ENCLOSURE

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Inspection Report: 50-298/95-13

License: DPR-46

Licensee: Nebraska Public Power District
1414 15th Street
Columbus, Nebraska

Facility Name: Cooper Nuclear Station

Inspection At: Brownville, Nebraska

Inspection Conducted: September 25-29 and October 3-4, 1995

Inspectors: M. Runyan, Reactor Inspector, Engineering Branch
Division of Reactor Safety

C. Myers, Reactor Inspector, Engineering Branch
Division of Reactor Safety

Approved: _____ 10-23-95
Chris A. VanDenburgh, Chief, Engineering Branch Date
Division of Reactor Safety

Inspection Summary

Areas Inspected: Routine, announced inspection of followup of engineering issues.

Results:

Engineering

- The inspectors questioned the operability of four motor-operated valves that had been identified in a contractor study as being susceptible to pressure locking. These concerns involved the ability of the valve to close under pressure-locking conditions with degraded voltages. The licensee aggressively pursued these concerns and on October 2, 1995, resolved the issue by performing an engineering analysis of the valves' ability to close using the most recent pressure-locking analysis methodology available in the industry (Section 1.1).

- The inspectors identified that, prior to this inspection, the licensee had not formally documented its operability assessment of valves identified in a November 1994 contractor study as being susceptible to pressure locking and thermal binding. In addition the inspectors determined that the licensee's September 28, 1995 operability evaluation for Valves CS-MO12A/B depended upon a bonnet depressurization rate that was inconsistent with test results conducted at many plants. The licensee stated that valves CS-MO12A/B would be tested during the next refueling outage. The inspectors will review these test results to evaluate assumptions in the licensee's pressure locking calculations and will further evaluate assumptions related to bonnet depressurization in a future inspection. The failure to formally document an operability evaluation and the adequacy of the September 28, 1995 engineering evaluation was identified as an unresolved item pending completion of this review (Section 1.1).

- Although the inspectors identified that the licensee had implemented the component design-life specifications in the design control of essential electrical equipment, the engineering department had not adequately controlled and documented the design life of safety-related electrical components (Section 1.3).

Summary of Inspection Findings:

- Inspection Followup Item 298/9308-16 was reviewed, but left open (Section 1.1).
- Unresolved Item 298/9513-01 was opened (Section 1.1).
- Violation 298/9318-02 was closed (Section 1.2).
- Violation 50-298/9427-01 was closed (Section 1.3).
- Inspection Followup Item 50-298/9513-02 was opened (Section 1.3).
- Violation 50-298/9414-01 was closed (Section 1.4).
- Inspection Followup Item 50-298/9414-03 was reviewed, but left open (Section 1.5).

Attachment:

- Attachment - Persons Contacted and Exit Meeting

DETAILS

1 FOLLOWUP OF ENGINEERING ISSUES (92903)

1.1 (Open) Inspection Followup Item 298/9308-16: Licensee Unable to Justify Method of Dispositioning Valves Susceptible to Pressure Locking

Background

The licensee had hired an independent engineering group to conduct a susceptibility evaluation of the motor-operated valves to pressure locking and thermal binding. Evaluation Report R122-89-10.07, "Pressure Locking and Thermal Minding Susceptibility Evaluation," was completed in May 1993. The evaluation addressed all motor-operated valves contained in the Cooper Nuclear Station Generic Letter 89-10 motor-operated valve program. The evaluation indicated that 11 motor-operated valves were potentially susceptible to pressure locking and that 2 were potentially susceptible to thermal binding. The licensee reviewed these motor-operated valves and provided dispositions. Four motor-operated valves were considered to be not susceptible after further evaluation, 2 motor-operated valves were scheduled for modification during the 1994 outage, and 6 motor-operated valves were dispositioned through plant procedure changes.

The licensee had used plant operating records to demonstrate that certain motor-operated valves were not subject to pressure locking. The inspectors had expressed disagreement with this position, noting that the plant had not experienced several accident conditions under which the motor-operated valves would be most likely to become pressure locked. Eighteen motor-operated valves had been dispositioned as "not susceptible" using this approach.

Followup

After the previous inspection, the same independent engineering group that performed the original study reanalyzed the licensee's motor-operated valves for pressure locking and thermal binding. The results of this study were documented in a report entitled, "Cooper Nuclear Station Generic Letter 89-10 MOV Program Pressure Locking and Thermal Binding Update," dated November 14, 1994. This report identified 12 motor-operated valves as being susceptible to pressure locking and 2 motor-operated valves susceptible to thermal binding. In this study, the contractor did not use maintenance history as a principal criterion for determining susceptibility to pressure locking. However, the contractor report stated that maintenance history could be used in combination with an analytic technique to provide additional assurance of safety as long as the conditions under which the motor-operated valve was stroked were similar to those determined to represent the greatest potential for pressure locking and thermal binding. Also, the contractor recommended that the licensee use maintenance history as an "interim justification" for some of the motor-operated valves before modifications or calculations could be performed.

The results of the November 1994 study are summarized below.

Motor-Operated Valves Susceptible to Pressure Locking:

CS-MOV12A/B, Core Spray Inboard Injection

HPCI-MO19, High Pressure Coolant Injection

HPCI-MO58, High Pressure Coolant Injection Suppression Pool Suction

RCIC-MO21, Reactor Core Isolation Cooling Injection

RCIC-MO41, Reactor Core Isolation Cooling Injection Suppression Pool Suction

RHR-MO13A/B/C/D, Low Pressure Coolant Injection Suppression Pool Suction

RHR-MO16A/B, Residual Heat Removal Pump Minimum Flow Recirculation

Motor-Operated Valves Susceptible to Thermal Binding:

RHR-MO39A/B, Residual Heat Removal Suppression Pool Cooling

The report stated that interim justification for operability could be established for Valves HPCI-MO19, RCIC-MO21, RCIC-MO41, RHR-MO13A/B/C/D, and RHR-MO39A/B based on maintenance history under conditions similar to those representing the design scenario for pressure locking or thermal binding, as appropriate. The licensee intended to modify Valves CS-MO12A/B during the Fall 1995 refueling outage. The contractor concluded in the November 1994 report that, "once CS-MO12A/B is modified as planned, and the maintenance history is updated for the five aforementioned valve groups, only HPCI-MO58 and RHR-MO16A/B will lack interim justification." Since the time of the contractor's study, Valves RHR-MO16A/B had been changed from normally closed to normally open, thereby, resolving the pressure locking concern for these motor-operated valves. Valve HPCI-MO58 was later determined to be not susceptible to pressure locking, based on results of a special test and a thermal analysis.

The inspectors noted that the licensee had not formally evaluated the operability of the susceptible motor-operated valves following receipt of the contractor's November 1994 report. Condition Report 94-1124, issued to collate several motor-operated valve issues pertinent to startup following an extended 1994 outage, included a mention of the pressure locking and thermal binding concerns, but did not provide for a formal assessment of the operability implications.

Prior to the November 1994 report, the licensee had contracted a pressure locking analysis of Valves RHR-MO25A/B, RHR-MO18, and CS-MO12A/B (Calculation NEDC 93-049, Revision 0). For Valves CS-MO12A/B, this evaluation included a theoretical calculation of valve bonnet depressurization using the

psig (reactor pressure) to 462 psig, the point at which the valve was calculated to have sufficient capability to open, in 12.5 seconds. Since Valves CS-MO12A/B would not receive an open signal until at least 20 seconds following the accident, the calculation concluded that these motor-operated valves could perform their safety function. The inspectors expressed concern regarding the validity of the calculated depressurization because various industry test results suggested that valve bonnets typically depressurize at a much slower rate under the assumed conditions. Additionally, the calculation predicted that a bonnet pressure in excess of 500,000 psig would be required to create a hard pressure seal between the seat and the disc. This appeared counter-intuitive and not consistent with industry test results.

In response to the inspectors' concerns, the licensee performed Operability Determination 95-045, dated September 28, 1995. In this document, the licensee formally presented its basis for concluding that each of the susceptible motor-operated valves were capable of operating under pressure-locked or thermal-bound conditions, as applicable.

After a review of Operability Determination 95-045, the inspectors concluded that immediate operability concerns remained for only four valves, CS-MO12A/B, HPCI-MO19, and RCIC-MO21. A telephone conference between the licensee, headquarter's and regional staff was held at the conclusion of the onsite inspection, during which the following NRC concerns were expressed:

- The bonnet depressurization rate calculated for Valves CS-MO12A/B in Calculation NEDC 93-049 was inconsistent with various industry test results. A slower depressurization rate would result in the calculated incapability of the motor-operated valves to open.

- Operability Determination 95-045 assumed that Valves HPCI-MO19 and RCIC-MO21 would not experience a rapid depressurization in response to a small break loss-of-coolant accident. The inspectors questioned whether an intermediate break accident could present a mid-range reactor pressure against which the valves would need to open.

The licensee provided additional information on October 2, 1995, in a document entitled,"Basis for Operability CS-MOV-MO12A/B, HPCI-MOV-MO19, and RCIC-MOV-MO21." Additionally, a licensee contractor performed Calculation 95-176, dated October 2, 1995, that addressed the capability of Valves CS-MO12A/B, using the pressure locking analysis method developed by Entergy Operations, Inc. The contractor used actual measured parameters for Valve CS-MO12A as a basis to select a valve factor and stem friction coefficient in the new calculation. Test results for Valve CS-MO12B were not considered appropriate for the calculation because this motor-operated valve was tested in 1991 using diagnostic equipment that the licensee no longer uses and

considers unreliable (this motor-operated valve will be retested with the VOTES diagnostic testing system during the next refueling outage). The calculation predicted adequate thrust capability for Valves CS-MO12A/B to open when pressure locked, even if the valve bonnet pressure remained at the pre-accident value of 1040 psig. This calculation eliminated the bonnet depressurization assumptions as a basis for operability.

A conference call was conducted on October 3, 1995, among the licensee, Region IV, and NRC headquarters personnel to discuss additional questions related to the new information. The following four questions were presented to the licensee:

1. The licensee has assumed a stem friction coefficient of 0.1 based on static test data. The licensee indicates that the valve factor used in the calculation was derived from a dynamic test of a core spray valve. Does the licensee have a value for stem friction coefficient from the dynamic test? If not, how does the licensee account for load-sensitive behavior in the assumed stem-friction coefficient?

2. How was the static-unwedging load determined? Is diagnostic equipment uncertainty accounted for in the assumed unwedging load?

3. If a loss-of-coolant accident causes reactor pressure to fall rapidly below 450 psig, does this result in an operability concern for the core spray valves?

4. What is the effect of ambient temperature on the motor output capability?

A followup conference call was conducted October 4, 1995, during which the licensee addressed the four questions listed above. During this call, the licensee stated that even if the stem friction coefficient measured under dynamic conditions (0.13) were used in tandem with the measured dynamic valve factor (0.31), the motor-operated valves would most likely open if pressure locked (a very small torque capability deficit was calculated using this procedure). The inspectors concluded that the licensee had acceptably answered the four questions and had, thereby, satisfactorily demonstrated a basis for short-term operability of its Generic Letter 89-10 motor-operated valves with respect to pressure locking and thermal binding.

The licensee intended to modify Valves CS-MO12A/B, HPCI-MO19, and RCIC-MO21 during the Fall 1995 outage (scheduled to commence October 14, 1995) by drilling a small hole in the upstream valve disc. This modification will eliminate the potential for pressure locking of these motor-operated valves. Other gate valves in the licensee's Generic Letter 89-10 program in addition to air- and hydraulic-operated valves will be assessed as part of the licensee's response to Generic Letter 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves."

Conclusion

The inspectors concluded that the licensee did not document an operability evaluation for the valves identified as being susceptible to pressure locking and thermal binding in a November 1994 contractor study. Rather, the licensee used an informal basis to consider the valves acceptable for an interim period. In addition, the inspectors determined that the licensee's September 28, 1995 operability evaluation depended upon a 1993 engineering calculation, which estimated a valve bonnet depressurization rate that was inconsistent with test results conducted at many nuclear plants. The licensee stated that valves CS-M012A/B would be tested during the next refueling outage. The inspectors will review these test results to evaluate assumptions in the licensee's pressure locking calculations and will further evaluate assumptions related to bonnet depressurization in a future inspection. The failure to formally document an operability evaluation and the adequacy of the September 28, 1995 engineering evaluation was identified as an unresolved item pending completion of this review (298/9513-01). The licensee aggressively pursued these concerns and on October 2, 1995, demonstrated short term operability by performing an engineering analysis of the valves' ability to close using the most recent pressure-locking analysis methodology available in the industry.

1.2 (Closed) Violation 50-298/9318-02: Design Change Involved Unreviewed Safety Issue

Background

The licensee approved Design Change 90-226, which modified a drywell ventilation Radiation Monitor RMV-RM-4. The change, which was not implemented at the time, would have replaced a radiation monitor rated at 58 psig with a monitor rated at 2 psig. The licensee's safety review pursuant to 10 CFR 50.59 addressed the fact that the new monitor would be nonfunctional during an accident, but failed to properly address and provide mitigation for the fact that the failed monitor would provide a radioactive material release path. Although the release path was recognized by those performing the modification package, this fact was not communicated to all interested parties and no actions were taken to prevent or mitigate the consequences of the offsite release. The inspectors identified this as an unreviewed safety question.

Followup

The licensee generated Amendment 2 to Design Change DC 90-226, which installed testable primary containment isolation valve islands on both the sample and return lines for Monitor RMV-RM-4. The motor-operated valves were designed to close on a "Group 2" isolation signal to block a radioactive material release path from the failed monitor.

The licensee took additional corrective actions to lessen the likelihood of a recurrence of this violation. Specifically, Engineering Procedure 3.4.6 was revised to include a 10 CFR Part 50, Appendix J, checklist which would ensure that appropriate people review all design changes against Appendix J criteria.

An Appendix J signoff was placed on the design change cover sheet to provide additional assurance of an adequate review. In addition, the licensee provided training to appropriate engineering personnel on 10 CFR Part 50, Appendix J, criteria and the applicability to Cooper.

The inspectors reviewed the procedural changes and records of the training conducted on this topic.

Conclusion

The inspectors concluded that the licensee had taken actions sufficient to correct this deficiency and to prevent a similar discrepancy from occurring in the future.

1.3 (Closed) Violation 50-298/9427-01: Failure to Establish Design Life of Energized Relays

Background

This violation involved a failure to adequately review and incorporate industry information related to the design life of continuously energized Agastat relays. NRC Information Notice 94-20 had alerted the industry to manufacturer information which identified that the design life for certain Agastat relays in continuously energized applications was lower than that published for intermittent-duty applications. In Condition Report CR 94-0709, the licensee responded to Information Notice 94-20 and replaced or reviewed the adequacy of 32 energized Agastat relays prior to startup. However, for the long term, the licensee had failed to establish a relay replacement frequency incorporating a design life appropriate for the application.

Followup

The inspectors reviewed the licensee's preventative maintenance index sheets and found that the maintenance department had established preventative maintenance activities for replacement of essential (nonenvironmentally qualified, but safety-related) relays. The inspectors reviewed the preventative maintenance activities, which had been revised by the licensee for the 32 energized Agastat relays. The scheduled relay replacement frequency was consistent with published industry information and with the design life limits determined in the engineering disposition of Condition Report 94-0709.

As a result of this review, the inspectors noted that engineering had not routinely evaluated and specified the design life of electrical components. The licensee confirmed that engineering did not routinely specify the design life for nonenvironmentally qualified electrical components. Rather, the maintenance department determined the replacement frequency for life-limited components from vendor manuals or by case-by-case technical evaluations of vendor information, such as that documented in Condition Report 94-0709. The inspectors considered the lack of ownership by engineering of component design

life specifications to be a weakness in the design control of essential electrical equipment. The licensee acknowledged the inspectors' concern and confirmed their intent to implement a review of the adequacy of their engineering control and documentation of the design life of safety-related electrical components. This was identified as an inspection followup item (50-298/9513-02).

The inspectors found that the licensee had implemented a extensive program to improve their review of operational events. The inspectors reviewed licensee documentation of the development and implementation of their revised program.

Conclusion

In response to the original concern, the inspectors concluded that the licensee had incorporated the appropriate design life of energized electrical relays as the basis for replacement. In addition, the inspectors noted that the licensee had taken sufficient actions to correct the deficiency in their review of operational events and to prevent a similar discrepancy from occurring in the future. The inspectors also noted a weakness concerning the lack of engineering involvement in the control and documentation of the design life of safety-related electrical components.

1.4 (Closed) Violation 50-298/9414-01: Inadequate Flow Diagrams

Background

This violation involved a failure to follow Engineering Procedure 3.8, "Drawing Control Procedure," Revision 7, which required that safety-related drawings be identified on a safety-related drawing list. Flow Diagram 2028, "Reactor Building and Drywell Equipment Drain System," Revision N27, identified safety-related containment isolation valves for containment penetrations; however, Flow Diagram 2028 was not identified on the list of safety-related drawings. The inspectors identified that the following five safety-related motor-operated valves were not identified on Flow Diagram 2028, "Reactor Building and Drywell Equipment Drain System":

Valve NBI-502	Manual containment isolation valve for the air-to-vessel flange leak off detection air-operated valve
Valve MS-900	Manual containment isolation valve for the air-to-reactor vessel head vent
Valve MS-501	Manual containment isolation valve for the air-to-vessel flange leakoff detection air-operated valve
Valve MS-899	Manual containment isolation valve for the air-to-vessel head vent

Valve (unlabeled) Vent isolation valve downstream of valve RW-254

Followup

The licensee identified that the procedural requirement to maintain the safety-related drawing list was an earlier administrative control associated with controlling the as-built configuration of the plant. Subsequent programs for revalidation of the as-built configuration were considered by the licensee to supersede the earlier administrative control. Consequently the licensee deleted the procedural requirement to identify safety-related systems and components on the safety-related drawing list.

The licensee revised Flow Diagram 2028 to delete the one unlabeled valve to reflect the as-built configuration (This valve had been removed by a modification). In addition, the licensee identified that the four other valves were appropriately identified on other drawings and were not appropriate to be shown on Flow Diagram 2028.

The inspectors reviewed Flow Diagram 2028, Revision N34, and found that the drawing had been revised to delete the unlabeled valve downstream of Valve RW-254. Through discussions with licensee personnel, the inspectors determined that the other four valves were instrument-air valves identified on other drawings, listed in the equipment data files, and controlled by operating procedures.

Conclusion

The inspectors concluded that the licensee had taken actions sufficient to correct this deficiency and to prevent a similar discrepancy from occurring in the future.

1.5 (Open) Followup Item 50-298/9414-03: Operational Failure of Valve RHR-MOV-MO 16B

Background

This inspection followup item involved a failure of Valve RHR-MOV-MO16B to close during operation on May 26, 1994. Valve RHR-MOV-MO16B was the minimum flow valve for the Train B residual heat removal pump, connecting the pump discharge to the torus. The failure to completely close resulted in a water hammer in the shutdown cooling suction line and spurious isolation of shutdown cooling. At the time of the original NRC inspection, the licensee was conducting a review of the event to determine the root cause of the failure. The licensee reported the event in Licensee Event Report 94-10.

Followup

The licensee completed their review of the May 1994 operational failure of Valve RHR-MOV-M016B. The inspectors reviewed Condition Report 94-0198, which documented the licensee's review. The licensee determined that the root cause of the failure was debris in the actuator limit switch compartment resulting from a lack of cleanliness control during maintenance activities. The licensee concluded that, prior to the operational failure, foreign particles accumulated between the contacts of the closing torque switch while the contacts were open with the valve in a closed position. When the motor-operated valve was subsequently stroked open allowing the torque switch to close, the debris insulated the torque switch contacts leaving the closing circuit open. At the time, this condition went undetected because it did not affect the opening function of the valve. When the motor-operated valve subsequently failed to completely close on May 26, 1994, the open circuit was identified. Valve travel stopped at approximately 97 percent closed at the same time closed indication was received. The licensee implemented corrective actions to improve maintenance personnel awareness of the high degree of cleanliness required and the existing procedural controls for exclusion of foreign material during motor-operated valve maintenance. The inspectors reviewed the revised maintenance procedures and found the changes to be adequate.

The inspectors noted that the adequacy of the motor-operated valve control logic and the closing torque switch setting were not addressed in the licensee's review. Although the motor-operated valve was normally torque seated, the licensee's review had identified that the closing control logic for the valve included a limit switch (LS8), which bypassed the torque switch for 97 percent of the closing stroke. The inspectors were concerned that the torque switch setting may not have been adequate for the differential pressure conditions existing at the time the bypass limit switch opened. Also, inaccurate position indication appeared to allow the partially open valve condition to remain undetected. The inspectors were concerned that the design control logic may incorporate common limit switches for both position indication and motor control.

Conclusion

The inspectors concluded that the licensee had taken actions sufficient to correct the previous weakness in the control of cleanliness during maintenance activities. This item will remain open pending review of the adequacy of the torque switch setting and control logic used for Valve RHR-MOV-M016B and other valves, if any, that are similarly configured.

ATTACHMENT

1 PERSONS CONTACTED

*M. Bennett, Nuclear Licensing and Safety Manager
*M. Boyce, Engineering Support Manager
*S. Freeborg, Maintenance Engineering Supervisor
*J. Gausman, Plant Engineering Manager
*R. Godley, Nuclear Licensing and Safety Manager
*P. Graham, Division Manager of Engineering
D. Madsen, Licensing
J. Mueller, Site Manager
M. Tumicki, Motor-Operated Valve Program Engineer

In addition to the personnel listed above, the inspectors contacted other licensee personnel during this inspection period.

* Denotes personnel attending the telephone exit on October 4, 1995.

2 EXIT MEETING

An exit meeting was conducted by telephone on October 4, 1995. During this call, the inspectors reviewed the scope and findings of this report. The licensee did not express a position on the inspection findings documented in this report. The licensee did not identify as proprietary any information provided to, or reviewed by, the inspectors.