Duke Energy®
Crystal River Nuclear Plant
Docket No. 50-302
Operating License No. DPR-72

Ref. 10 CFR 50.54(f)

October 24, 2012
3F1012-08

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

Subject: Crystal River Unit 3 –Response to NRC Bulletin 2012-01: Design Vulnerability in Electric Power System

Reference: NRC Bulletin 2012-01: Design Vulnerability in Electric Power Systems, dated July 27, 2012

On July 27, 2012, the Nuclear Regulatory Commission issued NRC Bulletin 2012-01: Design Vulnerability in Electric Power System to all power reactor licensees and holders of combined licenses for nuclear power reactors. The purpose of this bulletin is to notify Licensees of a recent operating experience concerning the loss of one of the three phases of the offsite power circuit at Byron Station, Unit 2 in order to determine if further regulatory action is warranted. NRC Bulletin 2012-01 requires that each licensee provide a response to the Requested Actions within 90 days of the date of this bulletin. The enclosure to this submittal provides the response to the Requested Actions.

There are no regulatory commitments contained in this letter.

Please address any comments or questions regarding this matter to Mr. Dan Westcott, Superintendant, Licensing and Regulatory Programs at (352) 563-4796.

Sincerely,

Jon A. Franke
Vice President
Crystal River Nuclear Plant

JAF/par

Enclosure: Response to NRC Bulletin 2012-01 Required Actions

xc: NRR Project Manager
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IE76
NRR

STATE OF FLORIDA

COUNTY OF CITRUS

Jon A. Franke states that he is the Vice President, Crystal River Nuclear Plant for Florida Power Corporation; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission the information attached hereto; and that all such statements made and matters set forth therein are true and correct to the best of his knowledge, information, and belief.

Jon A. Franke
Vice President
Crystal River Nuclear Plant

The foregoing document was acknowledged before me this 24 day of October, 2012, by Jon A. Franke.

Carolyn E Portmann
Signature of Notary Public
State of Florida

CAROLYN E. PORTMANN
Commission # DD 937553
Expires March 1, 2014
Bonded Thru Troy Fain Insurance 800-385-7019

(Print, type, or stamp Commissioned Name of Notary Public)

Personally Known ✓ -OR- Produced Identification ______

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302 / LICENSE NUMBER DPR-72

ENCLOSURE

RESPONSE TO NRC BULLETIN 2012-01 REQUIRED ACTIONS

Response to NRC Bulletin 2012-01 Required actions

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
- Attachment 1 - Simplified One-Line Diagram
- Attachment 2 - Tables
    - Table 1 - ESF Buses Normally Powered From Offsite Power Source(s)
    - Table 2 - ESF Buses Not Normally Powered From Offsite Power Source(s)
    - Table 3 - ESF Buses Normally Energized Major Loads
    - Table 4 – ESF Bus Offsite Power Transformers
    - Table 5 – ESF Bus Protective Devices
    - Table 6 – Offsite Circuit Differential and Ground 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).***

See Attachment 1 for a simplified one-line diagram.

The 4160V Engineered Safeguards Buses are normally powered from preferred offsite power sources. The 4160V Engineered Safeguards Buses are not connected to the Crystal River Unit 3 (CR-3) main generator during normal operation. One preferred offsite circuit from the Crystal River 230 kV Switchyard supplies the unloaded Start-Up Transformer (SUT) and normally supplies 4160V Engineered Safeguards Bus 3B through the Back-Up Engineered Safeguards Transformer (BEST). The other preferred offsite circuit from the Crystal River 230 kV Switchyard normally supplies 4160V Engineered Safeguards Bus 3A through the Offsite Power Transformer (OPT).

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

The Generator Step-Up Transformers (GSUs) consists of three separate single phase transformers connected in a three phase Y configuration on the 500 kV side and a delta (Δ) configuration on the generator side. The 500 kV side has a solidly grounded neutral.

The Unit Auxiliary Transformer (UAT) is a three phase, three winding transformer with a Δ-Y-Y configuration. The 22 kV winding is a delta configuration. The 6900V winding neutral is grounded through a 6.67 ohm (Ω) resistor bank. The 4160V winding neutral is grounded through a 4.0 Ω resistor bank.

The SUT is a three phase, three winding transformer with a Y-Y-Y configuration. The 230 kV winding has a solidly grounded neutral. The 6900V winding neutral is grounded through a 6.67 Ω resistor bank. The 4160V winding neutral is grounded through a 4.0 Ω resistor bank.

The BEST and OPT are three phase, two winding transformers with a Y-Y configuration. The 230 kV windings have solidly grounded neutrals. The 4160V winding neutrals are grounded through 4.0 Ω resistor banks.

See Attachment 2, Table 4 for additional information on the CR-3 power transformers.

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, 4160V Engineered Safeguards Buses are supplied by preferred offsite sources.

The 4160V Engineered Safeguards Buses supply all of the Class-1E loads and limited low voltage non-safety related loads.

See Attachment 2, Tables 1 and 2 for 4160V Engineered Safeguards Bus power sources (in table form)

See Attachment 2, Table 3 for 4160V Engineered Safeguards 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 design of the CR-3 preferred offsite circuits has been changed since the original licensing basis.

CR-3 was originally licensed with one preferred offsite circuit using the CR-3 SUT and the other preferred offsite circuit using the Crystal River Unit 1&2 Start-Up Transformer. The CR-3 SUT was replaced by the BEST and the Crystal River Unit 1&2 Start-Up Transformer was replaced by the OPT as the source of power to the 4160V Engineered Safeguards Buses. The changes were made so that starting of large non Class-1E induction motor loads would not impact 4160V Engineered Safeguards Bus voltages.

Subsequently, the 4160V BEST Auxiliary Bus 3 was inserted into the preferred offsite circuit from the BEST so that the Alternate AC Diesel Generator could be used to power a 4160V Engineered Safeguards Bus in the event that offsite power was lost and the Emergency Diesel Generator failed to re-energize the bus.

The following at power (normal operating condition) configuration has been confirmed to be consistent with the current licensing basis and the intent of 10 CFR 50 Appendix A General Design Criterion (GDC) 17 (reference the CR-3 Final Safety Analysis Report (FSAR) Section 8.1, 8.2.2.4, 8.2.3.1.1 and the CR-3 Improved Technical Specifications Bases B3.8.1):

1. BEST is the preferred offsite circuit from the Crystal River 230 kV Switchyard to the 4160V Engineered Safeguards Bus 3B
2. OPT is the preferred offsite circuit from the Crystal River 230 kV Switchyard to the 4160V Engineered Safeguards Bus 3A

Reference the response to Question 1c below for two procedurally allowed alternative electrical alignments (seldom used during power operations).

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. Also, include the following information:***

Consistent with the current licensing basis and GDC 17, existing protective circuitry will separate the 4160V Engineered Safeguards Buses from a connected but failed preferred offsite source due to a loss of voltage or a sustained, balanced degraded grid voltage concurrent with certain design basis accidents.

The protection schemes for the 4160V Engineered Safeguards Buses will not detect and automatically respond to single-phase open circuit conditions on the preferred off-site circuits from the Crystal River 230 kV and 500 kV switchyards. The loss-of-voltage and degraded voltage relaying were designed so that the loss of a single potential transformer (PT) fuse will not cause an undervoltage relaying actuation and separate the 4160V Engineered Safeguards Bus from the preferred offsite circuit. The actual loss of a single phase would appear to the undervoltage relaying like a loss of a PT fuse.

High Impedance Ground Fault Condition:

The electrical protection scheme of the preferred offsite circuits has been reviewed with regard to high impedance ground faults. The review examined ground faults at all segments of the preferred offsite circuits and determined that the effect of a high impedance ground is of no consequence as it relates to a sustained bus voltage imbalance. A summary of the review follows.

Attachment 2, Table 6 lists ground protection / alarms and the basis for the device setpoint(s).

- Ground fault on the BEST, OPT 230 kV side or GSU 500 kV side:

  A high impedance ground fault that does not generate sufficient current to actuate the protective relaying could not result in a voltage imbalance due to the "stiffness" of the 230 KV grid and the relatively short conductor spans to CR-3; the entire grid voltage would have to be imbalanced as a result of the high impedance fault, which is not credible. A high impedance fault capable of producing imbalanced 230 KV or 500 KV bus voltages could not be sustained; the fault would clear or propagate into a low impedance ground fault that would be detected by the protective relaying.

- Ground fault on UAT / GSUs 22 KV side:

  In the backfeed mode, with the CR-3 main generator offline and the generator disconnect links removed, the 22 KV system is an ungrounded Δ by design. Ground detection is provided by voltage relaying. Although a single phase ground in the 22 KV electrical distribution system while in the backfeed mode, can affect the line to ground voltages in the 22 KV system, the line to line voltages will not be impacted. Therefore, ground faults in this section of the distribution system cannot result in sustained imbalanced voltage conditions on the 4160V Engineered Safeguards Buses.

- Grounds fault on BEST / OPT / UAT 4160V side:

  The CR-3 4160V electrical distribution system is comprised of low impedance non-segregated metal enclosed bus duct (2000A and 1200A) and low impedance, medium voltage cabling systems in order to minimize voltage drop to the 4160V Engineered Safeguards Buses. The 4160V neutral connection of the secondary windings of the BEST / OPT / UAT are resistance grounded (4.0 Ω). Maximum single phase to ground fault current is limited by the resistance to approximately 600A. Relaying has been provided to limit the phase to ground current to 150 amps (ground differential current relaying) or 180 amps (ground overcurrent relaying). A sustained high impedance fault with a current just below the relaying trip setpoint would produce an insignificant voltage imbalance on the 4160V Engineered Safeguards Buses due to the low impedance 4160V electrical distribution system impedance. In addition, a sustained high impedance fault with a current below the relaying trip setpoint is not considered credible; the fault would clear or propagate into a low impedance ground fault that would be detected by the protective relaying.

Based on the above, grounds of any impedance value anywhere in the distribution system, including transformer connections to the switchyard breakers, will either be rapidly detected and automatically isolated by ground and/or differential relay protection circuitry or will have no impact on steady-state 4160V Engineered Safeguards Bus voltages.

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 and respond to a single phase open circuit condition.

Each 4160V Engineered Safeguards Bus undervoltage relaying scheme consists of the following:

- Y-Y connected bus PTs
- Two-out-of-three logic Loss-of-Voltage Relays (inverse-time induction disk); each relay monitors one phase to neutral (A-N, B-N, C-N)
- Three-out-of-three logic Degraded Voltage Relays (discrete time); each relay monitors phase to phase (A-B, B-C, C-A)

See Attachment 2, 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.

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.

Not Applicable - the 4160V Engineered Safeguards Buses at CR-3 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?

The current plant operating procedures, including operating procedures for off-normal (alternative) alignments, specifically call for verification of the voltages on all three phases of both 4160V Engineered Safeguards Buses every shift.

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.***

The 4160V Engineered Safeguards Buses and the preferred offsite circuits at CR-3 are normally lightly loaded. The protection schemes for the CR-3 4160V Engineered Safeguards Buses were not designed to automatically detect and respond to single-phase open circuit conditions on the preferred off-site circuits under any loading condition.

> ***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.***

CR-3 did not credit, in the Current Licensing Basis (CLB), that the Class 1E protection scheme for the 4160V Engineered Safeguards Buses were designed to detect and automatically respond to a single-phase open circuit condition on the credited offsite power source as described in the CR-3 FSAR and Improved Technical Specifications.

Since CR-3 did not credit the 4160V Engineered Safeguards Bus protection schemes 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 scheme or secondary level undervoltage protection system design criteria. Since open phase detection was not credited in the CR-3 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 in industry and the Institute of Electrical and Electronics Engineers literature. The difficulty in applying these documents to the CR-3 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 CR-3 specific Class 1E electric distribution system.

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

The 4160V Engineered Safeguards Buses are normally powered from offsite power sources. One preferred offsite circuit from the Crystal River 230 kV Switchyard supplies the 4160V Engineered Safeguards Bus 3B through the BEST. The other preferred offsite circuit from the Crystal River 230 kV Switchyard normally supplies 4160V Engineered Safeguards Bus 3A through the OPT. In this alignment, only one bus would be affected by a loss of a single phase on a preferred offsite circuit due to the design of the Crystal River 230 kV Switchyard.

The 500 kV backfeed is only used while CR-3 is shutdown and is not used to power both 4160V Engineered Safeguards Buses at one time.

One procedurally allowed, but seldom used, alternative alignment for any operational mode is the BEST powering the 4160V Engineered Safeguards Bus 3A and the OPT powering the 4160V Engineered Safeguards Bus 3B. The consequences of this alignment are no different than the normal alignment.

Another procedurally allowed, but seldom used, alternative alignment for any operational mode is both 4160V Engineered Safeguards Buses supplied by the BEST or OPT (both 4160V Engineered Safeguards Buses on one transformer); CR-3 operating procedures require this alignment duration to be minimized. This alignment is only used for testing the offsite power circuit breakers to ensure either transformer can supply either 4160V Engineered Safeguards Bus or if there is a potential threat or concern with the BEST or OPT or the associated preferred offsite circuits such as work taking place in the vicinity of the BEST or OPT. In this alignment, the loss of a single phase on the preferred offsite circuit connected to the 4160V Engineered Safeguards Buses would affect both 4160V Engineered Safeguards Buses.

CR-3 has procedures in place to recognize and address a loss of a single phase on a preferred offsite circuit that is connected to the 4160V Engineered Safeguards Buses:

- Administrative instructions list indications of a loss of a single phase on a preferred offsite circuit
- Annunciator response procedures include that a potential cause for a 4160V Engineered Safeguards motor overload or Engineered Safeguards Bus undervoltage relaying alarm could be a loss of a single phase on the associated preferred offsite circuit
- Surveillance procedures periodically observe 4160V Engineered Safeguards Bus volt meters and perform visual inspections (walkdowns) of the preferred offsite circuits in use
- Abnormal procedures direct actions in case a loss of a single phase on a preferred offsite circuit is identified

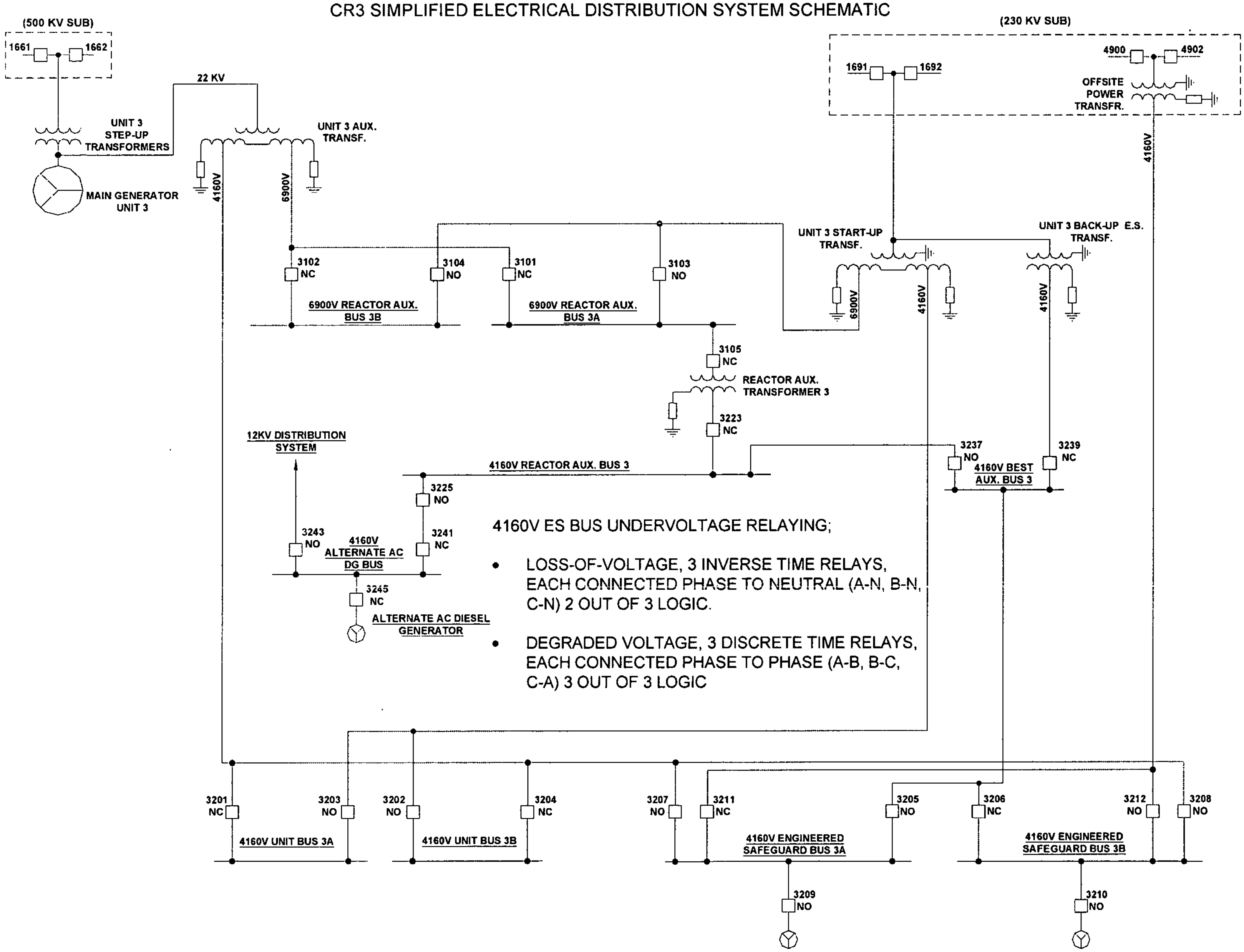
2.e. If a common or single offsite circuit is used to supply redundant ESF buses, explain why a failure, such as a single-phase open circuit or high impedance ground fault condition, would not adversely affect redundant ESF buses.

As indicated in the response to Question 2.c., the normal "at power" operating condition configuration does not have a single preferred offsite circuit supplying both 4160V Engineered Safeguards Buses.

In the unusual electrical alignment where both 4160V Engineered Safeguards Buses are supplied from the same preferred offsite circuit, CR-3 is consistent with the Current Licensing Basis. Protective circuitry will separate the 4160V Engineered Safeguards Buses from a 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 circuit was not evaluated as part of the approved design and licensing basis of the plant. No calculations for this scenario have been completed.

Consistent with the current station design, protective circuitry will protect from a ground fault condition with all three phases intact.

CR3 SIMPLIFIED ELECTRICAL DISTRIBUTION SYSTEM SCHEMATIC



Attachment 2 - Tables

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

Description of ESF Bus Power Source	ESF Bus Name (normal operating condition).	Original licensing basis configuration (Y/N)
Offsite Power Transformer (OPT)	4160V Engineered Safeguards Bus 3A	No
Back-Up Engineered Safeguards Transformer (BEST)	4160V Engineered Safeguards Bus 3B	No

Table 2 - ESF Buses Not Normally 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	None	N/A

Table 3 - ESF Buses Normally Energized Major Loads

ESF Bus	Load	Voltage Level	Rating (HP)
4160V Engineered Safeguards Bus 3A	MUP-1A Make-Up / HPI Pump A	4160V	700 HP
4160V Engineered Safeguards Bus 3A	MUP-1B Swing Make-Up / HPI Pump B	4160V	700 HP
4160V Engineered Safeguards Bus 3A	4160V / 480V Engineered Safeguards Transformer 3A	4160V Primary 480V Secondary	1333 KVA / FA (partially loaded)
4160V Engineered Safeguards Bus 3B	MUP-1B Swing Make-Up / HPI Pump B	4160V	700 HP
4160V Engineered Safeguards Bus 3B	MUP-1C Make-Up / HPI Pump C	4160V	700 HP
4160V Engineered Safeguards Bus 3B	4160V / 480V Engineered Safeguards Transformer 3B	4160V Primary 480V Secondary	1333 KVA / FA (partially loaded)

Note: only one of the three MUPs is operated at one time during normal operation

Table 4 – ESF Bus Offsite Power Transformers

Transformer	Winding Configuration	MVA Size (OA/FA/FOA)	Voltage Rating (Primary/Secondary)	Grounding Configuration
Back-Up Engineered Safeguards Transformer (BEST)	Y-Y	12/16/20 @ 55°C rise 22.4 FOA /@ 65°C rise	230 KV / 4.16 KV	H: Solidly Grounded X: Resist. Grounded 4Ω
Offsite Power Transformer (OPT)	Y-Y	12/16/20 @ 55°C rise 22.4 FOA /@ 65°C rise	230 KV / 4.16 KV	H: Solidly Grounded X: Resist. Grounded 4Ω
Start-Up Transformer (SUT)	Y-Y-Y	H: 33/44/55@ 55°C rise 61.6 FOA /@ 65°C rise X: 18/24/30@ 55°C rise 33.6 FOA /@ 65°C rise Y: 15/20/25@ 55°C rise 28 FOA /@ 65°C rise	230 KV / 6.9 KV / 4.16 KV	H: Solidly Grounded X: Resist. Grounded 6.67Ω Y: Resist. Grounded 4Ω
Unit Auxiliary Transformer (UAT)	Δ-Y-Y	H: 33/44/55@ 55°C rise 61.6 FOA /@ 65°C rise X: 18/24/30@ 55°C rise 33.6 FOA /@ 65°C rise Y: 15/20/25@ 55°C rise 28 FOA /@ 65°C rise	22 KV / 6.9 KV / 4.16 KV	H: Solidly Grounded X: Resist. Grounded 6.67Ω Y: Resist. Grounded 4Ω
Generator Step-Up Transformers (GSUs)	Y-Δ (Three single phase transformers)	1200 FOA /@ 65°C rise (400 FOA / Transformer)	500 KV / 21 KV	HV (Y): Solidly Grounded LV (Δ): Ungrounded

Table 5 – ESF Bus Protective Devices

Protection Zone	Protective Device	Output Logic	Setpoint (Nominal)	Function (Trip/Alarm)	Basis for Setpoint
4160V Engineered Safeguards Bus 3A and 4160V Engineered Safeguards Bus 3B	Loss of Voltage Relaying (three single phase induction disk relays connected between phase and neutral A-N, B-N, C-N)	2 of 3	2364 V (56.8% of 4160V), Inverse Time Characteristic (7.8 sec time delay at 0 Volts)	Trip	To actuate upon a complete loss of bus voltage condition on the bus and re-power the bus from the associated emergency diesel generator
4160V Engineered Safeguards Bus 3A and 4160V Engineered Safeguards Bus 3B	Degraded Voltage Relaying (three single phase relays each connected between two phases, A-B, B-C, C-A)	3 of 3	3952 V (95% of 4160V), 5 sec time delay	Trip	To ensure Class-1E loads receive adequate voltage and actuate on a sustained (balanced) degraded voltage on the bus. Actuation will re-power the bus from the associated emergency diesel generator
4160V Engineered Safeguards Bus 3A and 4160V Engineered Safeguards Bus 3B	Overcurrent Relaying (one per phase for each of the three bus source supply breakers on each bus)	1 of 3	4800 amps	Trip	To actuate if a phase overcurrent is detected on the bus
4160V Engineered Safeguards Bus 3A and 4160V Engineered Safeguards Bus 3B	Residual (Ground) Overcurrent Relaying (one relay for each of the three bus source supply breakers on each bus)	1 of 1	150 amps	Trip	To actuate if a phase to ground fault is detected on the bus

Table 6 – Offsite Circuit Differential and Ground Protective Devices

Protection Zone	Protective Device	Setpoint (Nominal)	Function (Trip/Alarm Only)	Basis for Setpoint
230 KV bus and supply circuit to Back-Up Engineered Safeguards Transformer (BEST) / Start-Up Transformer (SUT)	Differential Current Relaying	610 differential amps	Trip	To actuate if a fault is detected within the zone of protection
230 KV bus and supply circuit to BEST / SUT	Back-Up Differential Current Relaying (functions as an overcurrent relay)	1044 amps	Trip	Back-Up protection to actuate upon a fault
BEST and 4160V circuit to 4160V Engineered Safeguards Buses	Differential Current Relaying	Trip current is dependent on fault location since the zone of protection involves more than one system voltage level	Trip	To actuate if a fault is detected within the zone of protection
BEST 4160V circuit to 4160V Engineered Safeguards Buses	Ground Differential Current Relaying	150 differential amps	Trip	To actuate if a ground fault is detected within the zone of protection
BEST 4160V circuit to 4160V Engineered Safeguards Buses	Ground (transformer neutral) Overcurrent Relaying	180 neutral amps	Trip	To actuate if a ground fault is detected and to coordinate with the bus Residual (Ground) Overcurrent Relays
230 KV bus and supply circuit to Offsite Power Transformer (OPT)	Differential Current Relaying	83 differential amps	Trip	To actuate if a fault is detected within the zone of protection
230 KV bus and supply circuit to OPT	Back-Up Differential Current Relaying (functions as an overcurrent relay)	1044 amps	Trip	Back-Up protection to actuate upon a fault
OPT and 4160V circuit to 4160V Engineered Safeguards Buses	Differential Current Relaying	Trip current is dependent on fault location since the zone of protection involves more than one system voltage level	Trip	To actuate if a fault is detected within the zone of protection

Protection Zone	Protective Device	Setpoint (Nominal)	Function (Trip/Alarm Only)	Basis for Setpoint
OPT 4160V circuit to 4160V Engineered Safeguards Buses	Ground Differential Current Relaying	150 differential amps	Trip	To actuate if a ground fault is detected within the zone of protection
OPT 4160V circuit to 4160V Engineered Safeguards Buses	Ground (transformer neutral) Overcurrent Relaying	180 neutral amps	Trip	To actuate if a ground fault is detected and to coordinate with the bus Residual (Ground) Overcurrent Relays
500 KV supply circuit to Generator Step-Up Transformers (GSUs)	Overcurrent Relaying	354 differential amps	Trip	To actuate if a fault is detected within the zone of protection
GSU to Unit Auxiliary Transformer (UAT) 22 KV Bus	Voltage Relaying	Voltage based setpont	Trip	To actuate if a ground fault is detected on the ungrounded delta (Δ) bus
500 KV supply circuit to GSUs; GSUs; UAT	Overall Differential Current Relaying	Trip current is dependent on fault location since the zone of protection involves more than one system voltage level	Trip	To actuate if a fault is detected within the zone of protection
UAT and 4160V circuit to 4160V Engineered Safeguards Buses	Differential Current Relaying	Trip current is dependent on fault location since the zone of protection involves more than one system voltage level	Trip	To actuate if a ground fault is detected within the zone of protection
UAT 4160V circuit to 4160V Engineered Safeguards Buses	Ground (Neutral) Overcurrent Relaying	240 neutral amps	Trip	To actuate if a ground fault is detected and to coordinate with the bus Residual (Ground) Overcurrent Relays