

LICENSEE EVENT REPORT (LER)

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|--|--------|---|----------------|---------------------|-----------------|------------------|-----------------|--------------|---------------------|---|--------|-----------------|------------------|--|----------------------|--------|-----------|--------------|---------------------|
| FACILITY NAME (1) McGuire Nuclear Station - Unit 2 | | | | | | | | | | DOCKET NUMBER (2) 0 5 0 0 0 3 7 0 | | | | | PAGE (3) 1 OF 0 4 | | | | |
| TITLE (4) Reactor Trip on Turbine Trip Due to Protective Relay Actuation | | | | | | | | | | | | | | | | | | | |
| EVENT DATE (5) | | | LER NUMBER (6) | | | | REPORT DATE (7) | | | OTHER FACILITIES INVOLVED (8) | | | | | | | | | |
| MONTH | DAY | YEAR | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | MONTH | DAY | YEAR | FACILITY NAMES | | | | DOCKET NUMBER(S) | | | | | | |
| 0 7 | 1 2 | 8 5 | 8 5 | 0 1 9 | 0 0 | 0 8 | 1 2 | 8 5 | | | | | 0 5 0 0 0 | | | | | | |
| OPERATING MODE (9) | | THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR § (Check one or more of the following) (11) | | | | | | | | | | | | | | | | | |
| 1 | | 20.402(b) | | | | 20.406(c) | | | | <input checked="" type="checkbox"/> 50.73(a)(2)(iv) | | | | 73.71(b) | | | | | |
| POWER LEVEL (10) | | 20.406(a)(1)(i) | | | | 50.36(c)(1) | | | | 50.73(a)(2)(v) | | | | 73.71(c) | | | | | |
| 1 1 0 1 0 | | 20.406(a)(1)(ii) | | | | 50.36(c)(2) | | | | 50.73(a)(2)(vii) | | | | OTHER (Specify in Abstract below and in Text, NRC Form 365A) | | | | | |
| | | 20.406(a)(1)(iii) | | | | 50.73(a)(2)(i) | | | | 50.73(a)(2)(viii)(A) | | | | | | | | | |
| | | 20.406(a)(1)(iv) | | | | 50.73(a)(2)(ii) | | | | 50.73(a)(2)(viii)(B) | | | | | | | | | |
| | | 20.406(a)(1)(v) | | | | 50.73(a)(2)(iii) | | | | 50.73(a)(2)(ix) | | | | | | | | | |
| LICENSEE CONTACT FOR THIS LER (12) | | | | | | | | | | | | | | | | | | | |
| NAME Jerry B. Day - Licensing | | | | | | | | | | TELEPHONE NUMBER | | | | | | | | | |
| | | | | | | | | | | AREA CODE 7 0 4 | | 3 7 3 - 7 0 3 3 | | | | | | | |
| COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13) | | | | | | | | | | | | | | | | | | | |
| CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO NPDOS | CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO NPDOS | CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO NPDOS | CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO NPDOS |
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| SUPPLEMENTAL REPORT EXPECTED (14) | | | | | | | | | | | | | | EXPECTED SUBMISSION DATE (15) | | MONTH | DAY | YEAR | |
| <input type="checkbox"/> YES (If yes, complete EXPECTED SUBMISSION DATE) | | | | | | | | | | | | | | <input checked="" type="checkbox"/> NO | | | | | |
| ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16) | | | | | | | | | | | | | | | | | | | |
| <p>On July 12, 1985 at 0611, the unit main generator tripped from 100% (initiating a reactor trip) when both channels of the generator "X" phase differential current protective devices actuated, apparently initiated by a generator input/output mismatch signal. The cause of the differential current trip could not be determined until after the turbine trip on July 29, 1985 from the same cause</p> <p>Following the July 12 trip, the permanent magnet excitation generator was found extensively damaged. The data collected following the trip provided evidence that this failure had occurred after the trip.</p> <p>Following repair of the permanent magnet excitation generator, the unit was restarted. On July 29, 1985, at 0250, the Unit 2 main generator tripped from 60% power when the Channel I "X" phase differential current protective device actuated as on July 12. The cause of this trip was found to be cracked and misaligned aluminum flux shields on the generator current transformers.</p> <p>These two incidents are attributed to Component Failure/Malfunction because broken and misaligned current transformer flux shields caused erroneous current signals to be sent to the protective relay devices.</p> <p>All damage has been repaired and equipment will be monitored and inspected to verify repairs. All systems responded as expected to the trip.</p> | | | | | | | | | | | | | | | | | | | |

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED QMB NO. 3150-0104

EXPIRES: 8/31/85

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| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | | | |
| | | | | | | | |
| McGuire Nuclear Station - Unit 2 | 0 5 0 0 0 3 7 0 | 8 5 | — 0 1 9 | — 0 0 | 0 2 | OF | 0 4 |

TEXT (If more space is required, use additional NRC Form 366A's) (17)

On July 12, 1985, at 0611, the Unit 2 main generator tripped from 100% power when both channels of the generator "X" phase differential current protective devices actuated. This actuation was apparently initiated by a generator input/output current mismatch signal. The turbine trip initiated a reactor trip. Extensive testing and inspections were performed on the generator and buslines. The cause of the differential current trip could not be determined until after the turbine trip on July 29, 1985.

The permanent magnet excitation generator was found extensively damaged during the investigation which followed the turbine trip. The data collected following the trip provided evidence that this failure could not have caused the differential current relay actuation which led to the turbine trip but had occurred after the trip.

Following repair and restart, on July 29, 1985, at 0250, the Unit 2 main generator tripped again from 60% power when the Channel 1 "X" phase differential current protective device actuated. The cause of this trip was found to be cracked and misaligned aluminum flux shields on the generator current transformers.

These two incidents are attributed to Component Failure/Malfunction because broken and misaligned current transformer flux shields caused erroneous current signals to be sent to the protective relay devices.

The differential relay actuation in both of these events which caused the turbine to trip was not due to actual high differential current. The trip was actuated by erroneous current transformer (CT) outputs caused when the flux shield around the "X" phase CTs became misaligned. The flux shield was cracked at a 90 degree bend which allowed the shield to change position and vibrate around the CTs inside the enclosed bus duct. This movement of the flux shield caused a short circuit in a flux shield air gap which is intended to eliminate induced current in the shield itself. This induced current flow around the "X" phase CTs changed the output characteristics of the transformers enough to initiate the differential current relays.

The CTs were tested electrically following the first turbine trip and no problems were noticed. A visual inspection was not made until after the second trip.

The permanent magnetic generator (PMG) damage was apparently the result of both shaft vibration and bearing tolerance deviation. The PMG consists of permanent magnets mounted to the generator shaft and rotating around a fixed coil. This arrangement provides excitation voltage at 120 volts, 420 Hertz for the main exciter. A combination of close air gap clearances on the PMG, excessive gap on the shaft bearing, and high vibrations at certain critical shaft speeds contributed to the PMG damage.

The PMG was replaced prior to the unit restart and successfully placed in operation prior to the second turbine trip.

CORRECTIVE ACTIONS:

Immediate: Operators took appropriate actions to safely shut down the reactor following both trips.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

Following The First Trip:

- Subsequent:
1. Extensive tests were conducted to determine the cause of the trip. Some of the critical tests completed are as follows:
 - Overpotential testing on generator and buslines
 - Double testing on the generator breakers, metering pots, regulating circuits, relay pots, and generator
 - Crawl through inspections on the generator, buslines, and generator breakers
 - Voltage regulator circuitry test
 - Busline backcharge test
 2. The PMG was replaced. The damaged PMG was returned to Westinghouse for failure analysis.

Following The Second Trip:

- Subsequent:
1. Temporary oscillograph recorder equipment was brought in to monitor CT operation during subsequent startups.
 2. Further visual inspections revealed the defective busline CT flux shields.
 3. Repairs were made to the CT flux shields.
 4. Vibration analysis was performed by Westinghouse on the CT flux shields to help determine the failure cause.

- Planned:
1. CT outputs will be monitored on the temporary oscillograph to verify correct operation following the repairs.
 2. The CT flux shields will be replaced or have permanent repairs (dependent upon vendor evaluation) made during the next major outage.
 3. The Unit 1 flux shields will be inspected and repaired as necessary during the next major outage.

SAFETY ANALYSIS: The generator protective relaying sensors (CTs) provided an abnormal condition response to quickly isolate the generator from the system as designed. During the subsequent reactor trips, the equipment responded normally.

For the July 12 trip, plant response was normal. Primary pressure dropped to a minimum of 1972 psig, well above the safety injection setpoint, before recovering. Temperature settled out as expected to the no-load target. Steam pressure peaked post trip at 1111 psig in S/G's "A" and "C". The PORV on S/G "D" opened slightly below its setpoint but had no adverse impact upon primary temperature. Adequate heat removal was

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was maintained at all times with no ECCS actuation. Emergency Power was not required.

For the July 29 trip, plant response was normal. Primary pressure dropped to 2098 psig before recovering. Temperature dropped below the no-load target (557 degrees-F) to a minimum of 551.4 degrees due to auxiliary feedwater flow and falling steam pressure before recovering to the no-load target. Steam pressure peaked at 1099 psig in S/G "C" before stabilizing at 1045 psig. No S/G PORV's opened. S/G Level decreased to a minimum of 28% (narrow range) in S/G "A" before recovering. Adequate heat removal was maintained at all times with no ECCS actuation or Safety Injection. Emergency power was not required.

The health and safety of the public were not affected by this incident.

DUKE POWER COMPANY
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HAL B. TUCKER
VICE PRESIDENT
NUCLEAR PRODUCTION

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August 12, 1985

Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: McGuire Nuclear Station, Unit 2
Docket No. 50-370
LER 370/85-19

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report 370/85-19 concerning two reactor trips due to phase differential current protective devices actuating causing a turbine trip. This event was considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

H.B. Tucker
Hal B. Tucker

JBD/hrp

Attachment

cc: Dr. J. Nelson Grace, Regional Administrator
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