

U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket Nos: 50-454; 50-455  
License Nos: NPF-37; NPF-66

Report No: 50-454/99001(DRS); 50-455/99001(DRS)

Licensee: Commonwealth Edison Company

Facility: Byron Nuclear Power Station, Units 1 and 2

Location: 4448 N. German Church Road  
Byron, IL 61010

Inspection Dates: January 19-22, 1999

Inspector: Tirupataiah Tella, Reactor Engineer

Approved by: R. N. Gardner, Chief  
Engineering Specialist's Branch 2  
Division of Reactor Safety

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## EXECUTIVE SUMMARY

Byron Nuclear Power Station, Units 1 and 2  
NRC Inspection Report 50-454/99001(DRS); 50-455/99001(DRS)

The purpose of this inspection was to verify the adequacy of licensee programs, procedures, equipment and supporting documentation for the maintenance of medium voltage and low voltage circuit breakers. The following observations were made:

- The maintenance work on medium and low voltage breakers was being performed satisfactorily. However, a deficiency observed during maintenance, "hardened grease" was not documented in the work request. (Section M2.2)
- The lack of adequate maintenance history, both at the plant and from the vendor refurbishment reports, makes breaker performance and failure trending difficult. Most of the Safety-Related 4.1kV breakers and about 43% of safety related 480 Volt breakers at Byron had not been refurbished after 20 years. (Section M3.1)
- The licensee's recent self-assessment report identified a number of good breaker maintenance issues. However, some issues such as weaknesses in the documentation of breaker maintenance history and failure to translate breaker design (seismic qualification) criteria into plant procedures were not addressed. (Section M7.1)
- Calculations for supporting the minimum close and trip coil voltages were adequately prepared. However, a non-conservative error was noted in the calculation for the EDG 2A breaker. There was a need to re-review the calculations for other critical breakers. (Section E2.1)
- Adequate measures were not taken to translate the design data, regarding controls on the removal of 480 Volt breakers from their cabinets (without affecting the seismic qualification of the remaining safety related breakers) into applicable plant procedures. The licensee initiated prompt corrective actions to address this issue. (Section E2.2)
- The knowledge and performance of the electrical maintenance staff in the area of electrical circuit breakers was good. (Section M4)

## Report Details

### II. Maintenance

#### **M1 Conduct of Maintenance**

The primary focus of the inspection was to verify the licensee's program and procedures regarding proper maintenance of electrical power circuit breakers at the Byron Generating Station, Units 1 and 2.

##### M1.1 General Comments

The inspector reviewed maintenance records, surveillances, and corrective work requests for selected 4.1kV and 480 Volt electrical circuit breakers. The inspector observed maintenance work being performed. The inspector also reviewed the licensee's follow-up actions for vendor technical bulletins, industry communications and NRC Information Notices regarding electrical circuit breakers.

#### **M2 Maintenance and Material Conditions of Facilities and Equipment**

##### M2.1 Walkdown of Switchgear Areas

###### a. Inspection Scope

The inspector walked down selected switchgear areas.

###### b. Observations and Findings

The inspector walked down selected switchgear areas. The inspector also inspected the inside of two cubicles to verify condition of the cubicles, the breaker and the visible wiring connections. The areas inspected were generally clean. No loose objects or loose connections were noticed.

###### c. Conclusion

The inspector concluded the material condition of the areas toured was good.

##### M2.2 Observation of Maintenance Work

###### a. Inspection Scope

The inspector observed ongoing maintenance work on electrical circuit breakers.

###### b. Observations and Findings

The inspector observed ongoing maintenance work on two breakers. The first was replacement reactor trip breaker No. 1RD05E-2C. This breaker was to replace a

breaker which failed during a surveillance test. The breaker being replaced was previously refurbished by Westinghouse. The root cause for the failure of this breaker was not known at the conclusion of this inspection. This breaker was being prepared for shipment to Westinghouse for further inspection and repair.

The inspector also observed the surveillance of "UAT 141-2 Feed Breaker to 4.16 kV Bus 144" performed under Work Request No. 960077750-01. This is an important non-safety related 3000 amps feed breaker. During the surveillance, the electricians found that the trip latch and cam were slow to move. The electricians informed the inspector that the mechanism was "gummed up". The electricians attempted to free the mechanism by application of light machine oil. The mechanism continued to perform in a sluggish manner on the second day. As the licensee did not have any spares for this breaker, and as this breaker was urgently needed to be returned to service, the licensee requested assistance of Westinghouse, the vendor.

A vendor's representative was available at the site on the third day. He informed the inspector that this breaker should have been sent for refurbishing, if a spare was available. The vendor representative cleaned some parts of the operating mechanism, and applied some more light machine oil to the mechanism. He informed the inspector that the application of the light machine oil was a temporary fix to release the mechanism. Subsequently, the breaker was tested satisfactorily.

The inspector also noticed that licensee technicians were dependent on the vendor representative for torque values for bolts on the operating mechanism. The inspector obtained a copy of the Corrective Work Request No. 990006541-01, used for repair of this breaker. The inspector noticed that the observed cause for the lock up of the trip latch mechanism, i.e., the "gum up" was not mentioned in the work documents.

During the exit meeting, the plant maintenance supervisor informed the inspector that a problem identification form (PIF) was written for the failure of this breaker. The inspector noted that the PIF was not mentioned in the work request.

c. Conclusion

The inspector concluded that the maintenance work on breakers was being performed satisfactorily. However, the inspector was concerned that a deficiency observed during maintenance, "gum up" or "hardened grease" was not documented in the work documents. The inspector considered the incomplete documentation of observations during maintenance a weakness.

### **M3 Maintenance Procedures and Documentation**

#### **M3.1 Review of Past Maintenance Work**

##### **a. Inspection Scope**

The inspector reviewed selected past maintenance work orders, surveillances, Problem Identification Forms (PIFs), and circuit breaker related action items.

##### **b. Observations and Findings**

The inspector reviewed selected past maintenance records, PIFs, and action requests. The inspector noted the following:

1. The maintenance records indicated several failures of safety related and non-safety related breakers during the last three years. An increasing trend was observed with the problems associated with reactor trip breakers. Several problems were also noted regarding refurbished breakers.
2. The minimum voltage tests were not performed on any 4.1 kV or most of the safety related 480 Volt breakers. These tests were performed on some of the 480 Volt non-safety related breakers. Several of these breakers tested did not meet the acceptance criteria of the voltage tests. The minimum voltage tests would help with the identification of breakers with sluggish operating mechanisms and/or presence of hardened grease.
3. Breaker response time tests were not performed on the Byron breakers.
4. The work requests did not document the serial numbers of breakers for some safety related breakers and most non-safety related breakers. The lack of a unique identification for each breaker will make the tracking of breaker performance history difficult. The licensee mentioned that they were developing a "Uniquely Tracked Commodities" (UTC) system for the breakers. But this system is not yet in place.
5. As mentioned in Section M.2.2, the inspector noted that the condition of the lubricant for the one breaker observed was not indicated in the work request.
6. The Westinghouse reports on Refurbishment of Breakers did not include the following:
  - (a) As found condition of lubricants in the breaker mechanisms.
  - (b) As found data for clearances of breaker parts. They were marked just as "Acceptable."

- (c) As found data for timing tests.
- (d) Reasons were not given for replacing some parts of the breakers.

The inspector noted that the Byron purchase order for refurbishment did not clearly delineate a requirement to document the "as-found" data in the refurbishment reports.

The inspector noticed that whenever a breaker failed to function, it was replaced with a refurbished breaker, and was sent for refurbishment. As noted above, the refurbishment report did not include "as-found" condition of the lubricant and details of worn out components. Trending of breaker failures and maintenance of adequate breaker histories is difficult without such data. The inspector considered the lack of adequate breaker refurbishment data a weakness.

The inspector also noted that the Byron breakers were about 20 years old and most of the 4.1 kV breakers and about 47 percent of the safety related 480 Volt breakers were not yet refurbished. Westinghouse did not provide any recommendations for periodicity of refurbishment for their breakers. However, the other breaker manufacturers, such as Asea Brown Boveri (ABB) and General Electric recommend that their breakers be refurbished once every 10 years.. The licensee's refurbishment schedule indicates that all safety related breakers will not be refurbished until 2002 and all the non safety-related breakers until 2004. By then, the breakers would be about 25 years old. In view of the general experience in the industry, and the breaker failure reports from other nuclear power plants, the inspector was concerned that the Byron circuit breakers could be subjected to potential problems such as hardened grease.

c. Conclusion

The inspector concluded that the maintenance work on breakers was satisfactory. However, lack of adequate maintenance history, both at the plant and from the vendor refurbishment reports, makes breaker performance and failure trending difficult. The inspector was also concerned that even after 20 years in service, all the safety related breakers were not yet refurbished.

**M4 Maintenance Staff Knowledge and Performance**

a. Scope of Inspection

The inspector interviewed several maintenance technicians and observed their work.

b. Observations and Findings

The inspector observed the maintenance of two breakers in the shop and informally interviewed several electricians involved with breaker maintenance. The electricians were knowledgeable and experienced in the maintenance of the breakers. Some of the

electrical maintenance staff participated in the user's group meetings and found that these meetings were useful in discussing the breaker problems.

c. Conclusion

The inspector concluded that the knowledge and performance of the maintenance staff in the area of breakers was good.

**M7 Quality Assurance in Maintenance Activities**

M7.1 Self-Assessment of Breakers

a. Inspection Scope

The inspector reviewed a self-assessment report issued in January 1999, conducted by the licensee's Corporate System and Component Engineering.

b. Observations and Findings

The inspector reviewed the "Braidwood/Byron Nuclear Power Stations, 1998 Circuit Breaker Assessment" report.

This assessment was conducted to evaluate the stations' breakers maintenance programs, based on NRC Temporary Instruction 2515/137 (Revision 1) and the recommendations of the INPO SOER 98-02. The assessment reviewed the station maintenance procedures compared to vendor and industry recommendations. The assessment also reviewed the licensee's follow-up actions for NRC Information Notices. The assessment concluded that breaker maintenance at Byron was strong, while improvements were needed in documentation associated with NRC INs and Bulletins; and incorporation of all relevant industry experience into the station's program.

While the self assessment identified a number of good issues such as the preventive maintenance tasks not being completed by the scheduled dates, it did not address some of the items identified in this report, such as, the breaker lubrication issues, the inadequate evaluation of breaker removal from cubicles without seismic evaluations, and lack of review of adequate control voltages at the breaker coils.

c. Conclusion

The inspector concluded that the breaker self assessment was good. However, a few issues such as breaker lubrication, seismic qualification and lack of review for adequate control voltage were not addressed in the report.

### III. Engineering

#### **E2 Engineering Support of Facilities and Equipment**

##### **E2.1 Circuit Breaker Control Power**

###### **a. Inspection Scope**

The inspector reviewed the licensee's calculations to determine whether satisfactory circuit breaker operation was assured at a minimum operating voltage as per design.

###### **b. Observations and Findings**

The inspector reviewed two sets of calculations for the minimum voltages available at the breaker coils for Emergency Diesel Generator (EDG) 2B Breaker and the Residual Heat Removal (RHR) Pump 1B Breaker.

The inspector noted that the Byron Loss Of Offsite Power (LOOP)/Loss Of Coolant Accident (LOCA) calculations indicated the voltages available at the nearest buses. Additional calculations were needed to verify the voltage drops from the buses to the breaker coils. The inspector noted that at least 90 Vdc was available at each of the breaker close coils, which was acceptable.

During this review, the minimum voltage calculation for EDG 2A Breaker was also reviewed by the plant engineers. During this review, it was discovered that Calculation No. 19-AQ-43 (Revision 2) did not include a 75 feet length of control cable from the switchgear to the HACR Relay Cabinet. This resulted in a non-conservative estimate of the coil voltage. However, the revised calculated voltage at the breaker close coil was more than 90 Vdc and was acceptable. The licensee issued PIF No. B1999-00211, to address this finding. The PIF also stated that three EDG breakers were potentially affected by this discovery.

The inspector was concerned that the calculated voltages for several breaker coils were close to the minimum design voltage of 90 Vdc, and in view of the non-conservative error identified in one calculation, there was a need to re-review the minimum voltage calculations for the other critical breakers. Pending further review of the voltage calculations by the licensee and the NRC, this item is considered an Inspection Follow-up Item (IFI Nos. 50-454/99001-01(DRS); 50-455/99001-01(DRS)).

###### **c. Conclusion**

The inspector concluded that adequate calculations for supporting the minimum close and trip coil voltages were prepared. However, one non-conservative error was noted in the calculation for the EDG 2A breaker. There was a need to re-review the calculations for other critical breakers.



## E2.2 Seismic Qualification of Power Circuit Breakers

### a. Inspection Scope

The inspector reviewed the licensee's actions to maintain seismic qualification of safety related circuit breakers, when some breakers were completely removed from the cabinets.

### b. Observations and Findings

NRC issued Information Notice No. 97-53 on July 18, 1997, regarding circuit breakers left racked out in non-seismically qualified positions. The Information Notice stated: "It should be noted that removal of the circuit breaker from the switchgear will result in mass redistribution of the switchgear. Mass redistribution of the switchgear may then change the frequency of the switchgear and its dynamic response during a seismic event and may invalidate the original seismic qualification of the switchgear. Therefore, the situation must be evaluated to ensure that the removal of the circuit breaker will not invalidate the original seismic qualification of the switchgear."

The inspector inquired whether the licensee had evaluated the effect of the removal of some circuit breakers from their cabinets on the operability of the remaining safety related breakers in the cabinet. The licensee produced a letter from Westinghouse Electric Corporation, No. RRS/DSE (97)-547 (Revision 1) dated November 10, 1997, that addressed the evaluation for the removal of 480 Volt DS type switchgear in safety related applications. The conclusions were: "ComEd may remove up to 25% of the breakers without invalidating the existing seismic qualification of the switchgear regardless of the breaker locations in the switchgear cells; or, ComEd may remove up to 40% of the breakers without invalidating the seismic qualification of the switchgear provided that the removed breakers are randomly selected and no more than one half of the removed breakers are from the same elevation." This letter remained with the Byron site component engineer since November 1997, and was neither incorporated into the plant procedures, nor was any training provided to the plant personnel on the limitations of breaker removal.

The licensee committed in their UFSAR for Byron to comply with the NRC Regulatory Guide 1.29, "Seismic Design Classification," and IEEE 344-1971, "Recommended Practices for Seismic Qualification of Class IE Equipment for Nuclear Power Generating Station." The Regulatory Guide 1.29 (Revision 3) states that Class IE electrical equipments are designated as Seismic Category I and should be designed to withstand the effects of the Safe Shutdown Earthquake (SSE) and remain functional.

The licensee failed to incorporate the design basis data, available from Westinghouse since November 1997, regarding seismic qualification of safety related (Class IE) 480 Volt power circuit breakers (when some adjacent breakers were removed) into plant procedures up to January 21, 1999. This failure constitutes a violation of minor significance and is not subject to formal enforcement action.

The licensee promptly issued maintenance memo No. 1100-05 regarding the removal of 480 Volt circuit breakers. The licensee also issued Action Item No. 454-100-99-00100 to incorporate the maintenance memo 1100-05 into the breaker maintenance procedures.

The inspector also inquired about the qualification of 4.1 kV safety related circuit breakers when such breakers were removed from adjacent cubicles in the same cabinet. Subsequent to the inspection, the licensee provided documentation to demonstrate that the seismic qualification of 4.1 kV breakers were not effected by the removal of up to 16 similar breakers from adjacent cabinets.

c. Conclusions

The inspector concluded that adequate measures were not taken to translate the design data, regarding controls on the removal of 480 Volt power circuit breakers from their cabinets (without affecting the seismic qualification of the remaining safety related breakers) into applicable plant procedures. The licensee initiated prompt corrective actions to address this issue.

## V. Management Meetings

### **X1 Exit Meeting Summary**

On January 22, 1999, the inspection results were presented to the licensee management. The licensee acknowledged the findings presented. The licensee did not identify any material provided to the inspector during the inspection as proprietary.

## PARTIAL LIST OF PERSONS CONTACTED

### Licensee

W. Levis, Station Manager  
B. Adams, Regulatory Assurance Manager  
R. Colglazier, NRC Coordinator  
R. Crosby, Component Specialist  
D. Dillinger, OPEX Coordinator  
P. Donavon, Design Engineering Manager  
D. Goldsmith, Corporate System/Component Engineer  
A. Javorik, Manager, Corporate System/Component Engineering  
P. Johnson, Maintenance Manager  
J. Kroger, Electrical Maintenance Supervisor  
W. Kouba, Site Engineering Manager  
J. Lafontaine, Electrical Maintenance Superintendent  
P. McHale, Westinghouse Engineering Manager  
J. Schroeder, Electrical Maintenance Planner  
T. Schuster, Work Control Manager  
W. Vargas, Corporate Component Engineer.

### NRC

E. Cobey, Senior Resident Inspector

The above persons were present at the January 22, 1999, exit meeting.

## INSPECTION PROCEDURES USED

Sections of the following Inspection Procedures (IPs) were used for this inspection:

|          |  |
|----------|--|
| IP 37550 | Engineering  |
| IP 40500 | Effectiveness of Licensee Controls in Identifying, Resolving and Presenting Problems |
| IP 61700 | Surveillance Procedures and Records  |
| IP 62703 | Maintenance Observation  |

## ITEMS OPENED, CLOSED AND DISCUSSED

### Items Opened

|                     |     |  |
|---------------------|-----|--|
| 50-454/455-99001-01 | IFI | Calculations for Minimum Close and Trip Coils for Critical Circuit Breakers Need a Re-Review |
|---------------------|-----|--|

## LIST OF ACRONYMS USED

|       |   |
|-------|---|
| AC    | Alternating current                               |
| ABB   | Asea Brown Boveri                                 |
| CFR   | Code of Federal Regulations                       |
| DC    | Direct Current                                    |
| DRS   | Division of Reactor Safety                        |
| EDG   | Emergency Diesel Generators                       |
| EPRI  | Electric Power Research Institute                 |
| IEEE  | Institute of Electrical and Electronics Engineers |
| IFI   | Inspection Follow-up Item                         |
| IN    | Information Notice                                |
| INPO  | Institute of Nuclear Power Operation              |
| kV    | kilo Volts  |
| LOCA  | Loss of Coolant Accident                          |
| LOOP  | Loss of Offsite Power                             |
| MR    | Maintenance Rule                                  |
| NRC   | Nuclear Regulatory Commission                     |
| PIF   | Problem Identification Form                       |
| PM    | Preventive Maintenance                            |
| QA    | Quality Assurance                                 |
| OPEX  | Operating Experience Coordinator                  |
| RHR   | Residual Heat Removal                             |
| SOER  | Safety Operations Evaluation Report               |
| SSE   | Safe Shutdown Earthquake                          |
| TI    | Temporary Instruction                             |
| UFSAR | Updated Safety Analysis Report                    |
| UTC   | Uniquely Tracked Commodities                      |
| Vac   | Voltage in alternating current                    |
| Vdc   | Voltage in direct current                         |
| VTIP  | Vendor Technical Information Program              |
| VIO   | Violation   |
| WR    | Work Request                                      |

## PARTIAL LIST OF DOCUMENTS REVIEWED

### Westinghouse Technical Bulletins

ESBU-TB-96-05-R0  
ESBU-TB-97-04  
NSD-TB-91-06-R0  
NSD-TB-92-04-R0  
NSAL-93-020  
NSAL-94-024

### NRC Information Notices

IN 90-041,  
IN 95-19  
IN 96-44  
IN 96-50  
IN 97-053  
IN 98-03

### Byron Problem Identification Forms

B1998: 03511, 05357, 03159, 02811, 02739, 02561, 02440, 02022, 01631

### Byron Work Requests

960030869-01  
980101809-01  
980103612-01  
980111676-01  
980136008-01

### Byron Surveillances

1. 0/1/2 BHS AP-2 per WR#960080197-01 (1/14/99)
2. 0/1/2 BHS AP-1 (Revision 4) per WR#960070263-01 (1/16/99)