Attachment 1

Duke Power Company

Oconee Nuclear Station

Reportable Occurrence Report

RO-269/78-14

Duke Power Company

Oconee Units 1, 2, 3

Report Number: RO-269/78-14

Report Date: June 9, 1978

Occurrence Dates: April 25, May 10, May 15, 1978

Facility: Oconee Nuclear Station, Seneca, South Carolina

Identification of Occurrence: Keowee Unit 2, Field Flashing Breaker Inoperable

Conditions Prior to Occurrence: Unit 1 Cold S/D
Unit 2 100% FP
Unit 3 100% FP

Description of Occurrence:

This type of occurrence has occurred on six previous occasions and has been addressed in Reportable Occurrence Reports RO-269/77-29, 78-1, 78-3, 78-6, 78-7, and 78-9, transmitted by my letters of January 18, February3, March 23, April 7, and April 21, 1978, respectively. This particular report includes three separate failures. A summary of the history and status of this entire concern is being transmitted herewith.

On April 25, 1978, the Keowee Unit 2 Field Flashing Breaker failed to operate following an automatic-start command. The breaker operated properly on a second attempt seven minutes later. No abnormalities were indicated by the recorder installed to monitor such failures. This incident was determined during the investigation of the May 10, 1978 incident which follows.

On May 10, 1978, the Keowee Unit 2 Field Flashing Breaker failed to function properly following an attempted automatic-start. The breaker functioned properly three minutes later on a second attempt. The monitoring recorder indicated that the breaker received a close signal properly but did not respond accordingly. Additional monitoring was initiated.

On May 25, 1978, the Keowee Unit 2 Field Flashing Breaker failed to function properly on automatic-start. The breaker functioned properly two minutes later on a second attempt. The monitoring recorder indicated that the breaker closed in properly but immediately opened without receiving any trip signal.

Apparent Cause of Occurrence

The last two failures seemed to indicate a breaker problem of unknown origin. The task force established to deal with this problem is continuing its investigation, and bench test procedures for the breaker are being developed. Please refer to Attachment 2 for further detail.

Analysis of Occurrence:

Keowee Hydro Station is a source of emergency on-site power for the Oconee Nuclear Station. Either unit is capable of supplying full emergency load for all three Oconee units. During all three recent failures, the redundant backup unit, Keowee Unit 1, was connected to the underground feeder bus and capable of supplying any needed emergency power. This incident did not adversely affect public health and safety.

Corrective Action:

The Keowee Unit 2 Field Flash Breaker was replaced on May 25, 1978 by a spare load center breaker of similar design. An exact replacement is on order. Investigations regarding the cause of the failure are continuing.

NRC FORM 366 (7-77)

U. S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT

EXHIBIT A

CONTROL BLOCK: | | | | | | | (1) (PLEASE PRINT OR TYPE ALL REQUIRED INFORMATION)

0 1 | S C N E E 1 (2) | 0 0 - 0 0 0 0 0 - 0 0 (3) | 4 1 1 1 1 (4) | | (5)
LICENSEE CODE (9–14) · LICENSE NUMBER (15–25) · LICENSE TYPE (26–30) · CAT (57–58)

CON'T 0 1 | REPORT SOURCE L (6) | 0 5 0 0 0 2 6 9 (7) | 0 4 2 5 7 8 (8) | 0 6 0 8 7 8 (9)
DOCKET NUMBER (61–68) · EVENT DATE (69–74) · REPORT DATE (75–80)

EVENT DESCRIPTION AND PROBABLE CONSEQUENCES (10)

0 2 | On three occasions between April 25 and May 15, the Keowee Unit 2 Field
0 3 | Flashing Breaker failed to operate properly. The breaker always functioned
0 4 | normally on second attempt. The failure prevented the use of Keowee Unit 2
0 5 | as an emergency power source, if needed, but Unit 1 was available as were
0 6 | other sources of auxiliary power. The health and safety of the general public
0 7 | were not endangered by this incident.
0 8 |

SYSTEM CODE	CAUSE CODE	CAUSE SUBCODE	COMPONENT CODE	COMP. SUBCODE	VALVE SUBCODE
E E (11)	X (12)	X (13)	Z Z Z Z Z Z (14)	Z (15)	Z (16)

(17) LER/RO REPORT NUMBER

EVENT YEAR		SEQUENTIAL REPORT NO.		OCCURRENCE CODE	REPORT TYPE		REVISION NO.
7 8	—	0 1 4	/	0 3	L	—	0

ACTION TAKEN	FUTURE ACTION	EFFECT ON PLANT	SHUTDOWN METHOD	HOURS (22)	ATTACHMENT SUBMITTED	NPRD-4 FORM SUB.	PRIME COMP. SUPPLIER	COMPONENT MANUFACTURER
A (18)	A (19)	Z (20)	Z (21)	0 0 0 0	Y (23)	Y (24)	L (25)	Z 9 9 9

CAUSE DESCRIPTION AND CORRECTIVE ACTIONS (27)

1 0 | The probable causes of these failures are thought to be a malfunctioning
1 1 | breaker. Possible modes at failure have been postulated but not verified.
1 2 | The breaker has been replaced and investigation is continuing.
1 3 |
1 4 |

1 5 | FACILITY STATUS: E (28) | % POWER: 1 0 0 (29) | OTHER STATUS (30): NA | METHOD OF DISCOVERY: A (31) | DISCOVERY DESCRIPTION (32): Operator Observation

1 6 | ACTIVITY RELEASED: Z (33) | CONTENT OF RELEASE: Z (34) | AMOUNT OF ACTIVITY (35): NA | LOCATION OF RELEASE (36): NA

PERSONNEL EXPOSURES
1 7 | NUMBER: 0 0 0 (37) | TYPE: Z (38) | DESCRIPTION (39): NA

PERSONNEL INJURIES
1 8 | NUMBER: 0 0 0 (40) | DESCRIPTION (41): NA

LOSS OF OR DAMAGE TO FACILITY (43)
1 9 | TYPE: Z (42) | DESCRIPTION: NA

PUBLICITY
2 0 | ISSUED: N (44) | DESCRIPTION (45): NA | NRC USE ONLY

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Attachment 2

Oconee Nuclear Station

Keowee Field Flashing Breaker

Investigation Summary

Oconee Nuclear Station
Keowee Field Flashing Breaker
Investigation Summary

Since December 1977, there have been ten documented failures of Keowee Hydro Unit 2 to start due to problems associated with the Field Flashing Breaker. The exact nature of the failure is unknown. It had been considered that there has just been a failure of the breaker to close. However, during one failure that was witnessed the breaker appeared to close and trip back out immediately.

A task force, comprised of representatives from various Company departments, was formed in early April 1978 to investigate this recurring incident.

The following is a summary of the actions taken in the course of the investigation to date:

1. After initial failures, Duke Power personnel checked the breaker and could find no problems. Vendor personnel checked the regulator and could find no problems. Also, after initial failures, relays in the close circuit of the Field Flashing Breaker were replaced.

2. As there appears to be no breaker or regulator problems the investigation centered on the control circuits. Trip circuitry was especially suspect after the witnessed apparent trip free operation of the breaker. Equipment was installed to monitor all points which can trip the Field Flashing Breaker, as well as to monitor whether the breaker close circuit gets a signal. On April 10 and 11, Keowee Unit 2 was started 17 times. The intention was to monitor a failure and determine the problem circuit. However, no failures were encountered.

3. Relays directly in the trip circuitry were checked. Pickup points were satisfactory. The cabling involved in the trip circuitry, especially manual trips from Oconee, was meggered and checked satisfactorily.

4. As the circuitry in the manual control circuits from Oconee were highly suspect these were disabled on April 21. On April 25, another failure occurred, thus ruling out this trip path.

5. Common occurrences during all failures were investigated. Highly suspicious was the fact that the Governor Oil Pump 2C was verified to have started during six of seven failures through April 10. During all test starts on April 11, this pump was started with no failures of the Field Flashing Breaker.

6. Another problem that was thought to have a bearing on the Flashing Breaker failures, involved the Unit 2 Field Supply Breaker. There have been times when both open and closed supply breaker indicating lights were observed simultaneously in the Oconee control room. This could have affected closure of the Field Flashing Breaker as Supply Breaker auxiliary contact and "cell interlock" contacts are in the Flashing Breaker close circuitry. Investigation revealed that the dual light indication was due to insecure mounting of the Supply Breaker "cell interlock" contacts. This problem was corrected and is now thought to have had no bearing on the Flashing Breaker problems.

7. Equipment installed in the Flashing Breaker circuitry was able to monitor the failure of May 10 and a subsequent failure. Analysis showed that no relays in the trip circuits activated, indicating the problem is either in the close circuitry or the breaker itself. Monitoring equipment indicated that the "X" relay and the closing solenoid of the breaker both were energized on these last failures. A normally closed or "B" contact did change state indicating the breaker did try to close.

8. In a conversation with vendor personnel, it was indicated that the Field Flashing Breaker contains a high burden closing coil. This is done as a matter of routine in manufacturing a breaker of this type with no overcurrent trip devic This insures that the breaker will be able to close into high fault currents. It was suggested that a high burden closing coil in conjunction with an aging mechanism, and possibly in combination with our relatively high D.C. system voltage (132V), could result in the breaker "slamming out" (failure to latch).

9. On May 16 and 17, tests were conducted at Keowee on a spare Load Center DB-25 Breaker (to gain experience in testing and for comparison with the Flashing Breaker) and then on the DB-25 Field Flashing Breaker itself. Recording equipment during the tests was set up to monitor voltage on the "X" relay and the closing solenoid of the breaker as well as the time of energization. Tests were run from 140 volts at the D.C. source down to the point of low control voltage failure. The Field Flashing Breaker was found to fail between 70 and 75 volts at the D.C. source (slightly less at the breaker). The component to fail at low voltage was found to be the X coil, not the closing solenoid. The closing circuitry in the breaker itself was checked for high resistance. The only resistance measured was that of the coils, indicating internal breaker wiring good.

   The above tests rule out low control voltage at the breaker as being the cause of failure. Monitoring equipment from the last two failures show that the "X" coil did pick up. Plus, if there was a low voltage problem due to high resistance between the excitation equipment and the D.C. Distribution Systems, failures would probably occur on the Supply Breaker and Field Breaker also. (Closing voltage for these breakers is obtained from the same cable as the Flashing Breaker).

10. Further tests on May 17 of the Flashing Breaker were conducted to try to make the breaker fail by the "slam out" theory. The breaker was closed 50 times with 140 volts at the D.C. source. No failures occurred.

11. There is one remaining theory at this time as to the cause of failure. This involves the aging mechanism, in combination with the high burden close coil and the high control voltage (as suggested above) possibly in combination with vibration. The Field Flashing Breaker, at the time of closure, does experienc vibration from the accelerating unit plus the closure of the Field Breaker. The Field Breaker, located immediately below the Flashing Breaker, closes a ma ter of cycles before the Flashing Breaker.

12. Drawout equipment from one of the spare Load Center DB-25's has been removed s as to create a direct replacement for the bolt-in Field Flashing Breaker. As this Load Center Breaker has served as a spare, it has experienced few operati It, therefore, has a "like new" mechanism. As the theory regarding Field Flas ing Breaker failure, at this time, seems to hinge on wear, this "spare" breake was installed on May 25, 1978.

13. The monitoring equipment is to be left in the breaker circuitry for the next two months in case a failure occurs. Additional monitoring equipment will als be installed.

14. An exact replacement for the Field Flashing Breaker has been ordered from Westinghouse with delivery expected within a few weeks. This breaker will be used as a spare in the event failures occur to either Keowee Unit 1 or 2 Field Flashing Breaker 15. Other actions are being pursued and may be imple mented, based on the results of the corrective actions recently taken. These include other hardware modifications and increased maintenance program on this breaker.