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RBG-47702

August 17, 2016

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Subject: Licensee Event Report 50-458 / 2014-002-01
River Bend Station – Unit 1
Docket No. 50-458
License No. NPF-47

RBF1-16-0087

Dear Sir or Madam:

In accordance with 10 CFR 50.73, enclosed is the subject Licensee Event Report. This is a supplement to the LER originally submitted on December 16, 2014. New information is annotated by change bars in the right margin.

This document contains no commitments. If you have any questions, please contact Tim Schenk at 225-381-4177.

Sincerely,

WFM / dhw

Enclosure

cc: U. S. Nuclear Regulatory Commission
Region IV
1600 East Lamar Blvd.
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NRC Sr. Resident Inspector
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IE22
NRR

INPO
(via ICES reporting)

Central Records Clerk
Public Utility Commission of Texas
1701 N. Congress Ave.
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Department of Environmental Quality
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NRC FORM 366 (06-2016) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 10/31/2018

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA, Privacy and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to Infocollects.Resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an 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.

LICENSEE EVENT REPORT (LER)

(See Page 2 for required number of digits/characters for each block)

(See NUREG-1022, R.3 for instruction and guidance for completing this form http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
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4. TITLE

Reactor Scram Due to Average Power Range Monitor High-flux Signal Following a Malfunction of the Main Turbine Electro-hydraulic System

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
10	17	2014	2014	- 002	- 01	08	17	2016	FACILITY NAME	DOCKET NUMBER
										05000

9. OPERATING MODE	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*			
1	☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
	☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
	☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
	☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☑ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
10. POWER LEVEL	☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☑ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
	☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
	☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(C)	☐ 73.77(a)(1)
100	☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(D)	☐ 73.77(a)(2)(i)
	☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(vii)	☐ 73.77(a)(2)(ii)
		☐ 50.73(a)(2)(i)(C)	☐ OTHER Specify in Abstract below or in NRC Form 366A	

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT	TELEPHONE NUMBER *(Include Area Code)*
Tim Schenk, Manager - Regulatory Assurance	(225) 381-4177

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
(see text)									

14. SUPPLEMENTAL REPORT EXPECTED	15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☑ NO				

ABSTRACT *(Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)*

On October 17, 2014, at approximately 3:03 a.m. CDT, a reactor scram occurred in response to a high neutron flux signal from the average power range monitors (APRMs). The plant was operating at 100 percent power at the time. Immediately prior to that signal, an apparent malfunction in the main turbine electro-hydraulic control (EHC) system caused both the main turbine steam bypass valves to fully open, and also commanded all four main turbine control valves to close. The resulting increase in reactor steam pressure caused reactor power to immediately rise to the trip setpoint of the APRMs, at which point the actuation of the reactor protection system (RPS) occurred. After the scram occurred, an operator in the auxiliary control room erroneously removed all the main condensate system demineralizers from service, isolating condensate flow to the suction header of the main feedwater pumps. The running feedwater pump tripped on low suction pressure. The mis-operation of the demineralizer system was promptly corrected, and the main feedwater system was restored to service. The cause of the EHC malfunction has not been determined. Potential failure points were identitied, and those circuitry parts were replaced. A human performance error review was conducted regarding the mis-operation of the condensate deminerlizers, and appropriate procedure revisions have been made. This event is being reported in accordance with 10CFR50.73(a)(2)(iv) as an automatic actuation of the RPS system, and in accordance with 10CFR50.73(a)(2)(v) as a condition that potentially caused the loss of safety function of the affected RPS instruments.

LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

(See NUREG-1022, R.3 for instruction and guidance for completing this form http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/)

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NARRATIVE

REPORTED CONDITION

On October 17, 2014, at approximately 3:03 a.m. CDT, a reactor scram occurred in response to a high neutron flux signal from the average power range monitors (APRMs). The plant was operating at 100 percent power at the time. Immediately prior to that signal, an apparent malfunction in the main turbine electro-hydraulic control (EHC) [JI] system caused both the main turbine steam bypass valves to fully open, and also commanded all four main turbine control valves to close. The resulting increase in reactor steam pressure caused reactor power to immediately rise to the trip setpoint of the APRMs, at which point the actuation of the reactor protection system (RPS) [JC] occurred.

As explained below, the malfunction of the EHC system potentially affected the trip setpoint of certain safety-related instrumentation, and thus constituted an event that could have caused the loss of safety function of the affected instruments.

All reactor control rods inserted as designed in response to the RPS actuation, and operators implemented the appropriate response procedures. After the scram occurred, an operator in the auxiliary control room erroneously removed all the main condensate system demineralizers [SF] from service, isolating condensate flow to the suction header of the main feedwater pumps [SJ]. The "C" feedwater pump tripped on low suction pressure; the "A" and "B" feedwater pumps had been previously secured by the operators. The mis-operation of the demineralizer system was promptly recognized and corrected, and the main feedwater system was restored to service within approximately six minutes. In the interim, reactor water level decreased to Level 3, causing a second actuation of the RPS system, but remained well above the point at which actuation of the emergency core cooling sytems is required. The Level 3 signal also caused an automatic actuation of the containment isolation valves in the suppression pool cooling system, as designed. Reactor recirculation pump "B" failed to downshift to slow speed, and instead, tripped off. A controlled plant cooldown was commenced, and proceeded into cold shutdown conditions.

This event is being reported in accordance with 10CFR50.73(a)(2)(iv) as an automatic actuation of the RPS system, and in accordance with 10CFR50.73(a)(2)(v) as a condition that potentially caused the loss of safety function of the affected RPS instruments.

INVESTIGATION and IMMEDIATE ACTIONS

1. EHC Malfunction

An investigation team was formed to analyze the operating parameters of the EHC system and determine the source of the malfunction.

Earlier in that same shift, there were two actuations of the main control room alarm indicating that the turbine steam bypass valves were open. At 7:26 p.m., the alarm actuated and immediately cleared. Plant computer data indicated that both bypass valves had opened slightly, while the number 4 turbine control valve closed slightly. No accompanying changes were noted in reactor pressure or in any EHC parameters. At 11:14 p.m., the alarm actuated a second time. Computer data then showed that turbine bypass valve no. 1 had fully opened, and bypass valve no. 2 had opened approximately 20 percent. Turbine control valve no. 4 closed significantly, and there was a slight change in the turbine steam flow reference signal in the EHC system.

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Following the first actuation of the TURBINE BYPASS VALVE OPEN alarm, the operators appropriately recorded an entry and exit from the limiting condition for operation (LCO) for three safety-related functions for which the turbine bypass valves are assumed to be closed to support operability of the function. Those functions are reactor protection system (turbine stop valve closure and turbine control valve closure), end-of-cycle recirculation pump trip (EOC-RPT), and control rod block. Technical Specifications require that these functions must be enabled when reactor power is greater than or equal to 40% of rated capacity. This is normally accomplished automatically by turbine first stage pressure instruments. At the appropriate power level, pressure switches actuate to arm the trip circuitry.

If a turbine bypass valve opens during power operations, reactor steam pressure will be maintained constant by the main turbine electro-hydraulic control system. The automatic response to the opening of a bypass valve is a corresponding closure of the turbine control valves, leading to a decrease in turbine first stage pressure. If this occurs while reactor power is within a few percent above the point at which the safety functions described above are automatically enabled, then it is possible that those functions will be disabled. In this scenario, the required functions will be inoperable at a point where the plant design basis assumes that their safety function is enabled. Therefore, to consider these functions operable, the turbine bypass valves must remain shut when reactor power is greater than or equal to 40% of rated capacity. This condition constituted a potential loss of safety function of the affected instruments.

Analysis of EHC parameters immediately prior to the scram found that the steam flow reference signal went from 92 percent to negative 41 percent with no corresponding change in total steam flow demand. The error in the steam flow reference signal cleared in approximately five seconds, but the resulting pressure transient had caused the reactor scram by that point. The movements of the bypass valves and turbine control valves was appropriate for the loss of the steam flow reference signal.

A detailed circuit analysis was performed to identify which components within the system could cause the loss of this signal. Efforts to recreate the loss of the signal were unsuccessful. Based on the system response earlier in the shift, and the lack of any apparent fault, it was concluded that an intermittent failure with the steam flow reference signal was occurring.

The investigation initially postulated that failure in any of these five EHC circuit cards and their subcomponents could have caused this event:

- pressure load gate amplifier
- control valve amplifier input standby transfer
- load limit set runback analog / logic
- control valve flow reference signal
- load limit and load set runback

All these circuit cards, except one, were replaced and sent to the vendor for analysis. Discussion with vendor concerning the load limit and load set runback card concluded that its potential role as a source of the failure was extremely low.

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If a definite cause of the EHC malfunction is found, that information will be provided in a supplement to this report.

2. Mis-operation of the main feedwater system

When the operators in the auxiliary control room heard the plant announcement of a reactor scram, they began removing main condensate demineralizers from service to maintain proper system parameters for the expected decrease in feedwater flow. However, they inappropriately isolated all the demineralizers, isolating all flow to the main feedwater pump suction header. Main control room operators had already secured two of the three pumps; the last pump tripped on low suction pressure. The error was promptly recognized, and demineralizers were restored to service, allowing the re-start of a feedwater pump.

A human performance error review was conducted, which found the following:

• The auxiliary control room operators did not correctly follow the system operating procedure guidance on maintaining flow though individual demineralizers within specifications as overall system flow decreased. The operators imposed unnecessary haste by focusing on demineralizer channeling effects, and did not demonstrate knowledge of integrated system operation.

• Procedural guidance for the removal of condensate demineralizers from service following a scram was less than adequate, in that it promoted the practice that operators in the field have the authority to determine when they can perform actions without specific direction from the main control room.

• Operations department management had not clearly defined standards and expectations to preclude auxiliary operators from taking actions without direction from main control room operators, or a supervisor, during certain plant conditions. In this event, the condensate demineralizers were removed from service and then returned to service without direction from main control room, with the intent of not distracting those operators from the scram recovery. The system operating procedure promotes this long-standing practice.

CORRECTIVE ACTION TO PREVENT RECURRENCE

1. EHC malfunction

During the upcoming refueling outage in February 2015, an evaluation of a potential replacement of the obsolete card will be completed. A complete replacement with a digitial EHC system is planned for the refueling outage to occur in early 2017. These actions are being tracked in the corrective action program.

2. Mis-operation of the main feedwater system

The system operating procedure for the main condensate demineralizers has been revised to clarify the precautions regarding how many demineralizers are to remain in service. The scram response procedure has been revised to add

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a step for the main control room operators to communicate with the auxiliary control room operator regarding system operations.

PREVIOUS OCCURRENCE EVALUATION

No event reported by RBS within the last three years was caused by unexplained, erratic signals originating within the main turbine EHC control circuits.

SAFETY SIGNIFICANCE

When the main turbine EHC system began to display anomalous behavior, the reactor was operating at 100% power. The total steam flow capacity of the turbine bypass valves corresponds to approximately 10% reactor power. Therefore, when the system perturbations occurred prior to the failure which initiated the reactor scram, it is not possible that the required safety functions could have been disabled. Even with both bypass valves open, the response of the main turbine EHC system would be to close the turbine control valves only far enough to compensate for the diversion of 10% of full steam flow to the main condenser. At 100% power, this action could not have resulted in a decrease in turbine first stage pressure sufficient to disable the TS trip functions. Therefore, neither of the transients that occurred in the EHC system earlier in the shift constituted an actual loss of the safety function of the affected instruments.

At the time of the reactor scram, the reactor core isolation cooling system was out of service for planned maintenance. No plant parameters that would have required its actuation were exceeded. No other engineered safety features were out of service at the time. The plant response to this transient was as designed. Thus, this event was of minimal significance to the health and safety of the public.

(NOTE: Energy Industry Identification System component function identifier and system name of each component or system referred to in the LER are annotated as (**XX**) and [XX], respectively.)