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 1	0 5 0 0 0 3 6 9	1 OF 0 6

TITLE (4)
LOSS OF ALL NORMAL OFF-SITE POWER

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 8	2 1	8 4	8 4	0 2 4	0 0	1 1	0 5	8 4		0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9):
POWER LEVEL (10): 1 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check one or more of the following)* (11)

[ ] 20.402(b)	[ ] 20.405(c)	[ ] 50.73(a)(2)(iv)	[ ] 73.71(b)
[ ] 20.405(a)(1)(i)	[ ] 50.36(c)(1)	[X] 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 (AREA CODE)
SCOTT GEWEHR - LICENSING	7 0 4 3 7 3 - 7 5 8 1

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)

[ ] YES *(If yes, complete EXPECTED SUBMISSION DATE)* [X] NO

EXPECTED SUBMISSION DATE (15): MONTH | DAY | YEAR

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

At approximately 2400 on August 20, 1984, the McGuire switchyard computer was reported inoperable. On August 21, 1984, computer and inverter maintenance personnel performed corrective maintenance on the switchyard computer and static inverter. At 2114, the switchyard computer was re-started, checked for operability, and returned to service. At 2148, when the switchyard operator re-enabled the computer control outputs, thirty (30) power circuit breakers (PCBs) and associated disconnects opened, resulting in McGuire Unit 1 reactor trip and turbine trip, loss of Unit 1 offsite AC power, and startup of Unit 1 diesel generators A and B.

Unit 1 was in mode 1 at 100% power at the time.

This incident is classified as a Component Malfunction/Failure because the control circuits were changed to an undesirable state without a command from the computer, apparently during computer and inverter maintenance. Design Deficiency also contributed because the computer program did not include a function to reset the computer output control circuits to a predetermined state when the computer is restarted.

The behavior and control of the transient which resulted from the reactor and turbine trip were as could be expected, and the health and safety of the public were unaffected by this incident.

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FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
MCGUIRE NUCLEAR STATION UNIT 1	0 5 0 0 0 3 7 0	8 4	— 0 2 4 —	0 0	0 2 OF 0 6

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

Corrective actions included, or will include, a modification to the computer control of switchyard PCBs, increase settings on the two transmission lines which tripped on overcurrent to allow them to carry unit 1's full output, improvement of relay house lighting, review of operating and maintenance procedures to determine potential effects on off-site power, and scheduled replacement of existing equipment (e.g., the switchyard computer).

INTRODUCTION: On August 21, 1984, a reactor trip occurred at 2148:46, initiated by a Nuclear Instrumentation (N/I) Power Range Hi Flux Rate signal. The trip signal was caused by an electrical disturbance induced into the station when two transmission line power circuit breakers (PCBs) tripped on overcurrent. All of the Unit 1 generator output had been concentrated on the two lines seventeen (17) seconds earlier (2148:29) when all but eight 230KV and 525KV switchyard PCB's and associated disconnects simultaneously opened. The opening of thirty (30) switchyard PCB's occurred when the switchyard operator re-enabled computer control outputs by pressing the ENABLE pushbutton on the switchyard control board. The switchyard computer was being returned to service, following satisfactory operability checks which were performed at the completion of computer maintenance.

The incident is classified as a Component Malfunction/Failure because the control circuits were changed to an undesirable state without a command from the computer, apparently during computer and inverter maintenance. A Design Deficiency also contributed because the computer program did not include a function to reset the computer output control circuits to a predetermined state when the computer is restarted.

COMPUTER MAINTENANCE DESCRIPTION: The McGuire switchyard computer is a GE 4010 process control digital computer. Installed in 1971, it communicates with the Charlotte Area Operating Center (C-AOC) computer over a computer to computer data link. The data link is a dedicated point to point communications path which enables the C-AOC to remotely monitor and control the McGuire switchyard. The McGuire switchyard computer also has a data link to the McGuire Nuclear Station Unit 1 Operator Aid computer (OAC) which enables the McGuire Nuclear Station to remotely monitor the switchyard.

The switchyard computer has no "bulk storage" capability for saving a copy of the software programs that run in its "core" memory. A copy of the McGuire switchyard computer software is maintained at the C-AOC. Core memory is designed to retain its contents even upon loss of power. Occasionally the memory contents are destroyed due to overwriting by maintenance diagnostic programs or other events. If the core contents have to be restored, it can be achieved by transferring a copy of the McGuire software over the data link from the C-AOC.

Switchyard monitoring capability is in service whenever the computer is put in service; however, the control circuits, which may be disabled through various disabled interlocks, can only be enabled through a manual ENABLE pushbutton on the relay house switchboard. The McGuire switchyard computer can control a "Control Test Point" relay to verify its control capability and its status monitoring performance. The supply voltage to the test relay is not tied to the supply for the other computer control circuits so that the computer performance can be verified without having to enable control outputs to the switchyard.

The C-AOC dispatcher has full monitoring and control capability of the McGuire switchyard; however, C-AOC control of the eight (8) PCBs (8, 9, 11, 12, 58, 59, 61, and 62) that connect the unit bus lines to the switchyard is normally disabled.

On August 20, 1984 the McGuire switchyard computer was reported inoperable. On August 21 maintenance personnel performed corrective maintenance on the switchyard computer and the status inverter.

McGuire Switchyard Computer and Inverter Problems

Following the corrective maintenance on the computer, system operational checks were made which showed the computer system operating properly. The switchyard computer is used to perform control functions i.e., opening and closing PCB's as well as providing information about the status of switchyard equipment to the Charlotte dispatcher computer and the McGuire operator aid computer. The control output relays used are "Latching" type in both the open and closed positions. Power is required to change them from one state to the other. Since the state of the computer control output relay contacts is not readily observable or detectable by hardware or software, neither computer maintenance personnel nor the dispatcher were aware that the relay contacts were closed. At least some of the relays were in the wrong state at this time. There are no alarms or status lights to indicate the position of the output relay contacts. The closed relay contacts caused the subject PCB's to open when control voltage was reapplied to interposing relays via the ENABLE pushbutton.

Operation of Power Circuit Breakers in the McGuire Switchyard

When the "ENABLE" pushbutton was pressed by the switchyard operator, all of the PCBs opened except those associated with the Unit 1A and 1B bus line (PCBs 8, 9, 11, and 12) and Unit 2A and 2B bus line (PCBs 58, 59, 61, and 62). Switchyard computer control of these eight PCBs is normally disabled by selector switches in the McGuire Control Room. (This was the case during the event.) All of the Unit 1 generator output was then concentrated on the Craighead White Line and the Mecklenburg Black Line. The Craighead White Line overcurrent relay 51Z tripped PCB-8 and the Mecklenburg Black Line tripped at the Harrisburg Tie on overcurrent relay 51Y leaving McGuire Unit 1 generator feeding only its plant auxiliary equipment. The sudden loss of load caused a turbine overspeed condition, which caused the turbine overspeed protection to actuate. At this point the turbine sequential tripped scheme would normally detect a reverse power condition and trip the generator. But since Unit 1 was already separated from the transmission system, this (reverse power) could not occur. The 6.9 KV busses (1TA, 1TB, 1TC, and 1TD) spiked to ~7.4 KV and corresponding 450 ampere neutral current spikes were recorded from the 24 KV step-up transformers 1A and 1B. This produced a power supply spike on the nuclear instrumentation which resulted in an N/I Power Range High Flux Rate Trip signal, tripping the reactor. This electrical system disturbance is being evaluated to determine the cause and possible ways to minimize the effects should a similar incident occur.

As all offsite loads were disconnected from the generator, the turbine speed increased to 1957 RPMs, increasing generator frequency to 65.0 Hz. (Reactor and turbine had tripped by this time and main steam was isolated from the turbine.) The turbine speed and generator frequency then started decreasing until the generator volts/hertz relay tripped the generator circuit breakers. This caused an undervoltage on the 4160 V bus which initiated the blackout logic and started diesel generators (D/Gs) 1A and 1B. (Generator output voltage and 6.9 KV bus voltage remained relatively constant between the time the turbine tripped and the volts/hertz relay operated, even though frequency dropped to 51 Hz. This is attributed to compensation by the automatic voltage regulator.) When the blackout logic was initiated, both D/Gs were up to speed within 10 seconds and all 10 load groups were sequenced on within 15 seconds (both times are within the design requirements and Technical Specifications).

Unit 1 Reactor Trip Caused By N/I Power Range High Flux Rate Trip

The reactor tripped at 2148:46.230 from 100% power on Nuclear Instrumentation (N/I) Power Range High Flux Rate Trip. The setpoint for this type of trip is an excore power increase of greater than or equal to 5% in two seconds on two out of four excore channels. A review of plant parameters by the McGuire Reactor group indicated that no justification could be made to support an actual reactivity increase which could have resulted in a N/I Power Range High Flux Rate Trip. A review of the excore chart recorders indicated power range spikes on all four power range channels with channel N-42 and N-43 reaching the 5% trip setpoint. When the last transmission line was isolated, voltage immediately increased 8% on the 6.9 KV bus. If this action is assigned time zero, then the 24 KV main step-up transformer 1A and 1B neutral current spike ended in approximately 6 milliseconds. The voltage spike ended 1.23 seconds after time zero. The N/I Power Range High Flux Rate Trip was received at 1.25 seconds after time zero and reactor trip breaker "B" tripped at 1.31 seconds after time zero.

Transient Analysis

Reactivity was properly controlled by the reactor trip. Pressurizer pressure dropped immediately after the trip to ~2030 psig, then recovered to 2235 psig as pressurizer level increased because of high charging flow, with letdown isolated.

Pressurizer level dropped immediately following the trip to ~38%. Letdown was isolated about 50 seconds after the trip on a 0% level indication on channel 2 as a result of a voltage spike. Pressurizer level increased as the full charging flow of both centrifugal charging pumps was injected once they were loaded on the D/G, and as hot leg temperature increased. Level reached a post-trip maximum of ~46%, at which time the charging flow was decreased. Level then decreased toward its no-load target (25%). Level increased again to ~32% thirty minutes after the trip as charging flow was increased slightly and primary temperature began to recover. Level as indicated on channel 1 remained within acceptable limits at all times.

The pressurizer pressure master was taken to manual, and charging flow was reduced ~7 minutes after the trip. Letdown was reestablished at that time. Pressurizer pressure then began to decrease to its post-trip minimum of ~1954 psig. Pressurizer Water Temperature was almost constant during this period as the heaters had deeneriqized on load shed. When the backup pressurizer heaters were sequenced on to the diesel, the operators experienced difficulty in closing the breakers, because the low pressurizer level alarm had not yet been reset. (The pressurizer heaters are deenergized on low pressurizer level to prevent them from operating in a steam environment.) Once the alarm was reset, the operators were able to energize the heaters ~25 minutes after the trip. Pressure then began to recover toward its reference value. Pressure remained well below the uncompensated PORV setpoint (2335 psig) and above the Safety Injection setpoint (1845 psig) at all times.

Reactor Coolant System Hot Leg Temperature dropped immediately after the reactor trip as heat production decreased, and steam was relieved through the steam dump valves. Hot leg temperature began to rise again as the NC pumps coasted down and natural circulation flow developed. Core ΔT stabilized between 35 an 40°F, as expected for natural circulation. Both hot and cold leg temperatures then decreased as the steam pressure decreased. Temperature stabilized and began to recover once the steam pressure decrease ended. Minimum average coolant temperature was ~530°F.

Reactor coolant flow increased prior to the trip as frequency on the busses increased, and dropped as frequency dropped. The flow coasted down as expected once the Reactor Coolant Pump breakers tripped on underfrequency.

Steam pressure peaked at ~1150 psig after the trip. This is below the setpoint the first bank of Main Steam Safety Valves (1170 psig). The steam pressure was initially controlled by the steam dump to condenser valves, which opened following the trip. These valves all closed by 50 seconds after the reactor trip. The condenser was available for steam relief until the 6900 V busses deenergized 43 seconds after the reactor trip.

Steam pressure continued to decrease after the steam dump valves closed because of the high steam demand and high auxiliary feedwater flows needed to recover level. Unit 1 was carrying the auxiliary steam load for both units at the time of the trip. (Unit 2 was preparing to start up at the time of the trip, and was drawing steam for its main feedwater pumps and other needs.) Steam pressure reached a minimum of 735 psig at 22:10:34 when the operators manually isolated main steam. Pressure had recovered to ~790 psig thirty minutes after the trip.

Steam generator level had dropped to ~55% at the time of the trip when the steam pressure rose as the turbine governor valves closed. All four low-low steam generator level reactor trip signals came in within 0.155 seconds of the Power Range High Flux Rate Reactor Trip, and all 3 auxiliary feedwater pumps initiated on low-low steam generator level. Steam generator level fell following the trip to ~34% narrow range. Main feedwater was isolated on reactor trip with coincident low Tave at 2149:12. The motor driven pumps were load shed on blackout and re-started

~10 seconds later. Flow came on full when the pumps were restarted as the valves were already open. The operators secured the Turbine Driven Auxiliary Feedwater pump at 12:57:39 as levels were above their no-load target of 38%. The operators then adjusted auxiliary feedwater flow to maintain steam generator level with the higher than normal steam demand. The levels smoothed out once main steam was isolated. At 30 minutes after the trip all 4 steam generators were within 4% of the no-load target level.

At 2149:48 the 2 out of 3 undervoltage logic for ETA and ETB was satisfied. The blackout logic initiated properly for both trains, and both diesel generators started. Once the 8 second time delay and voltage test were completed, the two sequencers load shed and loaded the blackout load groups on the diesels. All loads were on the diesel within 15 seconds of the blackout logic actuation, as expected by the accelerated sequence. Containment ventilation was isolated at 21:49:34 when the circuit breaker for EMF's 38, 39, 40 opened.

No Safety Injection actuation occurred. The pressurizer PORV's and code safety valves were not challenged. Indicated pressurizer and steam generator levels remained on-scale. The primary temperature decrease was within the 100°F/hour Technical Specification limit. There was no abnormal release of radioactivity during this event, and no abnormal coolant leakage.

CORRECTIVE ACTION: Corrective actions have been initiated to prevent recurrence of this event. These actions include addition of a control output relay test circuit to provide computer maintenance and operating personnel with confirmation that all control output relays are open prior to re-enabling control outputs. Also, the computer's initialization software has been modified to reset all control output relays to the "open" position on re-initialization (manual and auto-restart).

Relay settings on the Craighead White and Mecklenburg Black lines, which tripped on overcurrent during the event, have been increased to allow these two lines to carry full Unit 1 output.

Other related corrective actions include:

1) Relay house emergency lighting will be improved. Low-level emergency lighting in the switchyard relay house hampered restoration of power to the switchyard.

2) Operating and maintenance activities will be reviewed for potential impact on off-site power.

3) Consideration is being given to the replacement of existing "latching" type control outputs with "momentary" type outputs.

4) Independent of this incident, plans had been made to replace the existing switchyard computer by December 1986. This schedule has been accelerated.

These corrective actions will be completed by 12/85.

DUKE POWER COMPANY
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November 9, 1984

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

Subject: McGuire Nuclear Station, Unit 2
Docket No. 50-369
LER 369/84-24

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report 369/84-24 concerning loss of off-site power which is submitted in accordance with §50.73 (a)(2)(iv). Initial notification of this event was made (pursuant to §50.72 Section (a)(3)) with the NRC Operations Center via the ENS on August 21, 1984, and an unusual event was declared. 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 / [illegible]

Hal B. Tucker

SAG/mjf

Attachment

cc: Mr. James P. O'Reilly, Regional Administrator
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