U.S. NUCLEAR REGULATORY COMMISSION

REGION III

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License Nos:	DPR-58; DPR-74
Report No:	50-315/99011(DRS); 50-316/99011(DRS)
Licensee:	Indiana and Michigan Power 500 Circle Drive Buchanan, MI 49107-1395
Facility:	Donald C. Cook Nuclear Generating Plant
Location:	1 Cook Place Bridgman, MI 49106
Dates:	April 26 through April 30, 1999
Inspector:	T. Tella, Reactor Engineer
Approved by:	R. Gardner, Chief Electrical Engineering Branch Division of Reactor Safety

EXECUTIVE SUMMARY

D. C. Cook Units 1 and 2
NRC Inspection Report 50-315/99011(DRS); 50-316/99011(DRS)

Engineering

- The root cause investigations for the electrical faults associated with motor control centers 2-AM-B and 12-TSC-S were promptly initiated. At the end of the inspection, the findings indicated that a contributing cause for the electrical fault in motor control center 2-AM-B was excessive dirt and dust due to inadequate cleaning; and that the electrical fault in motor control center 12-TSC-S was caused by a random age-related failure of the control power transformer. (Section E2.1)

- There was reasonable assurance that the electrical distribution systems necessary for cold shutdown plant operation were capable of performing their function. (Section E2.2)

- The operability basis for operability evaluations concerning the use of Anderol 732 to address circuit breaker hardened grease concerns did not have a sound technical basis. (Section E2.2)

- The planned long-term engineering-related corrective actions to address the motor control center failures were thorough and comprehensive. However, a number of breakers were not appropriately prioritized for refurbishment. (Section E2.3)

Report Details

On April 19, 1999, with D.C. Cook Units 1 and 2 in cold shutdown, Unit 2 600 Volt alternating current (Vac) motor control center (MCC) 2-AM-B experienced an electrical fault. Subsequently, on April 24, 1999, 600 Vac MCC 12-TSC-S also experienced an electrical fault.

In both cases, smoke was observed in the vicinity of the faulted MCCs, and fire alarms and other annunciator panel alarms were received. The fire brigade was dispatched to respond to these events, however no active fires were identified.

To review the engineering implications of these events, the inspector focused on the licensee's root cause investigation of the MCC failures, the operability of the electrical distribution systems required to support the current cold shutdown plant condition, and the licensee's engineering-related corrective actions.

III. Engineering

E2 Engineering Support of Facilities and Equipment

E2.1 Evaluation of Motor Control Center Failures

a. Inspection Scope (62705)

The inspector reviewed the licensee's root cause investigation efforts to assess the licensee's ability to identify the root cause(s) associated with the MCC failures which occurred on April 19 and April 24, 1999.

b. Observations and Findings

b.1 Review of Root Cause Investigation for Electrical Fault Associated With MCC 2-AM-B

On April 19, 1999, with D.C. Cook Units 1 and 2 in cold shutdown (Mode 5), an electrical fault in Unit 2 motor control center (MCC) 2-AM-B occurred. This fault affected the 600 Vac electrical distribution system and resulted in de-energizing various equipment, including both Unit 2 Containment Purge Exhaust Fans. Subsequent investigation identified that electrical components and structures in the vicinity of MCC 2-AM-B were severely damaged. In addition, the 2E Main Steam Valve Enclosure Space Heater Ventilation Fan motor experienced a phase-to-phase fault in the motor windings.

To address the electrical fault associated with MCC 2-AM-B, the licensee assembled a rapid event response team to conduct a root cause investigation and developed Engineering Action Plan 600AC-99-167. This plan consisted of elements which included quarantining of MCC 2-AM-B, completion of a root cause investigation and evaluation, inspection of the damage which occurred, a review of industry experience, and inspection of additional MCCs. The inspector conducted plant walkdowns, and assessed the scope and observed the progress of these efforts.

The inspector conducted plant walkdowns and visually inspected MCC 2-AM-B. In addition to the extensive damage to the MCC due to the fault, the MCC cabinet and bus bars were observed to be extremely dirty and dusty. The inspector also inspected adjacent MCC cabinets, which were also observed to be extremely dirty and dusty. These observations were consistent with those identified by the licensee during their root cause investigation.

The inspector reviewed the maintenance history of MCC 2-AM-B and determined that this MCC was last inspected and tested on December 18, 1996, although the vendor, Cutler-Hammer (Eaton), recommended that the MCC be inspected at least once a year. In addition, although the testing procedure for this MCC, 12IHP5030.EMP.006, "MCCB [Molded Case Circuit Breaker]/TOLR [Thermal Overload Relay] Testing and Electrical Enclosure Maintenance," Revision 4, dated September 22, 1998, included some cleaning of the MCC, this procedure did not prescribe a thorough cleaning of the MCC, MCC enclosure, and bus bars. In addition, a procedure which periodically accomplished a thorough cleaning of the MCC and associated bus bars did not exist. As a result, the MCC and bus bars had not been thoroughly cleaned since initial plant startup, about 27 years ago. These findings were consistent with those identified by the licensee during their root cause investigation.

The inspector also reviewed photographs of the failed MCC and the damaged 2E Main Steam Valve Enclosure Space Heater Ventilation Fan motor. The photographs of the MCC clearly indicated extensive damage to the MCC, its enclosure, and the associated bus bars. The photographs of the 2E Main Steam Valve Enclosure Space Heater Ventilation Fan motor indicated that the phase-to-phase fault in the motor winding was not extensive, which indicated that the motor winding fault might not be a cause for the MCC fault. This was confirmed by the fan motor vendor (Koontz-Wagner Electric Co. Inc) in a letter, dated April 29, 1999, which stated that the motor failure may have been caused by a voltage surge (fault) in the electrical distribution system.

At the end of the inspection, the rapid event response team had not issued a final root cause investigation report. However, licensee personnel indicated that the excessive dirt and dust identified in the MCC contributed significantly to the failure. Based upon the information identified by the rapid event response team and independently verified by the inspector, the inspector concluded that the determinations by the rapid event response team had a technically sound basis.

b.2 Review of Root Cause Investigation for Electrical Fault Associated With 12-TSC-S

Following the April 19 electrical fault in MCC 2-AM-B, on April 24, 1999, an electrical fault associated with MCC 12-TSC-S occurred. This fault also affected the 600 Vac electrical distribution system and resulted in a loss of air conditioning in the TSC, TSC battery room, and the Shift Supervisor's complex. However, for this event, the extent of damage to the MCC was limited to a control power transformer.

To address the electrical fault associated with MCC 12-TSC-S and the potential trend with MCC failures, the licensee assembled a rapid event response team and conducted a root cause investigation. The inspector conducted plant walkdowns, and assessed the scope and observed the progress of these review efforts.

The inspector conducted plant walkdowns and visually examined MCC 12-TSC-S, including the control power transformer. In this case, the damage was limited to the immediate vicinity of the control power transformer. The inspector reviewed the maintenance history of MCC 12-TSC-S and determined that this MCC was last inspected and tested on July 12, 1996 using Procedure 12IHP5030.EMP.006. The rapid event response team also identified that a 100 ampere feeder breaker tripped prematurely. The licensee replaced both the MCC and the feeder breaker.

At the end of the inspection, the rapid event response team had not issued a final root cause investigation report. However, based on testing of the control power transformer, the rapid event response team concluded that the failure mechanism for this MCC did not involve dirt and dust, but was due to a random age-related failure of the control power transformer.

Based upon the information identified by the rapid event response team and independently verified by the inspector, the inspector concluded that the determinations by the team for this MCC failure also had a technically sound basis, and that the two MCC failures were caused by different failure mechanisms.

c. Conclusions

The inspector concluded that the root cause investigations for the electrical faults associated with motor control centers 2-AM-B and 12-TSC-S were promptly initiated. At the end of this inspection, the findings indicated that a contributing cause for the electrical fault in motor control center 2-AM-B was excessive dirt and dust due to inadequate cleaning; and that the electrical fault in motor control center 12-TSC-S was caused by a random age-related failure of the control power transformer.

E2.2 Electrical Distribution System Operability

a. Inspection Scope (37550)

The inspector assessed the reliability of the 4 kV and 600 Vac electrical distribution systems required for cold shutdown operation, and reviewed operability evaluations concerning the use of the solvent/lubricant Anderol 732 to address circuit breaker hardened grease concerns.

b. Observations and Findings

The inspector reviewed the breaker configurations required for cold shutdown operation with licensee personnel and concluded that for Unit 1, a total of 22 4 kV breakers were required for cold shutdown operation. A review of the maintenance history for these breakers revealed that 11 of the 22 breakers had never been refurbished since initial installation 27 years ago, although the breaker vendor, Asea Brown Boveri, recommended that these breakers be completely refurbished at a 10-year maximum interval. Similarly, Unit 2 also required 22 4 kV breakers to support cold shutdown operation, of which 15 breakers had never been refurbished. The inspector also reviewed the maintenance history of 600 Vac breakers and identified that of the 199 circuit breakers installed in the plant, about 72 percent had never been refurbished.

During the inspection, the inspector also reviewed a number of operability evaluations which were performed to determine the continued operability of several electrical breakers where the solvent/lubricant Anderol 732 was used to address potential hardened grease concerns. In particular, Operability Evaluation 91-18-ODE-129, "Various Metal Clad Breakers, Anderol 732 Applied to Them and Never Were Refurbished," dated April 1, 1999, evaluated 59 safety-related 4 kV breakers following the determination that Anderal 732 was used as a lubricant on these breakers as a measure to ease sluggish operation due to grease hardening. In a letter to D.C. Cook, dated May 11, 1990, Asea Brown Boveri stated that when Anderol 732 was used to clean the breakers and allowed to dry, it also acted as a temporary lubricant. The letter also stated that the circuit breaker must be cleaned and re-lubricated during the next regularly scheduled maintenance activity.

The inspector reviewed this operability evaluation and determined that the conclusions did not have sound technical basis since it assumed that these breakers could be safely operated for an additional 3 years following the application of Anderol 732. In particular, the 3 year period discussed in the operability evaluation was based on the vendor manual which stated that the maintenance schedule should be between 1 and 3 years. However, the inspector identified that this statement assumed that all required maintenance was performed at the recommended frequencies which included:

- Circuit breaker exercising every 12-18 months;
- Racking mechanism exercising every 12-18 months;
- Primary interface connection inspections every 12-18 months and;
- Full circuit breaker refurbishment every 10 years.

However, as discussed above, since full refurbishment every 10 years had not been consistently accomplished, the inspector concluded that the operability basis in the operability evaluation was not well-justified.

Additionally, through a review of circuit breaker maintenance history, the inspector determined that all scheduled maintenance had been performed on circuit breakers required for cold shutdown operation and that the failure rate of the 4 kV and 600 Vac breakers during routine surveillance testing was not excessive.

Therefore, since the simultaneous failure of breakers in both divisions was considered remote, all scheduled circuit breaker maintenance had been performed, surveillance testing results were acceptable, and the licensee planned to expeditiously refurbish circuit breakers with an emphasis on those breakers required for cold shutdown operation, the inspector concluded that there was reasonable assurance that the 4 kV and 600 Vac electrical distribution systems were capable of performing their function until the breakers were refurbished.

c. Conclusions

The inspector concluded that there was reasonable assurance that the electrical distribution systems necessary for cold shutdown plant operation were capable of performing their function until the breakers were refurbished. However, the inspector determined that the operability basis for operability evaluations concerning the use of

Anderol 732 to address circuit breaker hardened grease concerns did not have a sound technical basis.

E2.3 Assessment of Corrective Actions

a. Inspection Scope (40500)

The inspector reviewed the licensee's engineering-related corrective actions in response to the MCC failures and 4kV breaker refurbishment issues.

b. Observations and Findings

To address the MCC failures, the licensee planned to complete the following corrective actions prior to plant restart:

- Refurbish all 4 kV circuit breakers.
- Refurbish all 600 Vac safety-related breakers which had not been refurbished within the last 10 years.
- Thoroughly clean all safety-related and nonsafety-related motor control centers, cubicles, and bus bars.

The inspector reviewed the licensee's planned long-term corrective actions and concluded that these actions were thorough and comprehensive. The inspector identified that although the licensee had begun to develop a prioritized list of 4 kV and 600 Vac breakers for refurbishment, the current cold shutdown plant condition was not factored into this determination. As a result, the inspector identified a number of breakers important for cold shutdown operation which were potentially susceptible to failure due to a lack of thorough cleaning which were not prioritized to receive refurbishment early in the refurbishment schedule. At the end of the inspection, the licensee was in the process of revising their refurbishment schedule to incorporate current plant mode considerations.

c. Conclusions

The inspector concluded that the licensee's planned long-term corrective actions were thorough and comprehensive. However, the inspector identified a number of breakers which were not appropriately prioritized for refurbishment.

V. Management Meetings

X1 Exit Meeting Summary

The inspector presented the inspection results to licensee management at the conclusion of the inspection on April 30, 1999. The licensee acknowledged the findings presented. The inspector asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

PARTIAL LIST OF PERSONS CONTACTED

J. Amamd, AEP ENP Engineer
J. Arias, Compliance Manager
C. Bakken, Site Vice President
R. Cash, AEP Maintenance
D. Cooper, Plant MOR Manager
D. Garner, Plant Eng. Mgr.
D. Kunsemiller, AEP Reg. Afffair Director
T. Quaica, Nuclear Safety Assessment
M. Rencheck, VP Nuclear Engineer

INSPECTION PROCEDURES USED

IP 37550:	Engineering & Technical Support
IP 62705:	Electrical Maintenance (Components and Systems), Observation of Work, Work Activities, and Review of Quality Records
IP 40500:	Effectiveness of Licensee Controls in Identifying, Resolving and Preventing Problems

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

None

Closed

None

Discussed

None

LIST OF ACRONYMS

ECAP	Electronic Corrective Action Program
kV	Kilovolts
MCC	Motor Control Center
MCCB	Molded Case Circuit Breaker
OE	Operability Evaluation
TOLR	Thermal Overload Relay
TSC	Technical Support Center
Vac	Volts Alternating Current

LIST OF DOCUMENTS REVIEWED

The following is a list of licensee documents reviewed during the inspection. Inclusion on this list does not imply that the NRC inspector reviewed the documents in their entirety, but rather that portions or selected portions of the documents were evaluated as part of the overall inspection effort. NRC acceptance of the documents or any portion thereof is not implied.

Electronic Corrective Action Program (ECAP) Documents

ECAP P-99-09394, "Electrical Fault on MCC 12-TSC-S," dated April 19, 1999
ECAP P-99-08620, "Electrical Fault on MCC 2-AM-B," dated April 19, 1999

Drawings

OP-1-12001-41, Revision 41, dated December 9, 1998
OP-1-12002-35, Revision 35, dated March 10, 1999
OP-2-12002-18, Revision 18, dated December 18, 1998
OP-2-12001-22, Revision 22, dated December 10, 1998

Operability Evaluations

OE 91-18-ODE-119, "Breaker 1-T11D1 May Have Had Anderol 732 Lubricant," dated March 26, 1999

OE 91-18-ODE-120, "Unit 2, 2-T21-A12 Breaker Was Refurbished with Improper Lubricant Anderol 732," dated March 11, 1999

OE 91-18-ODE-129, "Various Metal Clad Breakers, Anderol 732 Applied to Them and Never Were Refurbished," dated April 1, 1999

Procedures

12IHP5030.EMP.006, "MCCB [Molded Case Circuit Breaker]/TOLR [Thermal Overload Relay] Testing and Electrical Enclosure Maintenance," Revision 4, dated September 22, 1998

12IHP5021.EMP.012, "ITE 4KV Circuit Breaker Maintenance," Revision 3, dated September 25, 1998

Other

Engineering Action Plan 600AC-99-167, "MCC 2-AM-B Phase to Phase Short," dated April 26, 1999 Vendor Manual, "ITE Metal-Clad Medium Voltage Power Switchgear, Installation/Maintenance Instructions, Type 5HK, 7.5 HK, and 15 HK"