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Michael J. Colomb
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JAFP-12-0095
October 25, 2012

United States Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Subject: Response to IE Bulletin 2012-01, Design Vulnerability in Electric Power System
James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
License No. DPR-59

Reference: 1. NRC Letter to Entergy, Bulletin 2012-01, Design Vulnerability in Electric Power System, dated July 27, 2012

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. This letter provides Entergy Operations', Inc. 90-day response to Reference 1 for the James A. FitzPatrick Nuclear Power Plant (JAF) in Attachment 1.

There are no new commitments contained in this submittal.

Should you have any questions concerning the content of this letter, please contact Mr. Chris Adner at (315) 349-6766.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on the 25th day of October, 2012.

Sincerely,

Michael J. Colomb
Site Vice President

MJC/CA/kp

Attachments: 1. JAF 90-Day Response to NRC Bulletin 2012-01

cc: next page

cc:

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Attachment 1

JAFP-12-0095

JAF Response to NRC Bulletin 2012-01

Bulletin Response

Please note: NRC Questions are in bold print and italicized. James A. FitzPatrick Nuclear Power Plant (JAF) responses are indented.

Overview:

- System Description - Items 2., 1.d, 2.a, 2.c
- System Protection - 1., 1.a, 2.b, 2.d
- Consequences - 1.b, 1.c, 2.e
- Figure 1 - Simplified One-Line Diagram
- Tables 1 through 5
    - Table 1 - ESF Buses Continuously Powered From Offsite Power Source(s)
    - Table 2 - ESF Buses Not Continuously Powered From Offsite Power Source(s)
    - Table 3 - ESF Buses Major Loads
    - Table 4 - Offsite Power Transformers
    - Table 5 - 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).

At normal operating conditions the Engineered Safety Features (ESF) 4.16 kV Emergency Buses 10500 and 10600 receive normal and reserve power through double-tie breakers from Buses 10300 and 10400 respectively which is fed from Normal Station Service Transformer (NSST) 71T-4. An emergency source of power is available to Buses 10500 and 10600 from emergency diesel generators.

The 24 kV main generator leads are tapped to provide power to the NSST 71T-4. 71T-4 has two 4.16 kV low voltage windings; winding X and winding Y. During normal operation winding X feeds Buses 10100 and 10200, and winding Y feeds Buses 10300, 10400, and 10700.

Automatic transfer from normal to reserve power for 4.16 kV Buses 10100, 10200, 10300, and 10400 is initiated only when the normal supply breaker for that 4.16 kV bus is tripped automatically. If the normal supply breaker for one of these buses trips due to a fault condition, which will allow a fast transfer (this includes reactor scram and turbine trip), then the reserve supply breaker for this bus will close within 10 cycles. If the normal supply breaker for bus 10300 or 10400 is tripped due to a fault condition on the associated 4.16 kV bus, the 4.16 kV motor breakers on the bus will trip.

Reserve Service Station Transformers (RSSTs) 71T-2 and 71T-3 are fed from two off-site 115 kV sources. Each of 71T-2 and 71T-3 has two 4.16 kV low voltage windings; winding X and winding Y. During normal operation the transformers are energized but unloaded. During startup, shutdown, and standby, winding X of 71T-2 feeds Bus 10200, and winding Y of 71T-2 feeds Bus 10400. Winding X of 71T-3 feeds Bus 10100, and winding Y of 71T-3 feeds Bus 10300.

There is an alternate method of supplying plant power by backfeeding through the 345 kV System. This method can be used during plant outages when it is necessary or desirable to remove the 115 kV System from service.

See Figure 1, for a simplified one-line diagram.

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

RSSTs 71T-2 and 71T-3 : Each transformer is three-winding and rated as 115-4.16-4.16 kV, 3PH, 60 Hz with tap changer, H-winding 25 MVA solid grounded at neutral , X-winding 8.33 MVA resistor grounded at neutral, Y-winding 16.66 MVA resistor grounded at neutral.

NSST 71T-4 is three-winding transformer and rated as 22.8-4.16-4.16 kV, 3PH, 60 Hz with manual tap changer, H-winding 40 MVA delta connection, X-winding 13.33 MVA resistor grounded at neutral, Y-winding 26.7 MVA resistor grounded at neutral. This transformer is connected to main generator output to supply station power distribution.

See Table 4 for offsite power transformer winding and grounding configurations.

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.

For at power (normal operating condition) configurations, ESF buses 10500 and 10600 are not powered by offsite sources. ESF buses are powered from JAF generator output through NSST 71T-4. This line up is consistent with the original licensing basis and no changes were made since initial plant startup.

See Tables 1 and 2 for ESF bus power sources.
See Table 3 for ESF bus major loads energized during normal power operations, including their ratings.

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 engineered safeguard loads are divided between the two 4160 V emergency service buses so that the failure of either or both diesels of one emergency AC power source or failure of its associated emergency service bus does not preclude the safe shutdown of the reactor. The redundancy provided ensures that the failure of any one component of either of the emergency AC power sources does not affect the operation of the other. This description represents the normal operating configuration and consistent with the current licensing basis.

System Protection

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

1. Given the requirements above, 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.

During normal plant operation (Modes 1, 2 and 3) the emergency buses (10500 and 10600 buses) are powered from the NSST (71T-4). An open phase on the main power transformer (MPT) 345kV side would have no effect on the emergency bus voltage. Since the NSST is tied directly to the generator terminals, it will continue to receive three phase voltage on its primary side for as long as the generator remains online. If the generator trips on negative sequence due to the open MPT phase by the operator responding to negative sequence relay alarm, the emergency buses and the upstream balance of plant (BOP) buses 10300 and 10400 will automatically transfer to their off-site power source (RSST). Therefore, an open phase on the MPT high side while the plant is in normal operation is not of concern.

An open phase on the NSST primary side while the isophase generator and MPT connections remain intact is not credible due to the isophase bus connection arrangement, which makes it highly unlikely that a phase would open without also shorting to ground and tripping the generator.

During normal plant operation (Modes 1, 2 or 3) an open single-phase on the RSST primary has no effect on safety bus voltage since the emergency buses are powered from the NSST. Primary windings of RSSTs are connected to 115 kV common grid supplied for power by Line #4 from Nine Mile Point 1 (NMP1) and Line #3 from Lighthouse Hill Substation. Therefore, open phase on any one line will not interrupt power supply to RSSTs. Open phase is monitored through NMP1 current meter readings by telephone between NMP1 and JAF control rooms every shift. This method is considered very reliable verification for the open phase detection on JAF 115 kV lines. National Grid Power Control also has capability to detect open phase of the JAF 115 kV lines. Secondary windings of RSSTs are connected to BOP buses 10300 and 10400 through a non-segregated phase bus duct, which makes it unlikely that a phase would open. In case of an open phase in the cable connection between BOP bus 10300 (10400) and emergency bus 10500 (10600), the feeder breaker to the BOP bus will trip on overcurrent.

JAF 4.16 kV under voltage protection consists of two-out-of-two logic in which each

relay senses its own phase voltage. One relay senses phase voltage A-B, and the other relay senses phase voltage B-C. The opening of A phase or C phase will not result in an automatic transfer of the affected bus to the emergency diesel generator.

The electrical analyses for off-site circuits have been reviewed with regard to high impedance grounds. However, the effect of a high impedance ground has not been analyzed.

JAF 115 kV bus is protected from bus ground fault by bus differential. Any ground fault within the protected boundary will trip the 115 kV breakers 10012 and 10022. RSST are protected from transformer ground fault on H-winding, X-winding and Y winding separately and ground fault on any windings will trip the 115 kV breakers 10012 and 10022. If ground fault occurs either on transformer T2 or T3, the faulted transformer will be isolated from the 115 kV power source and its 4 kV buses will be de-energized. The other transformer will be available to supply its own train 4 kV buses by an automatic reclosure. Impact from high impedance ground fault on 115 kV system to limit fault current below ground fault relay setpoint has not been analyzed.

Although the degraded voltage protection scheme at JAF was not designed to detect and automatically respond to a single-phase open circuit condition on a credited off-site power circuit, preliminary evaluation has shown that the overcurrent relay will respond to this condition by tripping the 4 kV bus supply breaker, automatically starting the emergency diesel generators and transferring power to emergency diesel generators.

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 Attachment 3, Table 5 for undervoltage protective devices and the basis for the device setpoint(s).

Existing electrical protective devices are also sufficiently sensitive to detect a ground fault. Table 5 lists protective devices 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.

Primary windings of RSSTs are connected to 115 kV common grid supplied for power by Line #4 from Nine Mile Point 1 (NMP1) and Line #3 from Lighthouse Hill Substation. Therefore, open phase on any one line will not interrupt power supply to RSSTs. Open

phase is monitored through NMP1 current meter readings by telephone between NMP1 and JAF control room every shift. This method is considered very reliable verification for the open phase detection on JAF 115 kV lines.

A surveillance test requires that power is confirmed to be available with all phases intact by contacting the transmission owner, National Grid Power Control. This is a weekly surveillance.

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?

The current plant operating procedures, including operating procedures for off-normal alignments, specifically call for verification of current on all three phases of the ESF buses.

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, loss of voltage and degraded voltage relays were not designed to detect single phase open circuit conditions. Existing loss of voltage and degraded voltage relays may not respond to single-phase open circuit condition. JAF off site power transformers are not loaded during normal plant operation, and ESF buses are normally aligned to unit auxiliary transformer. There is insufficient current to detect a single-phase open circuit for this configuration.

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.

JAF did not credit in the Current Licensing Basis (CLB) that the Class 1E protection scheme (for the emergency safeguard 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.

Since JAF did 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 JAF design or licensing basis, no design basis calculations or design documents exist that previously considered 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 JAF 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 JAF specific Class 1E electric distribution system (EDS).

If power to 10300/10400 is transferred from normal to an offsite power source with a single open phase, the reserve power supply breaker will be tripped due to increased current, and motors connected to 4160 buses including emergency buses could be damaged. Reserve supply breaker is protected using GE IAC51A time overcurrent relays. If an open phase fault should occur on the primary or secondary of the RSST transformers with the transformer unloaded, there is currently in place no effective protective relaying which can detect the open phase condition.

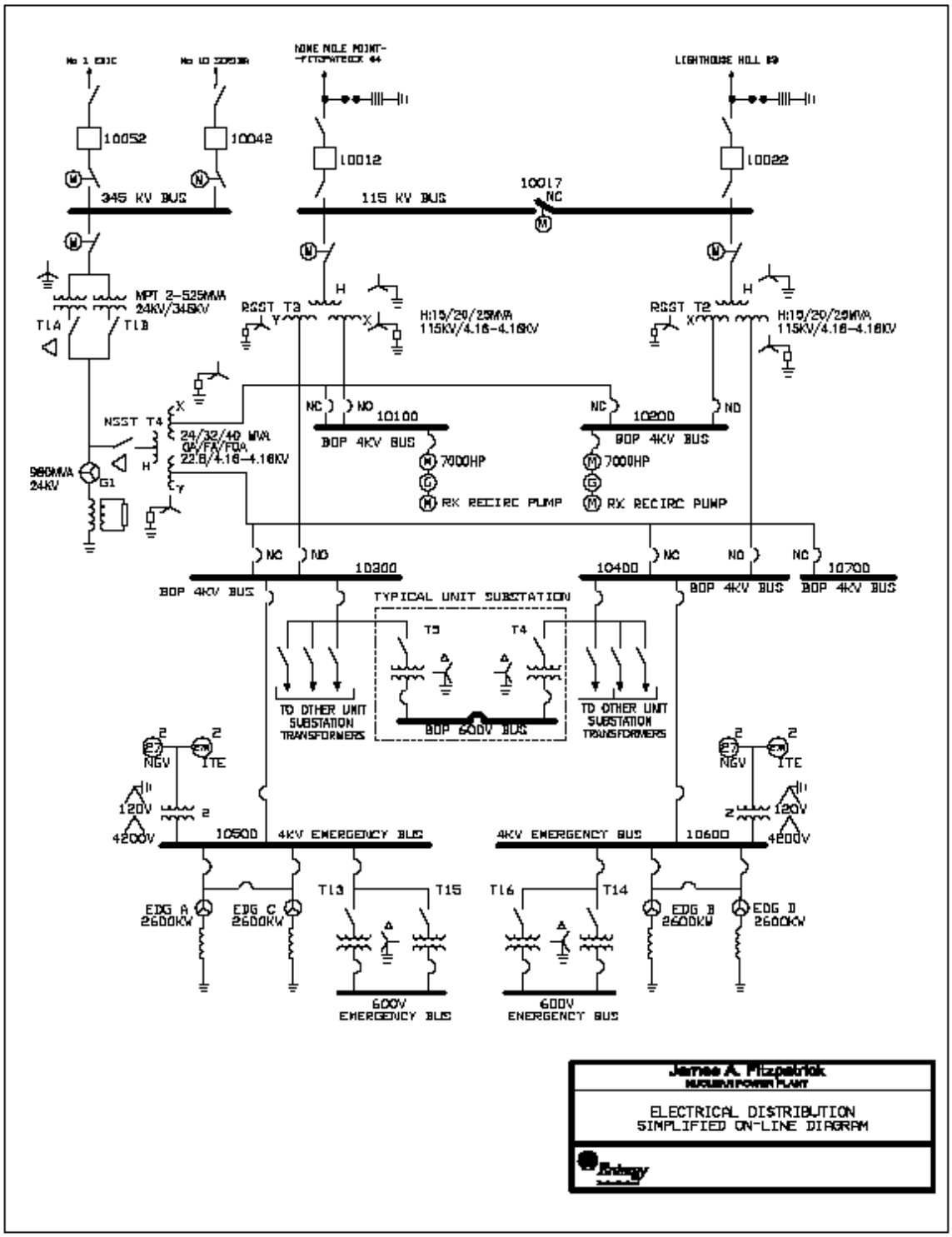
If load is connected to the transformer with open phase fault, motors would not start and would become thermally tripped and/ or damaged. If power is transferred from normal to reserve with the motors already running, the motors will be damaged. JAF 4 kV motor protection is designed not to trip for the running motors, but provide an alarm only. JAF 4 kV motor breaker will be tripped on an unsuccessful start only provided there is a fault on one phase.

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.

During normal plant operation (Modes 1, 2 or 3) an open single-phase on the RSST primary has no effect on safety bus voltage since the emergency buses are powered from the NSST. Primary windings of RSSTs are connected to 115 kV common grid supplied for power by Line #4 from Nine Mile Point 1 (NMP1) and Line #3 from Lighthouse Hill Substation. Therefore, open phase on any one line will not interrupt power supply to RSST.

Figure 1

Simplified One-Line Diagram



Attachment 1 - Tables

Table 1 - ESF Buses Continuously Powered From Offsite Power Source(s)

Description of ESF Bus Power Source	ESF Bus Name (Normal Operating Condition)	Original Licensing Basis Configuration (Y/N)
N/A Note: Table 1 is not applicable to JAF	N/A	N/A

Table 2 - ESF Buses Not Continuously Powered From Offsite Power Source(s)

Description of ESF Bus Power Source	ESF Bus Name (Normal Operating Condition)	Original Licensing Basis Configuration (Y/N)
UAT 1 (71T-4) Y-Winding	4kV bus 10500	Y
UAT 1 (71T-4) Y-Winding	4kV bus 10600	Y

Attachment 1 - Tables

Table 3 - ESF Buses Normally Energized Major Loads

ESF Bus	Load	Voltage Level	Rating (HP)
10500	Unit Substation L15	600 VAC	478 kW
10500	Unit Substation L25	600 VAC	533 kW
10600	Unit Substation L16	600 VAC	209 kW
10600	Unit Substation L26	600 VAC	323 kW

Table 4 - Offsite Power Transformers

Transformer	Winding Configuration	MVA Size (AO/FA/FA)	Voltage Rating (Primary/Secondary)	Grounding Configuration
RSST 71T-2	Wye-Wye-Wye (3 Leg)	15/20/25	115 kV/4.16 kV	Neutral Grounded
RSST 71T-3	Wye-Wye-Wye (3 Leg)	15/20/25	115 kV/4.16 kV	Neutral Grounded

Attachment 1 - Tables

Table 5 - Protective Devices

Protection Zone	Protective Device	UV Logic	Setpoint (Nominal)	Basis for Setpoint
4 KV ESF Bus 10500	Loss of Voltage Relay (GE NGV)	2 of 2 TD-2.5 Seconds	2975V (71.5% of 4160V)	To actuate upon complete loss of ESF Bus voltage condition
4 KV ESF Bus 10600	Loss of Voltage Relay (GE NGV)	2 of 2 TD-2.5 Seconds	2975V (71.5% of 4160V)	To actuate upon complete loss of ESF Bus voltage condition
4 KV ESF Bus 10500	Degraded Voltage Relay (ITE 27N)	2 of 2 TD-9 seconds for LOCA, 45 seconds for non-LOCA	3871V (93.1 % of 4160V)	To actuate upon degraded ESF Bus voltage condition
4 KV ESF Bus 10600	Degraded Voltage Relay (ITE-27N)	2 of 2 TD-9 seconds for LOCA, 45 seconds for non-LOCA	3871V (93.1 % of 4160V)	To actuate upon degraded ESF Bus voltage condition
4 KV ESF Bus 10500 and 10600	Ground Protection (GE PJC)		10 amps, instantaneous	Trip the feeder breaker for the grounded load circuit (ground fault current greater than 10 amps). The effect of a high impedance ground has not been analyzed.
4 KV BOP Bus 10300 and 10400	Ground Protection (GE IAC51)		12 amps, Time Dial 4.0	Trip the supply breaker from RSST for the grounded 4 kV bus (ground fault current greater than 12 amps). The effect of a high impedance ground has not been analyzed.
4 KV BOP Bus 10300 and 10400	Ground Protection (GE IAC53)		16 amps, Time Dial 5.0	Trip the supply breaker from NSST for the grounded 4 kV bus (ground fault current greater than 16 amps). The effect of a high impedance ground has not been analyzed.