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RBG-47210

February 21, 2012

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

Subject: Licensee Event Report 50-458 / 2011-003-00
River Bend Station – Unit 1
Docket No. 50-458
License No. NPF-47

RBF1-12-0021

Dear Sir or Madam:

In accordance with 10 CFR 50.73, enclosed is the subject Licensee Event Report. This document contains no commitments. If you have any questions, please contact Mr. Joseph Clark at 225-381-4177.

Sincerely,

Eric W. Olson

EWO/dhw

Enclosure

IE22
NRR

cc: U. S. Nuclear Regulatory Commission
Region IV
1600 East Lamar Blvd.
Arlington, TX 76011-4511

NRC Sr. Resident Inspector
P. O. Box 1050
St. Francisville, LA 70775

INPO Records Center
E-Mail (MS Word format)

Ms. Tracie Lowery
Public Utility Commission of Texas
1701 N. Congress Ave.
Austin, TX 78711-3326

Department of Environmental Quality
Office of Environmental Compliance
Radiological Emergency Planning and Response Section
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NRC FORM 366 (10-2010) | U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 10/31/2013

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 Section (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet 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 reverse for required number of digits/characters for each block)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
River Bend Station – Unit 1	05000 - 458	1 OF 5

4. TITLE

Automatic Reactor Scram Due to a Main Turbine Trip

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
12	23	2011	2011	-003-	00	02	21	2012		05000
									FACILITY NAME	DOCKET NUMBER
										05000

9. OPERATING MODE

1

10. POWER LEVEL

100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☒ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER *(Include Area Code)*
Joseph A. Clark, Manager – Licensing	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
n/a									

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

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

On December 23, 2011, at approximately 6:10 a.m. CST, the main turbine tripped unexpectedly, resulting in a reactor scram. The plant was stable at 100 percent power at the time of the event, and no safety-related systems were out of service. Operators implemented the appropriate response procedures, and began to stabilize reactor vessel pressure and water level. The closure of the turbine control valves resulted in the actuation of at least fifteen of sixteen main steam safety relief valves. A subsequent high reactor water level caused a trip of all three reactor feedwater pumps. As reactor water level lowered back through the normal operating range, operators attempted to restart a feedwater pump, but component malfunctions were encountered on "B" and "C" pumps. The reactor core isolation cooling (RCIC) system was manually actuated approximately nine minutes after the scram and injected water into the reactor for approximately two minutes. The "A" feedwater pump was restored to service approximately one minute after RCIC was initiated. The cause of the turbine trip was a spurious backup over-speed trip resulting from an electrical discharge from the turbine shaft in the vicinity of the EHC turbine speed pickup probe. The cause of the electrical discharge was due to a failure of the shaft grounding system. The plant responded as designed, and no emergency core cooling system actuation setpoints were exceeded. This event is being reported in accordance with 10 CFR 50.73(a)(2)(iv)(A) as a condition that resulted in the automatic actuation of the reactor protection system (RPS).

REPORTED CONDITION

On December 23, 2011, at approximately 6:10 a.m. CST, the main turbine (**TRB**) tripped unexpectedly, resulting in a reactor scram. The plant was stable at 100 percent power at the time of the event, and no safety-related systems were out of service. Operators implemented the appropriate response procedures, and began to stabilize reactor vessel pressure and water level.

The rapid closure of the turbine control valves caused a rise in reactor pressure that actuated at least fifteen of sixteen main steam safety relief valves (SRVs). The initial shrink in reactor water level accompanying the reactor scram caused a Level 3 alarm, with water level reaching a low point of -0.1 inches approximately 15 seconds after the scram (Level 3 is 9.7 inches). The main feedwater control system responded, and the subsequent increase in reactor water level caused a Level 8 trip of all three reactor feedwater pumps (**PMP**) approximately three minutes into the event.

As reactor water level lowered back through the normal operating range, operators attempted to restart a feedwater pump, but component malfunctions were encountered on "B" and "C" pumps. The reactor core isolation cooling (RCIC) (BN) system was manually actuated approximately nine minutes after the scram and injected water into the reactor for approximately two minutes. The "A" feedwater pump was restored to service approximately one minute after RCIC was initiated.

This event is being reported in accordance with 10 CFR 50.73(a)(2)(iv)(A) as a condition that resulted in the automatic actuation of the reactor protection system (RPS) (JC).

In the immediate notification performed in accordance with 10 CFR 50.72, it was reported that the reactor vessel Level 3 condition caused the actuation of primary containment isolation valves in the suppression pool cooling system. Those valves were already closed at the time of this event due to the system being out of service.

INVESTIGATION and CAUSAL ANALYSIS

1. Main turbine trip

The trip signal to the main turbine originated in the electro-hydraulic control (EHC) system, and caused a fast closure of all turbine control valves. Analysis of transient data found that both the primary and back-up turbine speed signals became erratic and indicated an overspeed condition. Within approximately one second, all four turbine control valves were commanded to go fully closed. The RPS system responded to the fast closure signals from the turbine control valves, initiating a reactor scram.

A root cause team was formed following the turbine trip. This investigation was performed using internal and external technical experts in EHC controls, magnetization, and electrostatic discharge.

The cause of the turbine trip was a spurious backup over-speed trip. An electrical discharge from the turbine shaft to the vicinity of the EHC turbine speed pickup probes generated electromagnetic pulses that influenced the speed probes, which act on magnetic flux associated with a toothed wheel coupled to the turbine shaft. Over-speed signals in at least 2 out of 3 channels caused a turbine trip signal. The cause of the electrical discharge was due to a failure of the shaft grounding system.

The turbine shaft grounding system was modified in 2004 to add a new brush at the mid-standard location (between the high-pressure turbine inboard bearing and the thrust bearing). There are four brushes assigned to the turbine shaft, three of which provide ground protection. The mid-standard brush was removed as part of troubleshooting the turbine trip and it was found to have very little wear for the time in service. An inspection conducted by both internal and external technicians concluded that the brush was not providing protection, given the level of wear observed. The brush is designed to pivot with bristle wear to maintain shaft contact. Since less wear was observed than expected, it is concluded the brush wore until the maximum range of the brush pivot was achieved, after which the brush lost contact with the shaft due to making hard contact within the indicator housing.

This investigation also found that the mounting bracket for that brush was improperly fabricated, such that the angle between the brush head and the shaft was not correct. Following this forced outage, the as-left reading on the brush wear indicator is about halfway between "replace" and "new." This allows adequate brush movement and shaft contact. Actions will be taken in the next refueling outage to correct the angle on this bracket to make it read accurately.

There were significant contributing factors in this event:

- The grounding brush at turbine bearing no. 2 was installed as part of a modification to add a new grounding point. At that time, the preventative maintenance (PM) task for measurement of shaft voltage should have been revised to include shaft voltage measurements from either the new grounding brush or the shaft voltage monitoring. The PM was not revised. Increased shaft voltage would indicate that the shaft grounding brush was not working properly.

- The post-modification testing following installation of the new brush in 2004 was not performed properly. An improperly fabricated mounting bracket built for that modification apparently does not allow the wear indicator to accurately show the "new" indication for a new brush head.

- Maintenance and Engineering personnel recognized that the wear indicator did not accurately measure actual brush wear, but did not document the deficiency in the corrective action program.

2. Reactor feedwater system malfunctions

The malfunctions that impeded the recovery of the reactor feedwater system are described as follows.

The operator first attempted to start the "C" feedwater pump. Part of the start sequence is the opening of the minimum flow valve, initiated by depressing the pump "start" button. When the pump start sequence was initiated, the operator observed the indication for the minimum flow valve start to travel from closed position to an intermediate position, instead of going fully open. The pump start circuitry is electrically interlocked with that valve position indication, so this failure prevented the pump from starting. Troubleshooting found that the valve was actually opening as commanded, but the limit switches were out of adjustment, preventing the fully open indication from being applied to the start circuitry.

The operator then attempted to start the "B" feedwater pump. One of the actions involved in starting a feedwater pump is to verify that the auxiliary lubricating oil pumps on the pump and the gearbox are operating correctly. Upon initiation of the pump start, the operator observed that the gearbox auxiliary oil pump was cycling "on" then "off," which is abnormal. Troubleshooting found that a pressure regulator in that lube oil system was out of adjustment. This issue was corrected prior to plant restart.

PREVIOUS OCCURRENCE EVALUATION

River Bend Station submitted Licensee Event Report 050-458/08-002-00 on May 2, 2008, following an automatic reactor scram that resulted from a malfunction in the main turbine EHC system. The root cause of that event was determined to be a loose electrical termination plug in the turbine speed sensing circuit. That failure mode has been eliminated in the investigation of the December 2011 event.

CORRECTIVE ACTION TO PREVENT RECURRENCE

The following actions are planned, and will be documented in the corrective action program:

- the wear indicator on the replaced brush will be corrected
- a monitoring plan has been established to monitor and trend speed signals, shaft voltages and power supply voltages
- outside technical expertise will be applied to independently review possible causes of shaft voltage buildup and develop corrective actions for the causes. In addition, further connection verifications of casing and turbine components to building grounds will be conducted

SAFETY SIGNIFICANCE

The reactor protection system and main steam safety relief valves responded as designed to the main turbine trip. Reactor pressure was controlled automatically by the brief SRV actuation and the main turbine bypass system throughout the event, until a controlled cooldown was established. Reactor water level reached a low point of -0.1 inches (the Level 3 alarm setpoint is 9.7 inches). The "A" feedwater pump was restored to service approximately nine minutes after the scram.

This event was of minimal safety significance to the health and safety of the public. The RPS actuation was successful, and no emergency core cooling systems actuation setpoints were exceeded.

(NOTE: Energy Industry Component Identification codes are annotated as (**XX**).)