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October 23, 2012 10 CFR 50.54(f)

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

Subject: Duke Energy Carolinas, LLC (Duke Energy)
Oconee Nuclear Station, Units 1, 2 and 3
Docket Nos. 50-269, 50-270 and 50-287
Response to NRC Bulletin 2012-01

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 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 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 Bob Meixell at (864) 873-3279.

I declare under penalty of perjury that the foregoing is true and correct. Executed on October 23, 2012.

Respectfully,

TPGillespie

T. Preston Gillespie, Jr.
Vice President
Oconee Nuclear Station

Enclosure: Oconee Response to NRC Bulletin 2012-01 Requested Actions
- Attachment 1 - Bulletin Response
- Attachment 2 - Simplified One-Line Diagram
- Attachment 3 - Tables

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ONS Response To NRC Bulletin 2012-01

Attachment 1 - Bulletin Response

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 2 - Simplified One-Line Diagrams
- Attachment 3 - Tables
  - 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 (Safety Related)
  - Table 4 - Offsite Power Transformers
  - Table 5 - Protective Devices
  - Table 6 - Loss of Phase Alarms

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).

During normal operation, all the plant auxiliary loads including the ESF buses (main feeder buses) are aligned to the non-safety related unit auxiliary transformers (UATs), (1T, 2T, and 3T) which are fed from the unit generator. The safety related startup auxiliary transformers (SATs), (CT1, CT2, and CT3) fed from the 230kV switchyard are charging the bus to the emergency breakers but are not supplying power to any plant loads.

See Attachment 2 for a simplified one-line diagram at normal operation.

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

See Attachment 3, Table 4 for offsite power transformer winding and grounding configurations.

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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 are not powered by offsite sources.

See Attachment 3, Tables 1 and 2 for ESF bus power sources.

Attachment 3 - Table 3, ESF bus major loads, is not applicable since the ESF buses are not normally powered by offsite power sources.

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

There has been one change that affects plant response during a grid disturbance. Each unit was originally designed to load reject without a unit trip. This feature would allow the unit to supply power to its auxiliary loads or another unit's auxiliary loads during a loss of the grid, Loss of Offsite Power. However, due to operating experience it has been shown that a load rejection would cause a reactor trip due to over pressurization. Due to this and the 1993 UFSAR update in which the hypothetical loss of all station power was replaced with a station blackout analysis, the circuitry to allow a load reject without a unit trip was deleted and the UFSAR revised.

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:

Per UFSAR section 3.1, the principal design criteria for Oconee 1, 2 and 3 were developed in consideration of the 70 General Design Criteria for Nuclear Power Plant Construction Permits proposed by the Atomic Energy Commission (AEC) in a proposed rule-making published for

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10CFR Part 50 in the Federal Register of July 11, 1967. UFSAR section 3.1.39, Criterion 39 and section 8, Electric Power, did not define degraded voltage as an unbalanced system. As such, the industry failure mode effects analysis (FMEA) (implied or otherwise) did not address an open phase as design criteria for a degraded voltage relay (DVR) scheme. Therefore, open phase detection was not credited in the plant's design or licensing basis. Consistent with the current licensing basis and AEC 39, existing protective circuitry will separate the ESF buses from a connected failed source due to a loss of voltage or a sustained, balanced degraded grid voltage concurrent with certain design basis accidents. Below are the two relaying protective schemes:

1. The 230kV voltage monitoring scheme is used in the degraded grid and external grid trouble circuitry. These two circuits are independent of each other and initiate a switchyard isolate during different conditions. The degraded grid circuitry monitors the 230kV yellow bus and arms the switchyard isolate circuitry upon detection of two or three phases being degraded (2 out of 3 logic). The external grid trouble circuitry monitors both the 230kV red and yellow buses and initiates a switchyard isolate upon detection of two or three phases of the yellow bus collapsing and two or three phases of the red bus collapsing (2 out of 3 logic for both buses).
2. The 4160V voltage monitoring scheme is used in detecting an under voltage condition, two out of three logic scheme, on the sources supplying power to the ONS auxiliary loads; 1) normal, 2) startup, and 3) standby buses (on site power source). The scheme will initiate a trip to the source breakers if supplying power to the auxiliary loads and block close of the source breakers.

In both voltage monitoring schemes, 230kV and 4160V, there are control room indications provided for a single phase condition (open circuit). The control room would receive annunciators and computer points of an under voltage condition on that phase, but no automatic trip would be initiated. The control room operators would respond per the appropriate Alarm Response Guide. See Attachment 3 Table 6 for associated alarms.

However, in certain cases it is not known if the loss of phase would be detected by the current relaying protection schemes to give control room indication. 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.

High impedance ground faults were not specifically analyzed on offsite power circuits. However, if a high impedance fault on an offsite power circuit is such that it affects the essential buses, the protective relaying will respond by isolating the offsite power circuit such that the equipment supplied by the essential buses are not impaired or operated outside of their designed ratings.

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

Consistent with the current licensing basis, existing electrical protective devices are sufficiently sensitive to detect design basis conditions like a loss of voltage or a degraded voltage on a balanced system (as stated above), but were not designed to detect a single phase open circuit condition. See Attachment 3, Table 5 for under voltage protective devices and the basis for the device set point(s). Attachment 3, Table 5 also lists ground protection/alarms on the ESF buses and the basis for the device set point(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.***

The Main Feeder Buses (ESF buses) at ONS (Oconee Nuclear Station) are not powered by off-site sources during normal plant operation.

ONS Technical Specification 3.8 requires the following:

> During Modes 1, 2, 3, and 4, two offsite sources are required to be connected to a unit startup transformer, via the 230 kV switchyard, and be capable of automatically supplying power to one main feeder bus.
>
> During Modes 5, 6, and movement of recently irradiated fuel assemblies, one source from the offsite transmission network to the onsite AC electrical power distribution system(s) is required.

Weekly surveillance procedures verify proper switchyard and unit breaker alignment to ensure two off-site sources are available to supply power to a startup transformer, if applicable. Additionally, voltage is verified on the main feeder buses during the weekly surveillances. 4160VAC source voltage from the off-site power source is not confirmed during the weekly surveillance; however there are control room annunciators that continually monitor each source to alert the control room of an undervoltage condition.

> ***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 off-normal operating procedures, do not specifically call for verification of the voltages on all three phases of the ESF buses. However, the control room does continuously monitor the voltage on all three phases of the power source to the ESF buses. This is accomplished by stat alarm and computer point indication.

See Attachment 3 Table 6 for Unit specific alarms.

<u>Consequences</u>

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

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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.

Oconee Nuclear Station (ONS) 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.

The offsite power circuits at ONS consist of two independent circuits from the ONS switchyards (230kV Unit 1 and 2 and 525kV Unit 3) to the UATs and SATs which feed the plant ESF buses. Note, the power path from the ONS switchyard to the UAT is only used during unit shutdown conditions. Additionally, the 100kV Central Tie Substation or Lee Steam Station, via the 100kV transmission line to CT5, can be used to supply emergency power to the ESF buses.

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

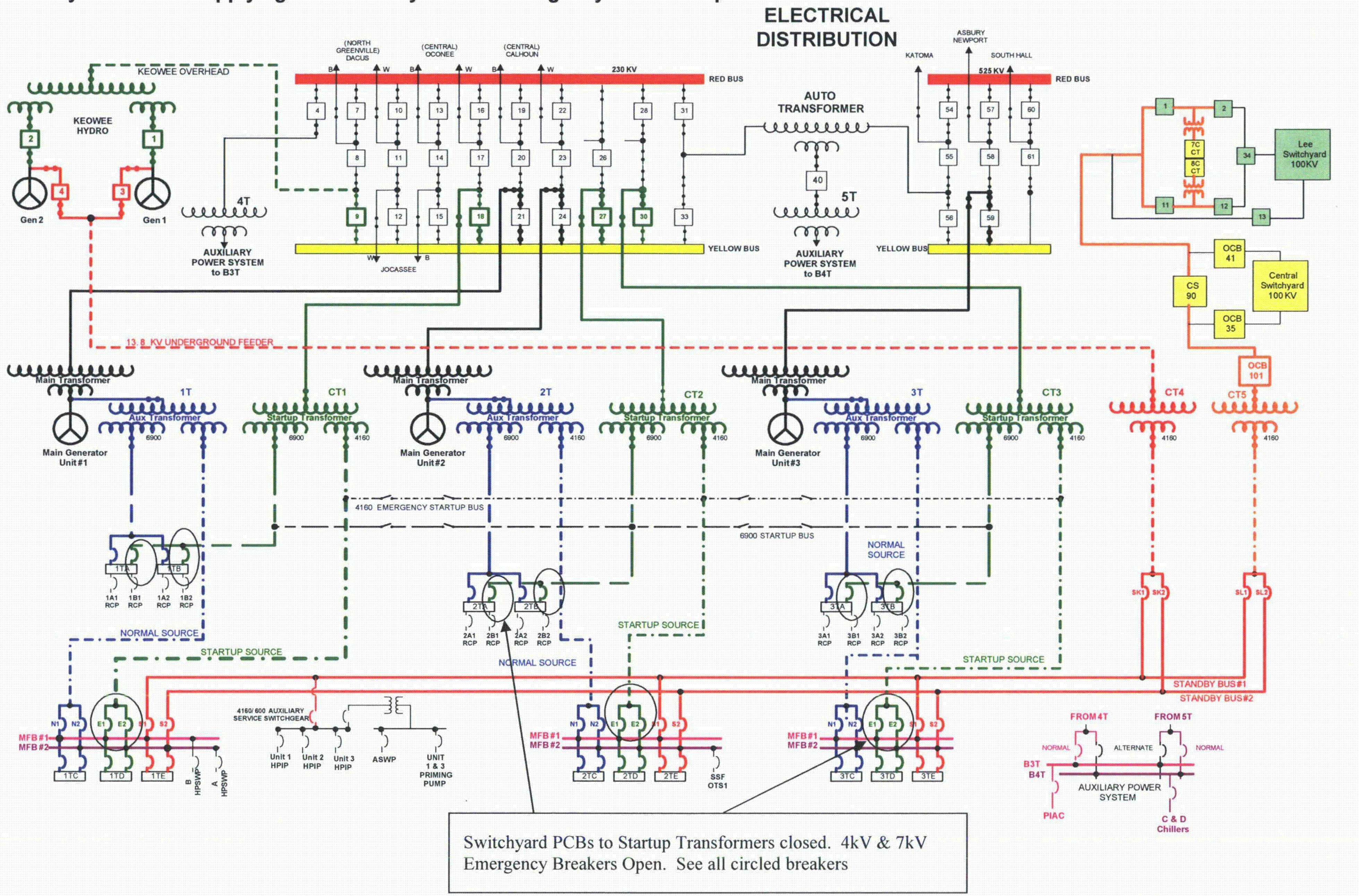
Without formalized engineering calculations or engineering evaluations, the electrical consequences of such an open phase event (including plant response), cannot be evaluated at this time.

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.

Consistent with the Current Licensing Basis and AEC 39, protective circuitry will separate the ESF buses from a failed source due to a loss of voltage or a sustained balanced degraded grid voltage concurrent with certain design basis accidents. Open phase detection was not credited in the ONS 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), cannot be evaluated at this time.

Generators feed unit auxiliary transformers which feed unit auxiliary loads. Startup Transformers are being charged from the switchyard but not supplying Unit auxiliary loads. Emergency breakers open.



Attachment 3 - 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	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)
Unit Generator - Unit Auxiliary Transformer (1T, 2T, 3T)	Main Feeder Bus 1 (MFB1)	Y
Unit Generator - Unit Auxiliary Transformer (1T, 2T, 3T)	Main Feeder Bus 2 (MFB2)	Y

Table 3 - ESF Buses Powered By Off-site Sources Normally Energized Major Loads

(No ESF Buses normally powered by Off-site sources)

ESF Bus (MFB)	Load	Voltage Level	Rating (HP)

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N/A	N/A	N/A	N/A

Table 4 - Offsite Power Transformers

Transformer	Winding Configuration	MVA Size (AO/FA/FOA)	Voltage Rating (Primary/Secondary)	Grounding Configuration
Startup Transformer (CT1, CT2, CT3)	*Wye-Delta-Wye* The 230kv, 6.9kv and 4.16 kv winding are Wye. The Stabilizing (sometimes called tertiary) winding is Delta.	*45/60 MVA OA/FA* *(FA - 67.2MVA @ 65°C)*	*230kV/6.9kV/4.16kV*	*Neutral Solidly Grounded via Neutral Bushing*
Auxiliary Transformer (1T, 2T, 3T)	*Delta-Wye* Both secondary windings are Wye	*1T &2T* *45/60 MVA OA/FA FA - 67.2MVA @ 65°C)* *3T* *42/56/70 MVA OA/FA/FA @ 65°C*	*18.1kV/6.9kV/4.16kV*	*Neutral Solidly Grounded via Neutral Bushing*
CT5	*Wye-Delta-Wye* The primary and secondary are Wye. The tertiary is Delta	*12/16/20 MVA OA/FA/FA (FA - 22.4MVA @ 65°C)*	*102.5kV/4.16kV*	*Neutral Solidly Grounded via Neutral Bushing*

Attachment 3 - Tables

Table 5 - Protective Devices

Protection Zone	Protective Device	Logic	Setpoint (Nominal)	Basis for Setpoint
4 KV Normal Source	*Loss of Voltage Relay*	*2 of 3*	*3526.5V drop-out (84.77% of 4160V)* *Tap set at 105V (120V)*	*Connected equipment is not exposed to excessively low voltages*
4 KV Startup Source	*Loss of Voltage Relay*	*2 of 3*	*3526.5V drop-out (84.77% of 4160V)* *Tap set at 105V (120V)*	*Connected equipment is not exposed to excessively low voltages*
Undervoltage Switchyard Isolate	*Loss of Voltage Relay*	*2 of 3 on both Red & Yellow Bus*	*6 sec @74 V (120V)* *148kV(230kv)*	*Set below the N & E under voltage relays above while still providing indication and protection from a collapsing system*
Degraded Grid Voltage	*Loss of Voltage Relay*	*2 of 3 on Yellow Bus*	113.7V drop-out (115V) 227468V (230kV)	Degradation of the voltage provided by offsite sources does not adversely impact the safety function of safety related systems and components.
CT5 Degraded Grid Voltage	*Loss of Voltage Relay*	*2 of 3 on 100kV system*	112.20V drop-out (120V) 3882V(4160V)	Degradation of the voltage provided by Central Substation does not adversely impact the safety function of safety related systems and components
4.16kV Essential Bus	*Bus Ground Over current Relay*	*N/A*	0.5 amp Tap (1.2 sec. @ 500%)	Provide primary ground protection for the bus.
Startup Transformer	*Differential*	*1 of 3*	2.61 amps pick/up	Provide differential current protection for transformer

Attachment 3 - Tables

(SAT)	*Current Relay*		(WDG 2 & 3) 0.96 amps pick/up(WDG 1)	
Swyd Bus to SAT	*Differential Current Relay*	*1 of 3*	87L p/u - 500 V, 87H p/u - 40A	Provide differential current protection for switchyard bus.

Table 5 - Protective Devices (continued)

Startup Transformer (SAT)	*Transformer Neutral Over current Relay*	*N/A*	6900V WDG -2 amp Tap (3 sec. @ 500%) 4160V WDG - 3 amp Tap (3 sec. @ 500%) 230KV WDG - 1 amp Tap (3 sec. @ 500%)	Provide backup protection of transformer in the event of a ground fault.
Swyd Bus to UAT	*Differential Current Relay*	*1 of 3*	**Unit 1 & 2** 1.35 to 1.65 amps pick/up (WDG 1 & 4) 0.86 to 1.06 amps pick/up (WDG 2 & 3) **Unit 3** 1.35 to 1.65 amps pick/up (WDG 1 & 4) 1.25 to 1.51 amps pick/up (WDG 2 & 3)	Provide differential current protection for switchyard bus.
Auxiliary Transformer (UAT)	*Differential Current Relay*	*1 of 3*	Unit 1 & 2 1.50 amps pick/up (WDG 1) 2.61 amps pick/up	Provide differential current protection for transformer.

Attachment 3 - Tables

			(WDG 2 & 3) Unit 3 1.38 amps pick/up (WDG 1) 2.61 amps pick/up (WDG 2 & 3)	

Table 6 - Loss of Phase Alarms

Under Voltage Alarms (Loss of any phase)	Unit 1	Unit 2	Unit 3
230kV system	*SA16-1, SA16-3* *ER 350 - ER 355* *ER 370 - ER 375*	*SA16-1, SA16-3* *ER 350 - ER 355* *ER 370 - ER 375*	*SA16-1, SA16-3* *ER 350 - ER 355* *ER 370 - ER 375*
4kV Normal Source	*1SA15-13* *O1D2568*	*2SA15-13* *O2D2568*	*3SA15-13* *O3D2568*
4kV Startup Source	*1SA15-14* *O1D2569*	*2SA15-14* *O2D2569*	*3SA15-14* *O3D2569*
100kV (CT5)	*SA16-12*	*SA16-12*	*SA16-12*