LICENSEE EVENT REPORT (LER) — Form Rev. 2.0

Facility Name (1)	Docket Number (2)	Page (3)
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Title (4)

Unit Two Automatic Reactor Scram During EHC Pressure Regulator Fail-Over Testing.

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 9	2 5	9 5	9 5	--	0 0 5	--	0 0	0 9	2 2	9 5	Quad Cities Unit 2	0 5 0 0 0 2 6 5
												0 5 0 0 0

OPERATING MODE (9): 4

POWER LEVEL (10): 0 6 0

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

20.402(b)	20.405(c)	X 50.73(a)(2)(iv)	73.71(b)
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)
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	
Nick Chrissotimos, Regulatory Assurance, Ext. 3100	3 0 9	6 5 4 - 2 2 4 1

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

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)

ABSTRACT:

On August 25, 1995, Quad Cities Unit 2 was operating at 60 percent of rated core thermal power. At 0848 hours, Unit Two experienced an automatic reactor [RCT] scram during an Electro Hydraulic Control (EHC) pressure regulator [RG] fail-over test.

The apparent cause of the event was attributed to the failure of General Electric (GE) and ComEd personnel to recognize that a pressure regulator failure would be a worse reactor transient than a 10 psig pressure step change at Quad Cities Station. Inadequate EHC system pressure regulator setpoint bias and small lag time constant settings were also contributors to the scram.

Corrective actions that have been completed include: adjustment of the EHC system pressure setpoint bias and time lag constants to obtain a smooth output curve that represents a small transient on the system when a pressure regulator fails.

Corrective actions to be completed include: revisions to the EHC lineup instructions for setting up the 3 psig "effective" pressure setpoint bias and inclusion of the correct minor lag time constant on the Steam Line Resonance Compensator circuit boards.

PLANT AND SYSTEM IDENTIFICATION:

General Electric - Boiling Water Reactor - 2511 MWt rated core thermal power.

EVENT IDENTIFICATION: Unit Two Automatic Reactor Scram during EHC Pressure Regulator Fail-Over Testing.

A. CONDITIONS PRIOR TO EVENT:

Unit: Two	Event Date: August 25, 1995	Event Time: 0848
Reactor Mode: 4	Mode Name: Run	Power Level: 60

This report was initiated by Licensee Event Report 265\95-005.

RUN (4) - In this position the reactor system pressure is at or above 825 psig, and the reactor protection system is energized, with APRM protection and RBM interlocks in service (excluding the 15% high flux scram).

B. DESCRIPTION OF EVENT:

On August 25, 1995, Quad Cities Unit 2 was operating at 60 percent of rated core thermal power. At 0848 hours, Unit Two experienced an automatic reactor [RCT] scram on Average Power Range Monitor (APRM) HI-HI flux.

QCTS 360-2, EHC Pressure Regulator Startup Test Procedure, was in progress on the Electro Hydraulic Control (EHC) system. This test involved failing the 'A' pressure regulator [RG] utilizing a "FAIL" switch [HS] contained within the EHC pressure control system to verify the 'B' pressure regulator would properly take control.

This testing was being performed to confirm proper transient operation of the EHC pressure regulation system by imposing various pressure transients on the reactor. The EHC pressure regulation system was tuned during the refuel outage as part of an EHC system refurbishment effort.

When the "FAIL" switch was engaged, an immediate reactor scram ensued. By failing the 'A' pressure regulator, a large pressure error signal was generated within the EHC pressure control circuitry. This error signal caused partial closure of the Turbine Control Valves (TCV) [PCV] that sent a rapid pressure increase to the reactor which in turn caused a scram on HI-HI APRM Flux.

The expected reactor water level transient, due to the collapse of voids following the scram, caused reactor water level to drop below the low level setpoint of +8 inches. Group II and III primary Containment Isolations (PCI) [JM] were received along with Reactor Building Ventilation Isolation [VA], Control Room Ventilation Isolation [VI] and Standby Gas Treatment (SBGT) [BH] initiation.

A reactor cooldown was immediately started and at 1534 hours, the reactor reached cold shutdown.

An Emergency Notification System (ENS) notification of this event was completed at 0948 hours on August 25, 1995 to comply with the requirements of 10CFR50.72(b)(2)(ii).

There were no other systems or components inoperable at the beginning of this event which could have contributed to this event.

C. **APPARENT CAUSE OF EVENT:**

This report is being submitted in accordance with 10CFR50.73(a)(2)(iv), which requires the reporting of any event or condition that results in manual or automatic actuation of any Engineering Safety Feature (ESF) [JE], including the Reactor Protection System (RPS) [JC].

The root cause for the reactor scram was attributed to the failure of General Electric (GE) and ComEd personnel to recognize that a pressure regulator failure would be a worse reactor transient than a 10 psig pressure step change at Quad Cities Station. The ComEd Test Director and on-site GE Field Engineer were advised by GE Nuclear Energy (GENE) that a 5 psig pressure regulator fail-over induced a reactor transient no worse than a 5 to 6 psig pressure setpoint step change. This was found to not be true. Prior to the scram, a 10 psig pressure step change was successfully performed on each pressure regulator with minimal reactor transient response. Therefore, regulator fail-over tests were not performed at smaller pressure setpoint bias' prior to performing the 5 psig fail-over test. This decision was based on the previous assumption that a 5 psig fail-over transient would be no worse than a 5 to 6 psig step change.

The following two items were determined to be contributing causes to this event:

1. During installation of the Steam Line Resonance Compensator (SLRC) circuit boards, GENE recommended that the small lag time constant be adjusted to a value of 256 milliseconds (mS). This is a generic value for Boiling Water Reactor (BWR) plants with approximately 400 foot long main steam lines. The main steam lines at Quad Cities Station are considerably shorter than a standard BWR and thus have a much shorter hydraulic lag time constant. Post SCRAM testing on the EHC pressure control system revealed that overshoot occurred on the gated output signal of the SLRC circuitry. This overshoot caused the TCV's to close further than desired during the time that the 'B' pressure regulator took control of the pressure transient. It was discovered during testing that this overshoot could be minimized by increasing the small lag time constant to a value which makes the total lag (hydraulic lag of steam lines plus small lag of SLRC) equivalent to a plant with longer steam lines.

2. The 'B' pressure regulator is biased each refuel outage such that, upon a failure of the 'A' regulator, the 'B' regulator will take control when the pressure error signal decreases 5.0 psig. After the scram, the 'B' pressure regulator was found with a 5.7 psig bias instead of 5.0 psig. The additional 0.7 psig bias was attributed to the voltage difference between the 'A' and 'B' pressure setpoint motor drives (approximately 0.003 Vdc) at a pressure setpoint of 920 psig. This voltage difference was not taken into consideration during the refuel outage calibration. EHC High Quality (HQ) pressure transducer calibration data obtained after the scram indicated that the output of the 'A' transducer was approximately .007 Vdc higher than the 'B' transducer at a turbine throttle pressure of 930 psig. The calibration difference is inherent to the HQ pressure transducers. The result of the transducer voltage difference placed an additional 1.4 psig bias on top of the as-found pressure setpoint bias of 5.7 psig.

   The two combined biases totalled an "effective" pressure setpoint bias difference of approximately 7.1 psig. This "effective" pressure setpoint bias differential was too large and caused excessive closure of the TCVs in response to the large pressure error signal generated within the EHC pressure control circuitry. This partial valve closure caused a rapid pressure increase in the reactor which in turn caused a SCRAM on HI-HI Flux. A method to determine the "effective" pressure setpoint bias at the time of the test was not employed. Testing personnel relied solely on the pressure setpoint bias dial indication which was calibrated with the reactor in cold shutdown. Inherent instrument calibration inaccuracies in the HQ pressure transducers and the pressure setpoint motor drives were not accounted for and caused the "effective" pressure setpoint bias to be larger than desired.

D. <u>SAFETY ANALYSIS OF EVENT:</u>

The safety significance of this event was minimal. All manual and automatic Engineered Safety Features (ESF) occurred as designed to bring the reactor to a safe shutdown condition. No safety limits were exceeded during this transient. This scram is bounded by the analysis described in UFSAR Section 15.2.2.1, Load Rejection Without Bypass. This analysis is performed each operating cycle to preclude violation of the fuel cladding integrity safety limit.

E. CORRECTIVE ACTIONS:

Corrective Actions Completed:

The immediate corrective actions were to assure proper equipment and personnel response to the scram and that no reactor safety limits were violated.

Further corrective actions were to adjust the EHC pressure control system to obtain a smooth output curve that represented a small transient on the system during a pressure regulator failure. This involved the following:

1. The "effective" pressure setpoint bias between the 'A' and 'B' pressure regulators was changed from a normal bias setting of 5.0 psig to 3.0 psig. This measure reduces the magnitude of the transient observed during a channel fail-over test or actual pressure regulator failure event. A pressure regulator setpoint bias of 3.0 psig is used widely in the industry. Experience to date indicates that the Unit 2 pressure regulators can withstand this tighter tolerance without the regulators interfering with each other. The "effective" pressure setpoint bias was set with the reactor at normal operating pressure by measuring the output voltage difference between each pressure amplifier and adjusting the pressure setpoint bias potentiometer for a voltage difference equivalent to 3 psig (150 mV). This compensates for the inherent inaccuracies of the HQ pressure transducers and pressure setpoint motor drives with the reactor pressurized.

2. The SLRC small lag time constant was increased to 500 mS. This setting minimizes the turbine control valve position demand overshoot following a pressure regulator channel failure. The 500 mS setting compensates for the shorter steam lines at Quad Cities Station by making the total lag (hydraulic lag of steam lines plus small lag of SLRC) equivalent to a plant with an average steam line length of 400 feet. GE field experience indicates that there have been no problems using this setting.

   Testing with the EHC pressure control system in the above configuration was performed on September 6, 1995 in accordance with Interim Procedure Number 995. The 'A' and 'B' pressure regulators were each pressure step change tested at 3 psig, 6 psig, and 10 psig. The 'A' pressure regulator was fail-over tested at "effective" pressure setpoint bias' of 1 psig, 2 psig, and 3 psig between the two regulators. The test results were satisfactory and confirmed the previously stated root cause.

Corrective Actions to be Completed:

The following revisions will be made to the vendor recommended EHC lineup instructions currently utilized at Quad Cities Station to calibrate the EHC system:

1. Proper method for setting up the 3 psig "effective" pressure setpoint bias between the pressure regulators (Instrument Maintenance;NTS #2651809500501).

2. Inclusion of the 500 mS minor lag time constant on the SLRC circuit boards (Instrument Maintenance;NTS #2651809500501).

F. **PREVIOUS EVENTS:**

There are no previous reportable events involving failure of the EHC pressure regulators at Quad Cities Station.

G. **COMPONENT FAILURE DATA:**

This event was not caused by a component failure.