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Point Beach Nuclear Plant
6610 Nuclear Road
Two Rivers, WI 54241

NRC 2001-006

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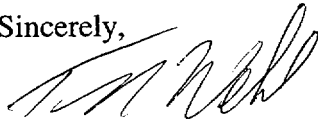
Ladies/Gentlemen:

DOCKET NO. 50-301
LICENSEE EVENT REPORT 301/2001-001-00
GROUND FAULT RELAY ACTUATION CAUSES GENERATOR
LOCKOUT AND REACTOR TRIP
POINT BEACH NUCLEAR PLANT UNIT 2

Enclosed is Licensee Event Report 301/2001-001-00 for the Point Beach Nuclear Plant Unit 2. This report is provided in accordance with 10 CFR 50.73(a)(2)(iv)(A) as, "any event or condition that resulted in a manual or automatic actuation of any of the systems listed in paragraph (a)(2)(iv)(B) of this section... including reactor scram and trip." This report documents an automatic reactor shutdown that occurred as a result of a turbine generator lockout and main turbine trip. Although no definitive cause was identified, the lockout was apparently initiated by a generator stator neutral ground fault device.

Immediate corrective actions have been completed and are listed in this report. Additional corrective action commitments are identified by italics in this report.

Please contact us if you require additional information concerning this event.

Sincerely,

T. J. Webb
Licensing Director

Enclosure

CWK/jlk

cc: NRC Resident Inspector
PSCW

NRC Regional Administrator
INPO Support Services

NRC Project Manager

IE22

LICENSEE EVENT REPORT (LER)

(See reverse for required number of
digits/characters for each block)

Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOF-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

FACILITY NAME (1)

POINT BEACH NUCLEAR PLANT UNIT 2

DOCKET NUMBER (2)

05000301

PAGE (3)

1 OF 4

TITLE (4)

Ground Fault Relay Actuation Causes Generator Lockout and Reactor Trip

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
02	06	2001	2001	B 001	B 00	03	07	2001	FACILITY NAME	DOCKET NUMBER
THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR *: (Check all that apply) (11)										
OPERATING MODE (9)			20.2201(b)			20.2203(a)(3)(ii)			50.73(a)(2)(ii)(B)	
			20.2201(d)			20.2203(a)(4)			50.73(a)(2)(iii)	
POWER LEVEL (10)			20.2203(a)(1)			50.36(c)(1)(I)(A)			X 50.73(a)(2)(iv)(A)	
			20.2203(a)(2)(i)			50.36(c)(1)(ii)(A)			50.73(a)(2)(v)(A)	
			20.2203(a)(2)(ii)			50.36(c)(2)			50.73(a)(2)(v)(B)	
			20.2203(a)(2)(iii)			50.46(a)(3)(ii)			50.73(a)(2)(v)(C)	
			20.2203(a)(2)(iv)			50.73(a)(2)(I)(A)			50.73(a)(2)(v)(D)	
			20.2203(a)(2)(v)			50.73(a)(2)(I)(B)			50.73(a)(2)(vii)	
			20.2203(a)(2)(vi)			50.73(a)(2)(I)(C)			50.73(a)(2)(viii)(A)	
			20.2203(a)(3)(i)			50.73(a)(2)(ii)(A)			50.73(a)(2)(viii)(B)	
OTHER Specify in Abstract below or in NRC Form 366A										

LICENSEE CONTACT FOR THIS LER (12)

NAME

Charles Wm. Krause

TELEPHONE NUMBER (Include Area Code)

(920) 755-6809

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTORER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTORER	REPORTABLE TO EPIX

SUPPLEMENTAL REPORT EXPECTED (14)

YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO	EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
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ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On February 6, 2001, at approximately 2150, the Point Beach Nuclear Plant (PBNP) Unit 2 tripped from 100% power. The trip was the result of a turbine generator lockout apparently caused by one of the generator stator neutral ground fault detection devices (27/59N relay). System and components required to perform following the reactor trip operated as designed with the possible exception of the cross over steam dump system. This system actuated as expected to minimize the turbine over speed; however, main condenser vacuum was lost when the dump valves apparently failed to reseal promptly. The reactor coolant system was maintained in hot standby following the trip with temperature maintained via the steam generator atmospheric steam dump valves.

Following extensive trouble shooting and a thorough incident investigation, PBNP Unit 2 was restarted on February 8th. Since the exact cause for the actuation of the 27/59N relay could not be determined, the plant was returned to operation after completing a temporary modification to change the relay circuit from a generator lock out actuation to a common alarm function. Prior to 1987, the PBNP units had operated without these relays. Other installed protective relaying is available to minimize the risk of faulting due to a stator ground.

The NRC was notified of this event via the ENS at 2244 on February 6, 2001. The safety and welfare of the public and the plant staff was not impacted by this event.

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

Event Description:

On February 6, 2001, at 2152 (all times are CST), while operating at 100% power, the Point Beach Nuclear Plant (PBNP), Unit 2, experienced a generator [TB] lockout which caused an immediate opening of the main generator breaker [BKR], followed closely by a turbine [TA] trip, and an automatic reactor [RCT] trip. The generator lockout was caused by the 27/59N relay [64], which is one of the stator neutral ground detection devices. The 27/59N relay, hereafter referred to as the "RAGEA" relay, is an electronic device installed in Unit 2 in 1987 and Unit 1 in 1988 as part of a system wide modification to provide additional fault protection and detection for the generator. The 27 device is designed to protect the last 5% of the generator windings closest to the neutral connection from a ground fault. The other 95% of the windings is protected by the 59 device of the RAGEA relay and a separate relay (the 59N relay), both of which did not actuate during the event.

The plant operating staff responded to the reactor trip by entering the appropriate Emergency Operating Procedure, EOP 0, "Reactor Trip or Safety Injection," and transitioned to EOP 0.1, "Reactor Trip Response." As expected following a loss of load from greater than 430 MW load, the cross over steam dump system [JI], which is designed to minimize turbine overspeed, actuated. Following this actuation, the plant experienced a loss of condenser [SG] vacuum. We believe this was a result of the cross over steam dump valves failing to reseal promptly. In response to this condition, the operating staff also entered AOP-5A, "Loss of Condenser Vacuum" in parallel with EOP 0.1. AOP-5A directed the shutting of the main steam isolation valves. Reactor Coolant System [AB] temperature and pressure were then controlled using the atmospheric Steam Dump system [RV]. All other systems and equipment necessary for operation following the trip operated as expected and the unit remained stable at normal hot shutdown temperature and pressure.

A post trip review, incident investigation, and root cause evaluation were initiated. The NRC was notified of the event in accordance with 10 CFR 50.72(B)(2)(iv)(B) at 2244 (Event Notification 37722). The unit trip and the loss of condenser vacuum following the cross over steam dump actuation have been documented in the corrective action program (CR 01-0389 and CR 01-0397 respectively).

Extensive trouble shooting and investigations were completed in an attempt to determine why the RAGEA relay 27 device actuated. These efforts are discussed in detail in the Cause and Corrective Action Sections of this report. PBNP Unit 2 was subsequently released for restart at 0100 on February 8. Unit 2 was taken critical at 1402 on the 8th and returned to service at 1426 on February 9, 2001.

Cause:

On December 17, 2000, while conducting generator voltage regulator [TL] testing, a generator lockout and turbine trip were initiated by this same RAGEA relay. At that time the reactor power was at 28% and, since the plant is designed to accept up to a 50% load rejection, the reactor was not automatically tripped and remained in operation. The Unit 2 voltage regulator had been modified during the PBNP Unit 2 Fall 2000 refueling outage. The post modification testing required testing of the minimum excitation limiter protective settings by operating with a leading power factor, i.e. bringing MVARS into the generator. While conducting this testing, at approximately 200 MVARS in, this same RAGEA relay actuated and caused a generator lock out and turbine trip. Our investigation of that event determined that the RAGEA relay, which uses the third harmonic (180 Hz) voltage on the generator neutral ground as an indication of a fault within the first 5% of the winding closest to neutral, had detected a decreasing third harmonic voltage and actuated correctly. Following this relay actuation, we found that the third harmonic voltage could be diminished when operating at low power levels with a leading power factor. The increase of MVARS in during the test caused the third harmonic voltage to decrease to the relay trip point. However, during the lockout on February 6, 2001, the unit was operating with a lagging power factor, 75 MVARS out, and there were no switching or other transients experienced on the transmission system. Furthermore, Point Beach Unit 1 has the same relay with the same setpoint. An actual system disturbance would, therefore, be likely to affect both units. No problems or abnormalities were observed on Unit 1. Accordingly, we do not believe that the cause of the February 6th RAGEA relay actuation is related to the December

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17th turbine generator trip.

The following actions were taken during the investigation of the cause of this trip included:

- Fault recorders in the stator ground protection relay circuit were checked and showed no evidence of an actual fault nor any abnormal third harmonic around the time of the trip. The information from the Unit 2 and Unit 1 recorders was similar.
- The generator phase to ground circuit was meggered and found to be satisfactory with no evidence of an actual ground. The primary and secondary neutral grounding connections were inspected with no loose connections found.
- The RAGEA relay was calibrated and tested in place and found to be functioning properly. This included verification of the four second trip time delay.
- The relay signal circuit connections were verified to be tight. The cables in the signal circuit were meggered and found to be satisfactory.
- The 2-59N-TG01 relay which provides ground fault protection for 95% of the stator windings was calibrated and found to be functioning properly.
- The neutral grounding transformer was disconnected and had a turns ratio test performed acceptably.
- Since the RAGEA relays may be sensitive to radio frequency (RF) transmissions, the possibility of radio transmissions in proximity to the relay was investigated. Interviews with personnel using radios that evening in the vicinity of the relay cabinet established that no one was located in the area at the time of the trip. Furthermore, no one recalled hearing any radio communications just prior to the trip.
- During the trouble shooting and investigation of this fault the PBNP engineering staff was assisted by protective relay experts from Wisconsin Electric Power Company and the American Transmission Company.

Despite the extensive post trip testing and information gathering and analysis, we could not substantiate or provide a reason for the RAGEA relay actuation. Indeed, our evaluation determined that the plant was operating under steady state conditions with no abnormalities noted prior to the time of the trip. At this time, our conclusion is that either the plant experienced a spurious relay actuation or there is an intermittent ground somewhere in that circuit that is currently gone or undetectable. Based on start up monitoring and the current unit operation without relay actuation at essentially the same conditions as the trip, we consider it unlikely that the latter condition existed.

Corrective Actions:

Since a definitive reason for the relay trip was not determined, the following corrective actions have been or will be taken:

- Based on the non-conclusive findings of our incident investigation and trouble shooting and the advice of the protective relay experts we had consulted, we completed a temporary modification to change the actuation of the 27 device of the RAGEA relay from initiating a generator lockout relay trip to initiating a common alarm function in the control room. As noted above, PBNP operated until 1987 for Unit 2 and 1988 for Unit 1 without these relays. There is minimal risk of a stator ground in the generator which would not be caught by other installed protective relaying. This action also minimizes the potential for additional plant and reactor transients which could be initiated

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by a future spurious relay actuation. Our review of industry operating experience identified another plant which had experienced a similar trip (eventually traced to an incorrect setpoint) with a RAGEA relay and took the same action (temporarily removing the trip function). The trip removal in that case was subsequently made permanent.

- Prior to the unit restart, test equipment was connected to measure composite neutral to ground voltage and the third harmonic frequency component of the neutral to ground voltage. Performance of this relay was monitored during the unit start up. During generator excitation and synchronization to the grid relay performance was observed by system protection experts and system engineers in the control room. No problems were observed with this device during the startup or subsequent operations.
- Guidance to the control room operators on how to respond to an alarm from the RAGEA relay has been provided.
- *The monitoring instrumentation and operations procedural guidance will remain in effect until we can conduct additional evaluations of this relay and determine longer term corrective actions.*
- *System engineering is evaluating the performance of the cross over steam dump system to assess whether the system performed as expected and to determine if corrective measures are necessary.*

Safety Assessment:

With the exception of the ground fault relay which initiated this event and the loss of condenser vacuum (which was likely due to the cross over steam dump valves not reseating promptly), the plant response during and following this inadvertent RPS actuation was as expected. Systems and equipment necessary to mitigate the consequences of this transient performed as designed and maintained the plant in a stable hot shutdown condition. Following the investigation of the cause of the unit transient and the modification to the relay actuation circuit to preclude a recurrence of the generator lock out in the event of another spurious relay actuation, no further problems were experienced during the subsequent unit restart and return to full power operations. We have, likewise, experienced no spurious relay actuation during the subsequent Unit 2 power operations. Other than the inadvertent challenge of the reactor protection system and other plant equipment necessary to remove shutdown decay heat and maintain the plant in a stable configuration, the safety significance of this event was minimal. The safety and welfare of the public and the plant staff was not impacted by this event. There was at no time a loss of a system, structure, or component related safety function; therefore, this event did not involve a safety system functional failure.

Similar Occurrences:

A review of recent LERs (past two years) identified the following event which involved a reactor trip due to a protective relaying related fault:

<u>LER NUMBER</u>	<u>Title</u>
301/200-007-00	Fault Associated with "C" Phase Main Step-up Transformer Results in Reactor Scram