities as Department Manager, Quality Performance, to serve on a Corporate Strategic Task Force addressing future RG&E business strategies. Several corporate management changes were made to support this temporary move, as discussed in inspection report 50-244/93-10. Effective June 1, 1994, Will McCoy returned to his original position as Department Manager, Quality Performance. As a result, the following organizational changes were made on July 1, 1994:

- Thomas A. Marlow, acting Department Manager, Quality Performance, returned as Superintendent, Ginna Production

- Richard A. Marchionda, acting Superintendent, Ginna Production, returned as Superintendent, Support Services

- Steven T. Adams, acting Superintendent, Support Services, was retained in a temporary position for a year, assisting the Plant Manager and Superintendents, in implementing critical initiatives such as the work control process and procedure review process

6.0 ADMINISTRATIVE

6.1 Backshift and Deep Backshift Inspection

During this inspection period, a backshift inspection was conducted on June 14, 1994. Deep backshift inspections were conducted on June 12, 16, and 27, 1994.

6.2 Exit Meetings

At periodic intervals and at the conclusion of the inspection, meetings were held with senior station management to discuss the scope and findings of inspections. The exit meeting for inspection report 50-244/94-15 (engineering programs, conducted June 6-10, 1994) was held by Mr. L. Prividy on June 10, 1994. The exit meeting for inspection report 50-244/94-17 (procurement, conducted June 27 - July 1, 1994) was held by Mr A. Finkel on July 1, 1994. The exit meeting for inspection report 50-244/94-18 (effluent and environmental monitoring programs, conducted July 11-15, 1994) was held by Ms. L. Peluso on July 15, 1994. The exit

meeting for inspection report 50-244/94-11 (control of software, conducted July 18-22, 1994) was held by Mr. J. Calvert on July 22, 1994. The exit meeting for the current resident inspection report 50-244/94-16 was held on July 27, 1994.