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RBG-47299

October 24, 2012

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

SUBJECT: 90-Day Response to Bulletin 2012-01, *Design Vulnerability in Electric Power System*
River Bend Station – Unit 1
Docket No. 50-458
License No. NPF-47

REFERENCE: 1. NRC Bulletin 2012-01 *Design Vulnerability in Electric Power System*, dated July 27, 2012

RBF1-12-0159

Dear Sir or Madam:

On July 27, 2012, the NRC issued Bulletin 2012-01 (Reference 1), requesting that each licensee submit a written response in accordance with 10 CFR 50.54(f) within 90 days of the bulletin to provide requested information. Entergy Operations, Inc. hereby provides the 90-day response to Reference 1 for River Bend Station – Unit 1 (RBS).

No new commitments are contained in this document. Should you have any questions concerning the content of this letter, please contact Joey Clark at 225-381-4177.

I declare under penalty of perjury that the foregoing is true and correct. Executed on October 24, 2012.

Sincerely,

Eric W. Olson

EWO/dhw

Attachment: RBS' 90-Day Response to NRC Bulletin 2012-01

IE76
NRR

cc: Regional Administrator
U. S. Nuclear Regulatory Commission, Region IV
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U. S. Nuclear Regulatory Commission
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NRC Senior Resident Inspector
River Bend Station
R-SB-14

U. S. Nuclear Regulatory Commission
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Attachment

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RBS' 90-Day Response to NRC Bulletin 2012-01

Overview

- System Description – Items 2., 1.d, 2.a, 2.c
- System Protection – Items 1., 1.a, 2.b, 2.d
- Consequences – Items 1.b, 1.c, 2.e
- Simplified One-Line Diagram
- Tables
  - Table 1 - ESF Buses Normally Energized Major Loads
  - Table 2 - Offsite Power Transformers
  - Table 3 - Protective Devices

System Description

(Items 2, 1.d, 2.a, and 2.c request system information and will be addressed in this section.)

2. Briefly describe the operating configuration of the ESF buses (Class 1E for current operating plants or non-Class 1E for passive plants) at power (normal operating condition).

The normal (unit auxiliary) ac power supply can provide electrical power for all non-safety station auxiliary loads when the main generator is operating. It consists of three normal station service transformers 1STX-XNS1A, 1STX-XNS1B, and 1STX-XNS1C. The preferred (start up) ac power supply can provide for all station auxiliary loads. Preferred power is taken from two physically and electrically independent 230-kV lines originating in the onsite 230-kV substation. The 230-kV line terminating at transformer yard 1 energizes transformers 1RTX-XSR1E and 1RTX-XSR1C. The 230-kV line terminating at the transformer yard 2A energizes transformers 1RTX-XSR1F and 1RTX-XSR1D.

Two of the standby 4.16-kV buses, 1ENS*SWG1A and 1ENS*SWG1B, are connected to preferred station service transformers, 1RTX-XSR1C and 1RTX-XSR1D, respectively. The standby 4.16-kV bus, 1E22*S004, is normally connected to the 4.16-kV in-station normal swing bus 1NNS-SWG1C. Each of these standby buses has a standby diesel generator capable of supporting it upon loss of normal and preferred power. Switching allows each of the 4.16-kV standby buses to have access to one of the two 4.16-kV in-station normal buses while the 4.16-kV standby bus 1E22*S004 is subordinate to the 4.16-kV in-station swing bus 1NNS-SWG1C.

1.d Describe the offsite power transformer (e.g., start-up, reserve, station auxiliary) winding and grounding configurations.

(See Table 2)

2.a Are the ESF buses powered by offsite power sources? If so, explain what major loads are connected to the buses including their ratings.

Two of the standby 4.16-kV buses, 1ENS*SWG1A and 1ENS*SWG1B, are connected to preferred station service transformers, 1RTX-XSR1C and 1RTX-XSR1D, respectively. The 230-kV line terminating at transformer yard 1 energizes transformer 1RTX-XSR1C and the 230-kV line terminating at the transformer yard 2A energizes transformer 1RTX-XSR1D. The standby 4.16-kV bus, 1E22*S004, is normally connected to the 4.16-kV in-station normal swing bus 1NNS-SWG1C. Switching allows each of the 4.16-kV standby buses to have access to one of the two 4.16-kV in-station normal buses while the 4.16-kV standby bus 1E22*S004 is subordinate to the 4.16-kV in-station swing bus 1NNS-SWG1C. Therefore, all three ESF buses 1ENS*SWG1A, 1ENS*SWG1B and 1E22*S004 are powered by offsite power sources through preferred station service transformers, 1RTX-XSR1C or 1RTX-XSR1D.

SWP-P2A (Standby service water pump motor; 4.16kV; 450 HP), E12-C002B (Residual heat removal pump motor; 4.16kV; 700 HP) and E21-C001 (Low pressure core spray pump motor; 4.16kV; 1250 HP) are powered by 1ENS*SWG1A and are normally de-energized.

SWP-P2B/2D (Standby service water pump motor; 4.16kV; 450 HP) and E12-C002B/2C (Residual heat removal pump motor; 4.16kV; 700 HP) are powered by 1ENS*SWG1B and are normally de-energized.

SWP-P2C (Standby service water pump motor; 4.16kV; 450 HP) and E22-C001 (High pressure core spray pump motor; 4.16kV; 2500 HP) are powered by 1E22*S004 and are normally de-energized.

(See Table 1)

2.c Confirm that the operating configuration of the ESF buses is consistent with the current licensing basis. Describe any changes in offsite power source alignment to the ESF buses from the original plant licensing.

The following at-power (normal operating condition) configurations have been confirmed to be consistent with the current licensing basis:

The normal (unit auxiliary) ac power supply can provide electrical power for all non-safety station auxiliary loads when the main generator is operating. It consists of three normal station service transformers 1STX-XNS1A, 1STX-XNS1B, and 1STX-XNS1C. The preferred (start up) ac power supply can provide for all station auxiliary loads. Preferred power is taken from two physically and electrically independent 230-kV lines originating in the onsite 230-kV substation. The 230-kV line terminating at transformer yard 1 energizes transformers 1RTX-XSR1E and 1RTX-XSR1C. The 230-kV line terminating at the transformer yard 2A energizes transformers 1RTX-XSR1F and 1RTX-XSR1D.

Two of the standby 4.16-kV buses, 1ENS*SWG1A and 1ENS*SWG1B, are connected to preferred station service transformers, 1RTX-XSR1C and 1RTX-XSR1D, respectively. The standby 4.16-kV bus, 1E22*S004, is normally connected to the 4.16-kV in-station normal swing bus 1NNS-SWG1C. Each of these standby buses has a standby diesel generator capable of supporting it upon loss of normal and preferred power. Switching allows each of the 4.16-kV standby buses to have access to one of the two 4.16-kV in-station normal buses while the 4.16-kV standby bus 1E22*S004 is subordinate to the 4.16-kV in-station swing bus 1NNS-SWG1C. Buses 1ENS*SWG1A, 1ENS*SWG1B, and 1E22*S004 are powered by offsite power sources through preferred station service transformers 1RTX-XSR1C or 1RTX-XSR1D.

System Protection

(Items 1., 1.a, 2.b, 2.d request information regarding electrical system protection and will be answered in this section.)

> **1. Describe how the protection scheme for ESF buses (Class 1E for current operating plants or non-Class 1E for passive plants) is designed to detect and automatically respond to a single-phase open circuit condition or high impedance ground fault condition on a credited off-site power circuit or another power sources. Also, include the following information:**

Consistent with the current licensing basis and GDC 17, existing protective circuitry will separate the ESF buses from a connected failed offsite source due to a loss of voltage or a sustained, balanced degraded grid voltage concurrent with certain design basis accidents. The relay systems were not specifically designed to detect an open single phase of a three-phase system. Detection of a single-open phase condition is beyond the approved design and licensing basis of the plant. Preferred power is taken from two physically and electrically independent 230-kV lines originating in the onsite 230-kV substation. Therefore, a single open phase condition does not affect both off-site sources.

The electrical analyses for off-site circuits have been reviewed with regard to high impedance grounds. The effect of a high impedance ground has been analyzed to be inconclusive without detailed studies.

RBS Division 1 and 2 ESF buses do have ground detection relay on the secondary side of the preferred Station service transformers. However, detailed loading analysis is needed in order to conclude that high impedance ground on single phase would result in an unbalanced voltage condition sufficient to adversely affect connected equipment.

RBS preferred station service transformers are primarily protected by differential protection with current transformers mounted on the high side of the transformer bushings and at the 4.16 kV switchgear on the low voltage windings. The zone of protection on the high voltage side overlaps with the 230 kV line protection.

Inverse time and instantaneous overcurrent protection on the high side of the preferred station service transformers causes the 230 kV line backup protection relay to be tripped. Ground fault protection is applied to both high and low side of transformer neutral with relays with an inverse time proportional characteristic. In the event of a ground fault the 230 kV line backup protection relay is tripped.

1.a The sensitivity of protective devices to detect abnormal operating conditions and the basis for the protective device setpoint(s).

Consistent with the current licensing basis and GDC 17, existing electrical protective devices are sufficiently sensitive to detect design basis conditions like a loss of voltage or a degraded voltage, but were not designed to detect a single phase open circuit condition. See Table 3 for protective devices and the basis for the device setpoint(s).

Existing electrical protective devices are also sufficiently sensitive to detect a ground fault. Table 3 lists ground protection on the ESF buses and the basis for the device setpoint(s).

2.b If the ESF buses are not powered by offsite power sources, explain how the surveillance tests are performed to verify that a single-phase open circuit condition or high impedance ground fault condition on an off-site power circuit is detected.

This item is not applicable. The ESF buses at RBS are powered by offsite power sources.

2.d Do the plant operating procedures, including off-normal operating procedures, specifically call for verification of the voltages on all three phases of the ESF buses?

Standing Order #257, Guidelines for Single Failed Phase Event, was issued to provide Operations with guidance and instruction on the symptoms and mitigation strategy in the event of a single failed open phase similar to the Byron event. The instruction and guidance provided to Operation in the event of a single failed open phase included recording of all three phase voltages on Division 1 and 2 switchgears on daily basis and taking actions to isolate the affected safety bus from offsite power in an event of single failed open phase.

Consequences

(Items 1.b, 1.c, and 2.e request information regarding the electrical consequences of an event and will be addressed in this section.)

1.b The differences (if any) of the consequences of a loaded (i.e., ESF bus normally aligned to offsite power transformer) or unloaded (e.g., ESF buses normally aligned to unit auxiliary transformer) power source.

Installed relays were not designed to detect single-phase open circuit conditions. Existing loss of voltage and degraded voltage relays may respond depending on load and possible grounds. In general, there will be no plant response for an unloaded (e.g., ESF buses normally aligned to unit auxiliary transformer) power source in the event of a single-phase open circuit on a credited off-site power circuit because there is insufficient current to detect a single-phase open circuit for this configuration.

The plant response for a loaded power source cannot be calculated without specifying the amount of loading and the specific loads involved.

1.c If the design does not detect and automatically respond to a single-phase open circuit condition or high impedance ground fault condition on a credited offsite power circuit or another power sources, describe the consequences of such an event and the plant response.

A high impedance ground will have no immediate effect on plant operation. If the ground is sufficiently large to affect plant operation, protective relaying will isolate the ground automatically.

Standing Order #257, Guidelines for Single Failed Phase Event, was issued to provide Operations with guidance and instruction on the symptoms and mitigation strategy for a single open phase similar to the Byron event.

The primary indications of a single failed phase event resulting in sufficiently low phase voltages are Division 1 and 2 safety-related buses PT Fuse Blown alarm in the Main Control Room. The instruction and guidance provided to Operations in the event of a single failed open phase included recording of all three phase voltages on Division 1 and 2 switchgears on daily basis and taking actions to isolate the affected safety bus from offsite power in the event of single failed open phase.

The RBS current licensing basis (CLB) does not assume that the Class 1E protection scheme (for the engineered safety feature (ESF) buses) was designed to detect and automatically respond to a single-phase open circuit condition on the credited off-site power source as described in the UFSAR and Technical Specifications.

The offsite power circuits at RBS consist of two independent circuits from R.S.S Leads to preferred Station transformers (Ref USAR Figure 8.1-4 and 8.1-5).

Since RBS does not credit the ESF bus protection scheme as being capable of detecting and automatically responding to a single phase open circuit condition, an open phase fault was not included in the design criteria for either the loss of voltage, the degraded voltage relay (DVR) scheme, or secondary level undervoltage protection system (SLUPS) design criteria. Since open phase detection was not credited in the RBS design or licensing basis, no design basis calculations or design documents exist that consider this condition.

Without formalized engineering calculations or engineering evaluations, the electrical consequences of such an open phase event (including plant response), can only be evaluated to the extent of what has already been published by EPRI and Basler, which is a generic overview. The difficulty in applying these documents to the RBS specific response is that these are generic assessments and cannot be formally credited as a basis for an accurate response. The primary reason is that detailed plant specific models would need to be developed (e.g., transformer magnetic circuit models, electric distribution models, motor models; including positive, negative, and zero sequence impedances (voltage and currents), and the models would need to be compiled and analyzed for the RBS specific Class 1E electric distribution system (EDS)).

As part of corrective actions plan, RBS initiated CR-RBS-2012-01000 to track this vulnerability. Further analysis needs to be performed to determine what type of modification will be needed for open phase detection.

A corrective action has been initiated to perform a design change modification such that a Single Failed Phase Event will be detected and result in automatic transfer of the affected safety related buses to the respective emergency diesel generator. This modification is tentatively scheduled for installation in refueling outage no. 18 (Spring 2015).

2.e If a common or single offsite circuit is used to supply redundant ESF buses, explain why a failure, such as a single-phase open circuit or high impedance ground fault condition, would not adversely affect redundant ESF buses.

This item is not applicable, since RBS does not use a common or single offsite circuit to supply redundant ESF buses.

Simplified One-line Diagram

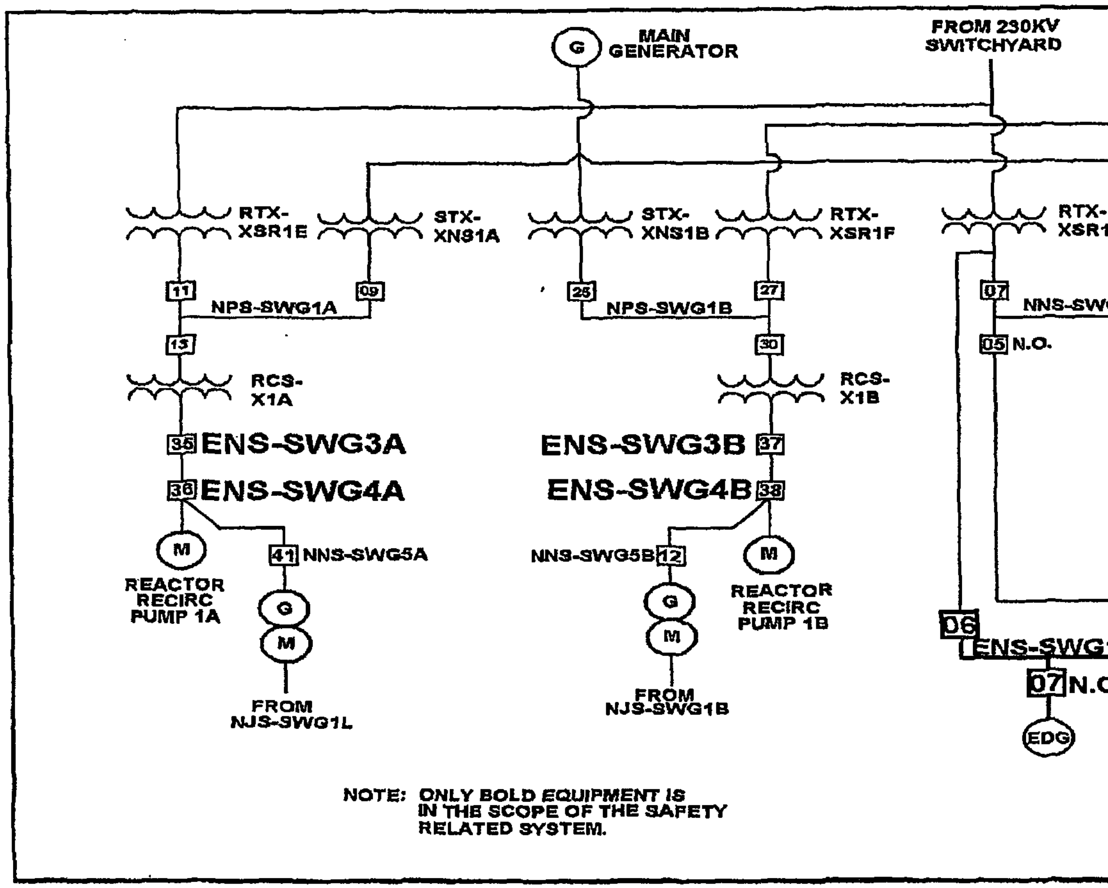

FIGURE 1

SAFETY RELATED 4.16KV ELECTRICAL SYSTEM

Table 1 - ESF Buses Normally Energized Major Loads

1ENS*SWG1A	Load	Voltage	Rating
1EJS*SWG1A	1HVC*ACU1A (Control Room Air handling unit)	480V	75 HP
1EJS*SWG1A	1HVK*CHL1A (Control Building Chiller Motor)	480V	250 HP
1EJS*SWG1A	1HVC*CH1A (Control Room Reheat Coil)	480V	65 kW
1EJS*SWG1A	1HVC*ACU2A (Swgr. Room AHU)	480V	75 HP
1EJS*SWG1A	1BYS-CHGR1A (Normal Swgr. Building Normal Charger)	480V	80 KVA
1EJS*SWG1A	1ENB*CHGR1A (Control Room Stdby. Battery Charger)	480V	80 KVA
1EJS*SWG1A	1SFC*P1A(Fuel Pool Cooling)	480V	100 HP
1EJS*SWG2A	1DRS-UC1A/C/E (Drywell Unit Cooler)	480V	3X60HP
1EJS*SWG2A	1HVR*UC11A (Aux Building Unit Cooler)	480V	75 HP
1EJS*SWG2A	1HVR-UC1A (Containment Unit Cooler Motor)	480V	150 HP
1ENS*SWG1B	**Load**	**Voltage**	**Rating**
1EJS*SWG1B	1HVC*ACU1B (Control Room Air handling unit)	480V	75 HP
1EJS*SWG1B	1HVK*CHL1B (Control Building Chiller Motor)	480V	250 HP
1EJS*SWG1B	1HVC*CH1B (Control Room Reheat Coil)	480V	65 kW
1EJS*SWG1B	1HVC*ACU2B (Swgr. Room AHU)	480V	75 HP
1EJS*SWG1B	1BYS-CHGR1B (Normal Swgr. Building Normal Charger)	480V	80 KVA
1EJS*SWG1B	1ENB*CHGR1B (Control Room Stdby. Battery Charger)	480V	80 KVA
1EJS*SWG1B	1SFC*P1B (Fuel Pool Cooling)	480V	100 HP
1EJS*SWG2B	1HVR-UC1C (Containment Unit Cooler Motor)	480V	150 HP
1EJS*SWG2B	1HVR*UC11B (Aux Building Unit Cooler)	480V	75 HP
1EJS*SWG2B	1IHS-CHRG1D (Normal Swgr. Building 1NFC Hdlg Sys Bat Charger)	480V	80 KVA
1EJS*SWG2B	1DRS-UC1B/D/F (Drywell Unit Cooler)	480V	3X60HP

Table 2 – Offsite Power Transformers

Transformer	Winding Configuration	MVA Size (AO/FA/FA)	Voltage Rating (Primary/Secondary)	Grounding Configuration
1RTX-XSR1C	Wye-Wye	10/12.5MVA, OA/FA	230-4.16 kV	230 kV Wye windings with Solidly grounded neutrals. 4.16 kV wye windings with resistance grounded neutrals.
1RTX-XSR1D	Wye-Wye	10/12.5MVA, OA/FA	230-4.16 kV	230 kV Wye windings with Solidly grounded neutrals. 4.16 kV wye windings with resistance grounded neutrals.
1RTX-XSR1E	Delta-Wye	51/68/85 MVA, OA/FOA/FOA	230-13.8 kV	13.8 kV Wye windings with resistance grounded neutrals.
1RTX-XSR1F	Delta-Wye	51/68/85 MVA, OA/FOA/FOA	230-13.8 kV	13.8 kV Wye windings with resistance grounded neutrals.

Table 3 - Protective Devices

Protection Zone	Protective Device	UV Logic	Setpoint (Nominal)	Basis for Setpoint
4.16kV ESF Bus (ENS-SWG1A/B)	Loss of Voltage Relay (27-1A, B &C)	2 out of 3	2970.46V (71.40% of 4160V)	To actuate upon complete loss of ESF Bus voltage condition
4.16kV ESF Bus (E22-S004)	Loss of Voltage Relay (27N1 &N2)	1 out of 2	3045V (73.2% of 4160V)	To actuate upon complete loss of ESF Bus voltage condition
4.16kV ESF Bus (ENS-SWG1A/B)	Degraded Grid (27/62-2A,B &C)	2 out of 3	3714.29V (89.2% of 4160)	To actuate when grid voltages fall below the lowest expected value.
4.16kV ESF Bus (E22-S004)	Degraded Grid (27/62-1 and 62-2)	2 out of 2	3700.2V (88.9% of 4160)	To actuate when grid voltages fall below the lowest expected value.
230 kV Wye winding 1RTX-XSR1C/D	Ground Protection (Device 51G)	N/A	50 Amps	To actuate upon failure of insulation of the transformer to ground.
4.16 kV wye winding 1RTX-XSR1C/D	Ground Protection (Device 64)	N/A	96 Amps	To actuate upon failure of insulation of the transformer to ground.