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Clinton Power Station
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Wayne D. Romberg
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Public

ILLINOIS POWER
An Illinova Company

U-602803
4F.190

August 1, 1997

PRIORITY ROUTING

First		Second	
RA		RC	
DRA		EIC	
DRP		SGA	
DRS		OI	
DNMS		PAO	
DRMA			

FILE

Docket No. 50-461

Mr. A. Bill Beach
Regional Administrator, Region III
U. S. Nuclear Regulatory Commission
801 Warrenville Road
Lisle, Illinois 60532-4351

Subject: Update on Westinghouse 4160-Volt Circuit Breakers at Clinton Power Station

Dear Mr. Beach:

This letter is an update to previous letters providing rationale that our safety-related circuit breakers will continue to meet operational requirements in light of the recent problems we have identified with Westinghouse 4160-volt circuit breakers at Clinton Power Station. These problems were originally detailed in Illinois Power letter U-602799 dated July 25, 1997. The impact on circuit breaker operability from each of these problems is discussed below.

This letter contains the following commitments.

- Drawings for the undervoltage relay seal-in circuit will be revised to clearly show the removal of the internal jumper for the seal-in circuit. This will be completed by August 30, 1997.

- Maintenance and vendor personnel will review the Westinghouse circuit breaker vendor maintenance instructions against plant procedures for consistency. This will be completed prior to startup from the current outage.

- Maintenance procedures that perform maintenance on ABB 480-volt and General electric 4160-volt circuit breakers will be reviewed for consistency with the vendor instructions. This will completed by August 30, 1997.

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- A sample of electrical, mechanical, and control and instrumentation procedures will be reviewed for conformance with vendor instructions. This will be completed by August 1, 1998.

- Westinghouse 4160-volt safety-related circuit breakers will be inspected after switching operations to ensure they have operated completely and the charging springs are charged. This inspection will be performed on each circuit breaker prior to startup from the current outage. Operating procedures will be revised to initiate this inspection.

- The failed safety-related Westinghouse circuit breaker will not be placed back in service unless the cause of the failure can be determined.

- An independent circuit breaker expert will assist in determining the cause of the Westinghouse safety-related circuit breaker failure.

Westinghouse Safety-Related Circuit Breaker Failure To Trip

On July 22, 1997, a Westinghouse 4160-volt safety-related circuit breaker failed to open when required. Failure of this circuit breaker during plant operation would not have caused the plant to trip off line. Inspection of the circuit breaker while it remained in the cubicle revealed it was in an intermediate position (photographs of the circuit breaker in the intermediate position are enclosed). In this position the circuit breaker is still able to carry electrical load. In order to remove the circuit breaker from the cubicle, it was fully closed and was successfully opened from that position.

The cause of the circuit breaker to operate to the intermediate position could not be conclusively determined. The circuit breaker was inspected onsite by Westinghouse and Illinois Power personnel and dismantled offsite by Cutler-Hammer (the current manufacturer of the circuit breaker).

Illinois Power analyzed the as found intermediate position of the circuit breaker and determined the possible deficiencies that could cause the circuit breaker to be in this position. The possible deficiencies that would cause the circuit breaker to be in the intermediate position when operating in either the closed or open directions are: bent or misaligned operating linkages, degraded lubricant, binding of operating mechanism, debris preventing circuit breaker operation, weak closing or opening springs, malfunction of the trip latch.

During the offsite dismantling of the circuit breaker the possible causes of the circuit breaker being in the intermediate position after a trip signal was received (i.e. failure in the opening direction) were investigated. The operating linkages were checked for misalignment or physical damage. No damage of these linkages was noted. The puffer tube assembly was found slightly out of alignment. The puffer tube assembly was readjusted with no affect on circuit breaker operation. The lubricated portions of the operating mechanism were inspected for degraded lubricant. Some dry, sticky lubricant was found on the pivot points for the circuit breaker's contact operating rods. However,

these pivot points have fairly loose tolerances and still operated freely. Inspection of the circuit breaker bearing lubricant disclosed that the lubricant was in like-new condition. Extensive examination and testing of the operating mechanism was conducted. No binding or abnormal operation was observed. No debris was found during the inspection which could have caused the circuit breaker to fail to operate. The spring strength and alignment were checked with no abnormalities noted.

During the offsite dismantling of the circuit breaker the possible causes of the circuit breaker being in the intermediate position after a close signal (i.e., failure in the closing direction) was also investigated. The operating linkages were checked for misalignment or physical damage. No damage of these linkages was noted. The puffer tube assembly was found slightly out of alignment. The puffer tube assembly was readjusted with no affect on circuit breaker operation. The lubricated portions of the operating mechanism were inspected for degraded lubricant. Some dry, sticky lubricant was found on the pivot points for the circuit breaker's contact operating rods. However, these pivot points have fairly loose tolerances and still operated freely. Inspection of the circuit breaker bearing lubricant disclosed that the lubricant was in like-new condition. Extensive examination and testing of the operating mechanism was conducted. No binding or abnormal operation was observed. No debris was found during the inspection which could have caused the circuit breaker to fail to operate. The spring strength and alignment were checked with no abnormalities noted. The trip latch was inspected for a condition which may have caused it to properly latch when attempting to close the circuit breaker. The inspection revealed that the trip latch was slightly out of specification but we could not make it fail to operate on several subsequent cycles.

During testing of the circuit breaker it was consistently demonstrated that if the circuit breaker was fully open or closed it would operate when required. Illinois Power believes that the circuit breaker was in the intermediate position when it was closed prior to the failure of the circuit breaker to open. A failure of the circuit breaker to completely close can be detected by a visual inspection of the circuit breaker local mechanical position indication.

The vendor analysis of the condition of the circuit breaker after testing and disassembly stated that the previous preventive maintenance activities performed on the circuit breaker were satisfactory to maintain the circuit breaker and should be continued. **The vendor also noted that, based on the condition of this circuit breaker, the other in-service Westinghouse circuit breakers will operate satisfactory on demand. No abnormalities were detected through tests or inspections that could have caused the circuit breaker to fail to open.** (Attached is a copy of the Westinghouse preliminary report).

In order to ensure that circuit breakers at Clinton Power Station will operate when required the Westinghouse 4160-volt safety-related circuit breakers will be inspected after switching operations and prior to startup from the current outage. This inspection will verify that the circuit breaker has operated completely to the expected position and that the charging springs are fully charged. Operating procedures will be revised to require notification of electrical maintenance to verify the mechanical indication of circuit breaker

position and charging springs. Electrical maintenance personnel will conduct, document, and track this inspection in accordance with the maintenance work request procedure. This inspection will continue to be performed by electrical maintenance technicians that have been specifically trained for this inspection. This inspection will be performed until the Westinghouse 4160-volt safety-related circuit breakers have been replaced with new or refurbished circuit breakers. Also, the circuit breaker that failed on July 22, 1997 will not be placed back into service at Clinton Power Station unless the cause of the failure to open can be determined.

Illinois Power is continuing to pursue the cause of the failure of this circuit breaker. An independent circuit breaker expert will review the failure mode and inspection and test data to assist in cause determination.

As detailed in Illinois Power letter U-602787, dated July 16, 1997, Illinois Power plans to have installed new or refurbished Westinghouse 4160-volt safety-related circuit breakers in-service in all Division II circuit breaker cubicles before the start of a planned mid-cycle outage. This mid-cycle outage is scheduled for April 1998. Nine of the ten Division I Westinghouse 4160-volt safety-related circuit breakers will be replaced with new or refurbished circuit breakers by September 25, 1998. The remaining Westinghouse 4160-volt safety-related circuit breakers will be replaced with a new or refurbished circuit breaker during the next refueling outage. This outage is scheduled for the spring of 1999.

Based on the opinion of the circuit breaker vendor that performed the tests and inspections, Illinois Power's review of the circuit breaker's condition, and compensatory actions Illinois Power is taking to ensure proper circuit breaker operation, there is reasonable assurance that the in-service safety-related Westinghouse 4160-volt circuit breakers will operate when required.

Failure of Westinghouse 4160-Volt Circuit Breaker Due to Relay Mis-Wiring

In a separate event on July 22, 1997, during restoration from an electrical bus outage, two non-safety related Westinghouse 4160-volt circuit breakers failed to close on demand. The first failure of a Westinghouse non-safety related circuit breaker to close on demand was because a contact for a seal-in circuit in an undervoltage relay on the electrical bus was mis-wired. This caused the circuit breaker to not receive the signal to close. It is suspected that the seal-in circuit mis-wiring may have been caused by a lack of clarity in the design drawings. Removal of the contact from the seal-in circuit can be accomplished by either moving the contact out of the way, so it does not make contact when the relay actuates, or removing an internal jumper in the relay. The drawings for this circuit do not show that the contacts for the seal-in function are enabled. The drawings also do not describe the method to disable the seal-in function of the relay. The contact for this electrical bus undervoltage relay has been rewired (i.e. jumper removed) so the seal-in function is disabled. The applicable drawings will be revised to clearly indicate that the jumper should be removed to disable the seal-in function for these relays.

A review of the potential for the seal-in function of this relay to be enabled on safety-related and non-safety related electrical distribution systems was performed. There

are seven relays in the safety-related electrical distribution system and forty-six in the non-safety related electrical distribution system that could cause this problem. The results of this review disclosed that the safety-related electrical busses have had the internal jumper removed from the undervoltage relay to prevent the seal-in function from operating. The removal of this jumper is periodically verified for the safety-related relays during the performance of surveillance procedures. However, these surveillances are not performed on the non-safety related distribution system. A maintenance work request has been issued to remove the jumper or verify that no jumper exists on all forty-six of the affected non-safety related relays. **Because the safety-related relays are periodically verified to not have the seal-in circuit activated this condition does not affect the associated safety-related Westinghouse circuit breakers.**

Failure of Westinghouse 4160-Volt Circuit Breaker Due to Latch Check Adjustment

The cause of the second failure of a non-safety related Westinghouse circuit breaker to close was that the contacts on the latch check switch, which provides a permissive to close the circuit breaker, did not make-up as required. This was caused by the latch check switch being out of adjustment. During preparation for the adjustment of the latch check switch it was discovered, with assistance from Westinghouse personnel, that the method used in the plant procedure to adjust the latch check switch was incorrect. This correct method was used to check and readjust the switch as necessary on both safety and non-safety related circuit breakers. However, prior to the procedure being revised in April 1997, the instructions in the procedure were correct and consistent with those in the vendor manual. Review of maintenance history showed that only one circuit breaker was checked for proper latch check switch adjustment using the deficient procedure. This circuit breaker was subsequently checked for proper latch check switch adjustment. Adjustment of this latch check switch was not required.

Because the latch check switch was found out of adjustment on the non-safety related circuit breaker, and CPS procedures are the same for safety-related circuit breakers, all of the safety-related circuit breakers that are needed to actively close to perform their safety function (twenty-two of twenty-four in-service safety-related circuit breakers) have been checked for proper latch check switch adjustment. Those that were not properly adjusted have been corrected. To date, the check of the adjustment of the latch check switches has revealed that twenty of twenty-eight checked (this includes some non-safety related circuit breakers) were out of adjustment. The procedure that checks this adjustment has been revised to reflect the correct method of performing this task and is normally performed during circuit breaker preventive maintenance activities. **Therefore, since this condition has been corrected on those circuit breakers that are needed to actively close to perform their safety function there is no impact on the ability of these circuit breakers to perform their safety function.**

Illinois Power is also taking actions to determine if there are additional problems with maintenance procedures that implement vendor instructions. Maintenance personnel will review the Westinghouse circuit breaker vendor maintenance instructions against the instructions in the maintenance procedure to determine if there are other instances where the circuit breaker maintenance procedures are not consistent with those in the vendor

manual. Also, an independent contractor will perform the review described above separately from maintenance personnel. Any discrepancies found will be reviewed for potential impact on circuit breaker operability. This review will be complete prior to start-up from the current outage. In addition, the procedures that perform maintenance on the ABB 480-volt and General Electric 4160-volt circuit breakers will be reviewed in the same manner to that of the Westinghouse circuit breakers. This review will be complete by August 30, 1997.

In an overall effort to improve the quality of maintenance procedures a sample of electrical, mechanical, and control and instrumentation procedures will be reviewed for conformance with vendor instructions. The results of this review will determine the necessity to increase the scope of this review to include all or some additional portion of maintenance procedures based on vendor instructions. The review of the sample of procedures will be complete by August 1, 1998.

In summary, in light of our recent corrective actions and planned compensatory measures, Illinois Power has reasonable assurance that our 4160-volt circuit breakers will perform their safety function.

If you have any questions about the resolution of these circuit breaker problems please contact me at (217) 935-8881 extension 3400.

Sincerely yours,

Wayne D. Romberg

Wayne D. Romberg
Assistant Vice President

MRS/krk

Enclosure

cc: J. L. Caldwell, USNRC, Region III
G. C. Wright, USNRC, Region III
M. A. Ring, USNRC, Region III
NRC Resident Office, V-690
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2000 Cheswick Avenue
Cheswick, PA 15024-1358

July 28, 1997
RRS/AQ&T(97)-045

Mr. Don Lukach
Illinois Power and Light Company
Clinton Station
P.O. Box 678
Clinton, IL 61727

Subject: Preliminary Report
DHP Breaker Failure Analysis
Illinois Power Co. Clinton Power Plant
Shop Order 01YN005B4 Serial #2

Dear Mr. Lukach:

This is a preliminary failure analysis report. This analysis was conducted in the Greenwood manufacturing plant, Greenwood, South Carolina on Saturday, July 25, 1997.

The scope of the failure analysis was performed following purchase order instructions (P.O. # 705276), General Order # ST30865, N.S.E.D. Attachment #1, 90356 Rev. #1. Prior to beginning the failure analysis, the analysis steps to be performed were reviewed and approved by Illinois Power and Cutler-Hammer representatives.

The circuit breaker was removed from the shipping container and visually inspected. The breaker appeared to be in good condition and the only noticeable sign the breaker had failed was the blackened open coil. The circuit breaker operations counter indicated 551 operations. The breaker was exercised mechanically without failure. Main contact gaps were checked and found to be slightly wider than outlined in DHP circuit breaker I.L. 32-253-4B. Main contacts and arching contacts showed minimal wear, contact alignment was good, contact synchronization good and contact penetration good. The puffer adjustment was checked and found to be slightly over the recommended setting. The contacts were not adjusted for this analysis. The mechanism mechanically operated freely which is a good measure of the effectiveness of past preventative maintenance.

The open coil (trip coil) was replaced including the complete trip solenoid assembly. This was done because the open coil could not be removed from the assembly without further damaging the assembly. The close coil was also replaced because it had a black mark on the coil insulation caused when the open coil overheated and open. The breaker was electrically operated, 5 times at normal voltage, 5 times at maximum voltage, 5

times at minimum voltage and 5 this at normal voltage to verify the anti pump feature. All electrical operations were crisp and without failure.

The circuit breaker opening and closing intervals were recorded using a PROGRAMA Circuit Breaker Test Device. The close interval was within specification and the trip interval was just out (or slightly slower) than the specification limits.

In order to determine if any mechanical component may have contributed to the failure of the breaker, we changed opening springs, main contact kick off springs, adjusted the main contact hinge bolts and puffer. These replacements and adjustments were made in sequence and timing was performed after each event. The results were inconclusive in that the effect of each adjustment of part change had very little effect on the opening or closing speed of the mechanism. The main contacts were not adjusted for this analysis because the slightly wider main contact gaps would promote quicker release and contact opening.

The mechanism was dismantled and each part associated with the opening or closing of the main contacts visually inspected. We found that the main shaft bearings were still in very good condition with original factory lubrication (breaker was manufactured in 1978). The pins connecting the main shaft to the main contact push rods were removed and found to have some lubricant on the pins, but the lubrication felt sticky indicating the lubrication was drying. We found the same condition on the puffer operating link pivot pins. The remaining parts in the mechanism were visually inspected and found to be in very good condition.

Conclusion:

The circuit breaker was operated a total of 51 times without failure. Part replacement and mechanism tear down did not provide evidence that would identify one particular cause for the in service failure. There is no evidence found to indicate a mechanical deficiency or a generic problem with this circuit breaker or with the existing preventative maintenance program. The cause of the breaker failure to open has not been determined at this time.

We will continue the analysis by measuring mechanism parts to determine if any part associated with the opening of the mechanism is out of tolerance or worn to the point where replacement would be recommended. The analysis should be completed by the end of this week with a final report a few days later.

Preliminary Recommendations:

At this point, based on the preliminary inspection of this circuit breaker, it is my opinion the preventative maintenance performed on this circuit breaker was adequate to maintain the proper operation of the breaker. Using this circuit breaker as a sample of one, I believe that the remaining circuit breakers at the Clinton Power Plant, maintained under the same program should provide safe and effective operation.

No recommendations at this time. Continue to operate under existing procedures and guidelines.

Sincerely,

Thomas R. Critchlow, Engineer
Distribution Services Engineering

/eks

Attachments (2)

cc: Rick Redding Clinton Station
Linda DeGrofft Clinton Station
John Dence Cutler-Hammer
Chuck Kelley Cutler-Hammer
Bob Folino Westinghouse
Dale Rygg Westinghouse
Tom Moser Westinghouse
Dick Miller Westinghouse

Cutler-Hammer

Westinghouse & Cutler-Hammer Products
Aftermarket Product Center
2210 Laurens Highway
Greenwood, SC 29649

EATON

Type 50DHP 350 Amps 1200 Style No. 01YN005R4

Serial No. 2 G.O. No. 01YN00584

Original S.O.No. 01YN005R4

Mechanical Verification

1. Nameplate Verification		✓
2. Initial Veeder Counter Reading	00551	✓
3. Manual Charge, Close, and Trip		✓
4. Auxiliary Switch Operation		✓
5. Primary Disconnect Alignment		✓
6. Breaker Position Interlock Function		✓
7. Ground Contact Alignment		✓
8. Floor Tripper Operation		✓
9. Code Plate Verification		✓
10. Front Panel Installation		✓
11. General Appearance and Cleanliness		✓

Electrical Verification

12. Verify Motor, Close and Trip Voltages		✓
13. Close at Minimum, Nominal, and Maximum Voltages		✓
14. Trip at Minimum, Nominal and Maximum Voltages		✓
15. Contact Resistance's in Micro-Ohms at 100 Amps D.C. Phase 1 7.7 Phase 2 7.4 Phase 3 7.4		FAILED
16. Control Wiring Continuity		FAILED
17. Verify Breaker Wiring Matches S.O. Schematic		✓
18. Auxiliary Switch Wiring		✓
19. Operation of Undervoltage Trip		✓
20. Operation of Antipump Relay		N/A
21. General Appearance and Cleanliness		✓
22. Final Veeder Counter Reading	00583	N/A
23. Hi Pot Test		✓
24. Low Voltage Breaker Trip Unit Test Digitrip/Amplector		✓
		N/A

This circuit breaker meets all quality standards in accordance with the Aftermarket Product Center inspection procedures.

Mechanical Inspector 117 & 407 Electrical Tester 714

Date 7/26/97 Date 7-26-97

ATTACHMENT 1

TEST REPORT

TYPE DHP AIR CIRCUIT BREAKER

TESTED BY G-20

DATE 7-24-97
VRC START 005600
VRC FINISH 006833

2.1 IDENTIFICATION: G-20

TYPE OF BKR 50 DHP 350
MAX. KV 5
HERTZ 60
RATED S.C. CURRENT 41
STYLE NO. 01YN005B4
CONTINUOUS AMPS 1200
C & L KA 78
K FACTOR - 1.19
BIL KV - 60

CLOSING VOLTAGE 90-130DC
CLOSING AMPS 5
TRIP VOLTAGE 70-140DC
TRIP AMPS 5
MOTOR VOLTAGE 125DC
I.B. NO. 32-253-2
DATE OF MANUF. 5/78
SERIAL # 2
WEIGHT.

4.2 ADJUSTMENTS: G-20

LATCH CHECK SW.

5. ELECTRICAL OPERATIONS TEST G-20

		CLOSE / TRIP	
5.2	MIN. CONTROL VOLTAGE	90DC / 70DC	VOLTS
5.3	MAX. CONTROL VOLTAGE	130DC / 140DC	VOLTS NUCLEAR
5.4	NOM. CONTROL VOLTAGE – ANTI-PUMP TEST	125DC / 125DC	VOLTS 90DC / 70DC
5.5	NOM. CONTROL VOLTAGE	125DC / 125DC	VOLTS

7 INSULATION TESTS G-20

7.3 TEST ALL SECONDARY WIRING FOR 1 MIN. AT 1500 VOLTS 60 HZ.
7.4 TEST ALL PRIMARY INSULATION FOR 1 MIN. 60 HZ.
ALL 50 DHP BREAKERS 19 KV
~~ALL 75/150 DHP BREAKERS 36 KV~~

8 TIMING TESTS G-20 PASS CLOSE
FAIL TRIP

9. PRIMARY CONDUCTANCE TESTS G-20 - FAILED

ØA	ØB	ØC
7.7	7.4	7.4

10. DC UNDERVOLTAGE TRIP TESTS N/A

DROP OUT VOLTAGE N/A 35% TO 60%
PICK UP VOLTAGE N/A 80%

NOTES: Reviewed and Approved
Dave 7/25/97

As found condition of Westinghouse 4160-volt safety-related circuit breaker