NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

# LICENSEE EVENT REPORT (LER)

| FACILITY NAME (1) | DOCKET NUMBER (2) | PAGE (3) |
|---|---|---|
| McGuire Nuclear Station - Unit 2 | 0 5 0 0 0 3 7 0 | 1 OF 0 4 |

TITLE (4)
Reactor Trip on Loss of Generator Exciter Voltage Regulator

| 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 5 0 0 0 |
| 1 0 | 2 6 | 8 5 | 8 5 | — 0 2 7 | — 0 0 | 1 1 | 2 5 | 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) | 20.405(c) | X 50.73(a)(2)(iv) | 73.71(b) |
| POWER LEVEL (10) 0 9 1 | 20.405(a)(1)(i) | 50.36(c)(1) | 50.73(a)(2)(v) | 73.71(c) |
| | 20.405(a)(1)(ii) | 50.36(c)(2) | 50.73(a)(2)(vii) | OTHER (Specify in Abstract below and in Text, NRC Form 366A) |
| | 20.405(a)(1)(iii) | 50.73(a)(2)(i) | 50.73(a)(2)(viii)(A) | |
| | 20.405(a)(1)(iv) | 50.73(a)(2)(ii) | 50.73(a)(2)(viii)(B) | |
| | 20.405(a)(1)(v) | 50.73(a)(2)(iii) | 50.73(a)(2)(x) | |

LICENSEE CONTACT FOR THIS LER (12)

| NAME | TELEPHONE NUMBER |
|---|---|
| Jerry Day, Licensing | 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 NPRDS | | CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO NPRDS | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
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| SUPPLEMENTAL REPORT EXPECTED (14) | | EXPECTED SUBMISSION DATE (15) | MONTH | DAY | YEAR |
|---|---|---|---|---|---|
| YES (If yes, complete EXPECTED SUBMISSION DATE) | X NO | | | | |

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

On October 26, 1985, at 0240, the Unit 2 reactor tripped from 91% power due to a turbine trip. The turbine trip was initiated when an improperly aligned fuse in the generator voltage regulator sensing circuitry caused the voltage blocking relay to energize and swap control from "automatic" to "manual". Because of the deadband in the regulator automatic compensation circuits and the higher voltages applied from the recently installed permanent magnet generator, a significant step change in output voltage was seen by the protective relaying. The loss of field relay sensed this voltage step as a loss of excitation condition and operated to isolate and shutdown the generator.

The fuse was improperly installed due to a lack of training; therefore this incident is attributed to a management deficiency.

All systems responded properly to the trip with few exceptions. The fuse was reinstalled correctly and training on fuse installation will be developed.

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| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
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| McGuire Nuclear Station - Unit 2 | 0 5 0 0 0 3 7 0 | 8 5 | — 0 2 7 | — 0 0 | 0 2 OF 0 4 |

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

On October 26, 1985, at 0240, the Unit 2 reactor tripped due to a turbine trip from 91% power. The turbine trip was initiated when an improperly aligned fuse in the generator voltage regulator sensing circuitry caused the voltage balance blocking relay to energize and swap control from "automatic" to "manual". The swap to manual should not have caused a turbine trip. Because of the deadband in the regulator automatic compensation circuits and the higher voltages applied to the exciter from the recently installed permanent magnet generator, a significant step-change in output terminal voltage was seen by the generator protective relaying. The loss of field relay sensed this voltage step as a loss of excitation condition and operated to isolate and shutdown the generator. The reactor trip followed the turbine trip as designed.

Unit 2 was in Mode 1 at 91% power at the time of the incident.

The fuse was improperly installed due to a lack of training. Therefore, this incident is attributed to a Management Deficiency.

Background

The exitation switchgear and voltage regulator components control the field current to the main generator to accurately maintain the generator output voltage at its rated value. The exitation system operates in one of two modes: manual voltage control or automatic voltage regulation. Normal operation is in the automatic voltage regulation mode in which the electronic circuits automatically adjust the generator excitation to compensate for changes in generator load and power factor.

When in automatic operation, both the base adjuster and the automatic control system supply signals to the firing circuits. The automatic signal either adds to or subtracts from the base adjuster signal to equal the demand of the automatic control setpoint. When the automatic signal exceeds a preset level, the base adjuster follower circuit initiates a correction signal to move the base adjuster potentiometer until its output closely matches the automatic demand setpoint. This scheme prevents large changes in generator excitation if the system is unexpectedly swapped from automatic to manual mode by protective equipment.

Description of Event

The Unit 2 permanent magnet generator (PMG) was damaged beyond repair on July 12, 1985 following a turbine trip (reference LER 370/85-19). The PMG was replaced and the unit was placed back in service following that event. The new PMG was supplying approximately 150 volts AC during operation. The original PMG supplied 120 volts AC. The increase in exciter field voltage may have affected the exciter current control system.

A primary fuse in the potential transformer which measures the generator output voltage was incorrectly positioned in the fuse holder and was intermittently causing a false imbalance signal to the protective relaying circuits. To prevent false turbine trips when a fuse blows, a voltage balance blocking relay is used to defeat the trip function. When this relay actuates, the generator is automatically swapped from automatic to manual operation. The mispositioned fuse had caused the generator to automatically swap from automatic to manual on several occasions prior to this event without incident. The cause of these swaps could not be determined while the generator was still on line.

These and other fuses in the station are removed as required to isolate electrical circuits for personnel safety. The fuses are removed and replaced and appropriately "tagged" for safety. There are no specific procedures for removing fuses since the task is of a simple nature. These particular fuses are approximately 18 inches long. The metal contacts on the ends of the fuses have a shoulder which is an alignment device. This shoulder was in contact with the holder clamp and did not allow maximum contact of the holder and fuse.

The fuses had been removed in August 1985 to facilitate work on the main generator current transformers.

Conclusion

The mispositioned fuse caused the generator to swap to manual operation at a time when the base adjuster potentiometer was not closely matched to the automatic signal.

Under certain conditions the swap from automatic to manual would produce a large change in the exciter field current. This large drop in exciter current caused a drop in generator output voltage great enough to be sensed by the protective relaying. The loss of field relay actuated during this event to isolate and shut down the generator.

The momentary dip in the generator output voltage caused a voltage dip on the station transformers and load centers. The voltage on all three phases of the A train 4160 Bus (2ETA) dropped below the undervoltage trip setpoint which initiated a blackout signal and started the diesel generator 2A. The voltage dip was of short duration and the 2ETA load sequencer did not actuate. Only one phase on the 2ETB bus momentarily dropped low enough to pick up an undervoltage relay. This did not initiate a diesel generator 2B start.

During the subsequent unit startup, the generator tripped two times due to a loose X phase regulating potential transformer drawer. This drawer was not properly secured following the inspection of the potential transformer fuses. The result of the improperly secured drawer was the actuation of the neutral ground detection relay. A reactor trip did not occur at this low power level.

This is the first incident of this nature at McGuire. Due to the unique combination of the misaligned fuse and PMG voltage variance, this is determined to be an isolated event.

CORRECTIVE ACTIONS:

Immediate: Appropriate measures were taken to stabilize the unit following the turbine trip/reactor trip.

Subsequent: The potential transformer fuse was discovered installed incorrectly and was correctly replaced.

The voltage balance blocking relay function has been temporarily disabled to eliminate the automatic swapover from automatic to manual operation.

The unit main power oscillograph has been temporarily connected to monitor the regulator voltages. The voltage balance blocking relay was connected to initiate the oscillograph.

Planned: Training for the installation of these fuses will be developed and incorporated into the Employee Training and Qualification Program (ETQS) and also included in the Nuclear Equipment Operator Requalification Program.

The exciter is to be returned to Westinghouse for inspection and replacement of the PMG with a unit designed for this application.

SAFETY ANALYSIS:

The turbine trip/reactor trip in this incident was initiated by the main generator protective relaying circuits. The voltage balance blocking relay function has been temporarily defeated but the sensing circuit will still energize the relay and initiate the unit oscillograph. This defeated relay function reduces the units' ability to prevent a turbine trip due to a blown fuse in the sensing circuits.

TRANSIENT ASSESSMENT:

Primary system parameters responded properly following the trip will Tave converging to the no-load target of 557 degress -F, and pressure dropping to a minimum of 2034 psig before recovering to the post-trip reference value of 2235 psig. No Emergency Core Cooling Systems were actuated. Steam generator (S/G) levels responded properly, dropping to a minimum of 27% (Narrow Range) in S/G "C" before recovering to the target of 38%. The maximum steam pressure was 1102 psig in S/G "B"; no S/G PORV's opened (this is proper). The only anomaly was the feedwater pump recirculation valves responded slowly following the feedwater isolation. This led to a trip of the three condensate booster pumps then the main feedwater pumps. Auxiliary feedwater initiated on the feedwater pump trips to supply the steam generators, as designed.

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

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HAL B. TUCKER
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NUCLEAR PRODUCTION

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November 25, 1985

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

Subject: McGuire Nuclear Station, Unit 2
Docket No. 50-370
LER 370/85-27

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report 370/85-27 concerning a reactor trip due to the loss of generator exciter voltage regulator. This event was considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

Hal B. Tucker/jgm

Hal B. Tucker

JBD/jgm

Attachment

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