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10 CFR 50.54(f)

October 25, 2012

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

Subject: **San Onofre Nuclear Generating Station, Units 2 and 3**
Docket Nos. 50-361 and 50-362
90-DAY Response to NRC Bulletin 2012-01

Reference: NRC Bulletin 2012-01: Design Vulnerability in Electrical Power System, Dated July 27, 2012

Dear Sir or Madam:

On July 27, 2012, the Nuclear Regulatory Commission (NRC) issued Bulletin 2012-01, "Design Vulnerability in Electrical Power System" (Reference) to all power reactor licensees and holders of combined licenses for nuclear power reactors. The Bulletin requires that each licensee provide a response to the Requested Action within 90 days of the date of this bulletin. The Enclosure provides the Required Response to the Requested Actions of Bulletin 2012-01.

There are no regulatory commitments contained in this letter or the Enclosure.

If you have any questions or require additional information, please contact Linda Conklin at 949-368-9443.

In accordance with 10 CFR 50.54(f), the following affirmation is provided:

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

Executed on 10/25/2012

Thomas J. Palmisano
Vice President Engineering Projects and Site Support

Enclosure: NRC Bulletin 2012-01, "Design Vulnerability in Electric Power System"

CC: E. E. Collins, Regional Administrator, NRC Region IV
R. Hall, NRC Project Manager, San Onofre Units 2 and 3
G. G. Warnick, NRC Senior Resident Inspector, SONGS Units 2 and 3

P.O. Box 128
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Enclosure:

NRC Bulletin 2012-01

“Design Vulnerability in Electric Power System”

SONGS Units 2 and 3 Response

Date: 10/16/2012

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
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- Attachments
    1. Simplified Plant Electrical Overview
    2. Simplified Switchyard Diagram
    3. List Of Major Class 1E Running Load

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 [Engineered Safety Features] buses (Class 1E for current operating plants or non-Class 1E for passive plants) at power (normal operating condition).***

RESPONSE:

Each SONGS unit has two 4.16kV ESF buses that are normally powered from the offsite power source by each unit's two reserve auxiliary transformers. Each unit's reserve auxiliary transformers are fed from a common 230kV switchyard by a single circuit. A failure in the circuit from the switchyard to the reserve auxiliary transformers of one unit affects the normal offsite power source to both ESF buses of a unit. The alternate offsite power source is supplied from the companion unit and remains unaffected. See Attachment 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.***

RESPONSE:

All reserve auxiliary transformers are three-legged core, three winding transformers, with primary winding WYE-solid ground and two secondary windings X and Y both WYE-resistor ground.

The unit auxiliary transformers, which may be used to "backfeed," are three-winding configuration with primary winding delta (22kV) and WYE-resistor ground secondary X and Y windings (4.36kV). The main transformers are two winding transformers with primary winding WYE-solid ground (230kV) to secondary winding delta (22kV). See Attachment 2 for configuration.

> ***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.***

RESPONSE:

For at power (normal operating condition) configurations, the SONGS ESF buses are powered by offsite power sources. See Attachment 3 for the 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.***

RESPONSE:

The normal operating condition configurations have been confirmed to be consistent with the current licensing basis described in the Updated Final Safety Analysis Report (UFSAR) Section 8.3 and Technical Specification 3.8.1.

The normal preferred power source for each unit is its reserve auxiliary transformers XR1 and XR2. XR1 feeds one 4.16kV ESF bus, A04, and XR2 feeds the other 4.16kV ESF bus, A06, of the onsite Class 1E AC distribution system for each unit as shown in Attachment 1. The alternate preferred power source is the companion unit's reserve auxiliary transformers or the companion unit's unit auxiliary transformer through the train oriented 4.16kV ESF bus cross-ties (i.e., between the units).

The reserve auxiliary transformer 2XR1, 2XR2, 2XR3, 3XR1, 3XR2, and 3XR3 are powered from offsite power sources, i.e., the common switchyard, as shown in Attachment 2. Unit 2 Class 1E 4.16kV safety related buses 2A04 and 2A06 are aligned to reserve auxiliary transformer 2XR1 X-winding and 2XR2 X-winding, respectively. Unit 3 Class 1E 4.16kV safety related buses 3A04 and 3A06 are aligned to reserve auxiliary transformer 3XR1 X-winding and 3XR2 X-winding, respectively. Non-safety related buses (4.16kV and 6.9kV) are aligned to unit auxiliary transformer 2XU1, 2XU2, 3XU1, and 3XU2, with the reserve auxiliary transformers as the alternate standby source for the non-safety related loads. Each Class 1E 4.16kV safety related bus has its own emergency diesel generator.

When the main generator is not operating, each 4.16kV ESF bus can be connected to a third preferred power source via the unit auxiliary transformer by manually removing the links in the isolated phase bus between the non-operating main generator and the main transformer, and closing the 4.16kV circuit breaker to the unit auxiliary transformer of the same unit. In this alignment, the unit auxiliary transformer serves as the required normal preferred power source of the unit and the alternate preferred power source for the ESF bus(es) in the companion unit.

10CFR50, Appendix A, General Design Criteria (GDC) 17 requires that two physically independent connections to the offsite transmission network be available. One of the two circuits must be available within a few seconds. The SONGS original design provided two immediate access circuits from the preferred power system and exceeded the requirements of GDC17. Implementation of the degraded grid protection modification in 1995 converted the alternate preferred power source from an immediate access circuit to a delayed access circuit. The NRC approved the change March 17, 1995. (ML021990580)

System Protection

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

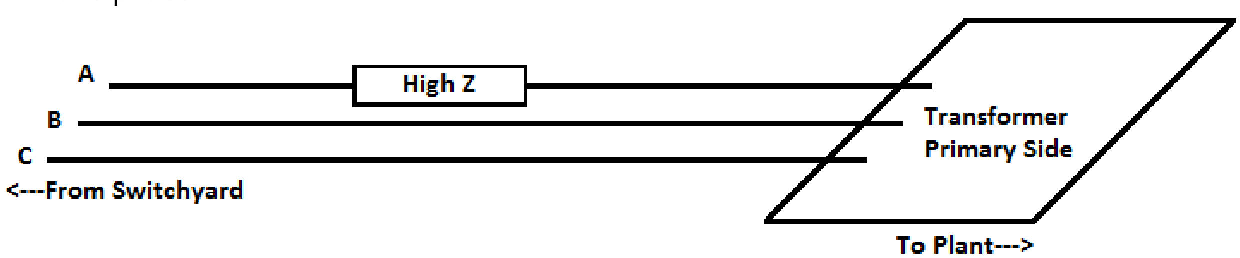
> ***1. Given the requirements above, describe how the protection scheme for ESF buses (Class 1E for current operating plants or non-Class 1E for passive plants) is designed to detect and automatically respond to a single-phase open circuit condition or high impedance ground fault condition on a credited off-site power circuit or other power sources.***

RESPONSE:

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. The degraded grid voltage signal is generated with a shorter time delay for design basis accidents than for a non-design basis accident condition. 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 or high impedance ground is beyond the approved design and licensing basis of SONGS.

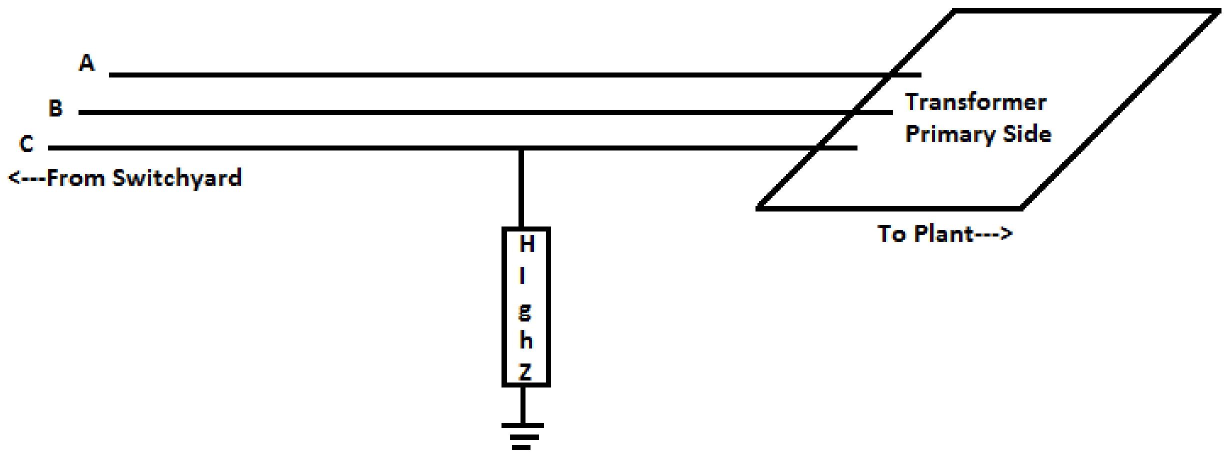
The following four scenarios were evaluated to address the above:

Scenario 1:
230kV side of the reserve auxiliary transformers with an open circuit or high impedance in series with one phase:



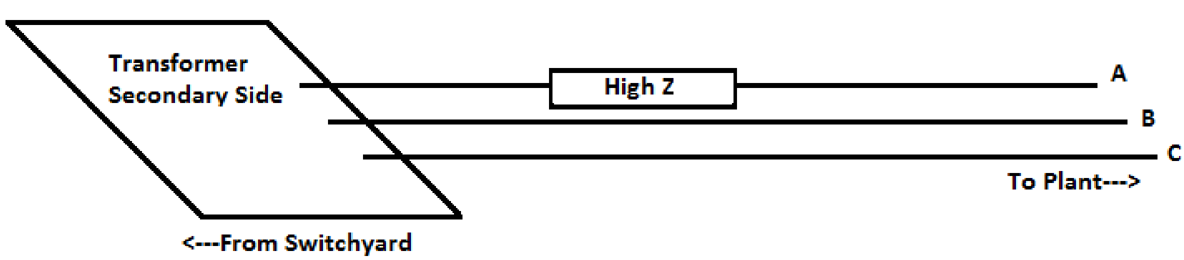
An open circuit with no ground or high impedance in series with one phase on the 230kV side of the reserve auxiliary transformer may go undetected by existing plant protection. The worst case impedance is a completely open phase or a break in the line. Due to the nature of the transformer under lightly loaded to no load conditions, the two undisturbed phases may sustain the transformer with adequate voltage and essentially recreate the affected phase with the result that the secondary side voltage of the transformer may appear as nominal. Under heavy loading, the transformer would not be able to support the voltage with the lost phase, therefore enough of an imbalance will occur to actuate plant protection such as degraded grid voltage scheme, loss of voltage scheme, or transformer differential protection.

Scenario 2:
230kV side of the reserve auxiliary transformers with high impedance from one phase to ground with no break in the other two phases (high impedance ground path in parallel to normal loading of one phase):



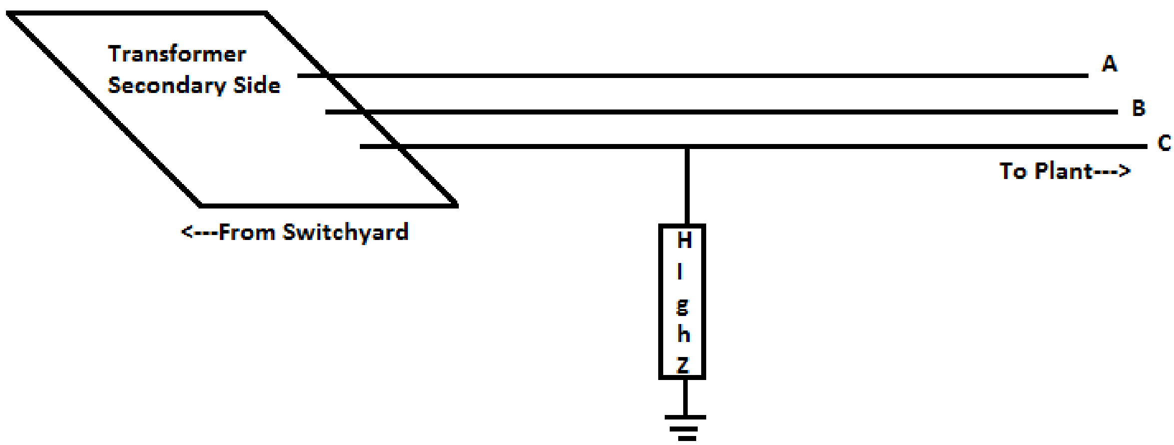
For a high impedance to ground on one phase of the 230kV side, the condition may initially go undetected by existing plant protection. A high impedance fault to ground on one phase may be considered as an additional load on that one phase. Due to the high impedance nature of the fault, the current diverted to ground may be insignificant, therefore the amount of voltage imbalance would be insignificant, especially under normal to no load conditions. Even though the primary side of the reserve auxiliary transformer is solidly grounded, the current through the neutral with the high impedance fault to ground may not be severe enough to be detected by the neutral current ammeter. Due to the high voltage of the 230kV system, a high impedance to ground circuit is expected to become a bolted fault and be cleared by corresponding overcurrent protection.

Scenario 3:
4.16kV side of reserve auxiliary transformer with an open circuit or high impedance in series with one phase:



A high impedance in series with one phase on the 4.16kV system will be detected because of running motor loads on the buses. The high impedance would be similar to a single open phase, which would cause motors to single phase and trip their respective protective devices. Degraded grid voltage (DGV) relays and loss of voltage (LOV) protection relays would also be actuated since a majority of the voltage would be dropped across the high impedance (which protection scheme would actuate first would depend on the impedance). The voltage that would be sensed by the DGV or LOV relays would be low enough to actuate the 2 out of 4 logic since all three phase-to-phase combinations are monitored by the relays.

Scenario 4:
4.16kV side of a reserve auxiliary transformer with high impedance from phase-to-ground on one phase with no break in any phase (high impedance ground path in parallel to normal loading of one phase):



A high impedance to ground fault may or may not be detected depending on the level of impedance in the fault path to ground. A low enough impedance can cause the one phase to have more loading than the other two phases which would create a current imbalance on the 4.16kV system. The secondary windings of the reserve auxiliary transformers are resistor grounded with 51N relays to provide ground fault protection. With a sufficiently low impedance path to ground, the ground fault relay can actuate. If the impedance to ground is high enough to not draw significant current, this situation may go undetected. It is expected on this medium voltage level that a high impedance fault will propagate into a bolted fault, therefore the corresponding overcurrent devices would clear this fault.

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

RESPONSE:

Per SONGS current licensing basis and GDC 17 requirements, the 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. Existing electrical protective devices are also sufficiently sensitive to detect a ground fault. Following are the protection devices, set points and basis for the set points:

1. 451 – HV Phase Overcurrent Relay – G.E. IAC53A

These 451 relays protect the H-winding (high side winding) of the reserve auxiliary transformers from overcurrent levels that can cause thermal damage to the winding. The design loading of the reserve auxiliary transformers is within the design rating of the transformers 77 to 75.3A (Max. current through H winding). These relays have a tap value set at 8A. The CT ratio for these relays is 200A/5A for a ratio of 40:1. Therefore, the primary current required to actuate the relay is 8A x 40 = 320A.

2. 450 – Local Breaker Failure Backup Relay for Switchyard Breaker – G.E. SBC21C1D

This relay operates when the 230kV breaker to the reserve auxiliary transformer in the switchyard fails to operate properly. The pickup setting for each phase is 1 amp. A neutral ($3I_0$) pickup is set at 0.5A which is equivalent to 200A of primary neutral current. The current transformer ratio feeding the relay is 2000A:5A or equivalent to 400A:1A and is configured in WYE. Therefore, a primary current of 400 amps rms or 200 neutral amps rms is required for the relay to start the internal timer before the relay operates. Per the relay manual, the "Trip outputs must be routed to initiate the tripping (or transferred tripping) of all breakers necessary to clear the fault upon failure of the breaker associated with the SBC21 relay." The main function of this relay is to clear faults associated with a breaker failure.

3. 461 – Switchyard Breaker Open Pole Alarm Relay – Westinghouse SLB-1

These open pole alarm relays are for monitoring the breakers in the switchyard and give an alarm to the control room when breaker opening or closing fails to properly occur. The relay monitors all three phases at once. The relay actuation logic and defined setpoints must also be met for relay to alarm. The relay will operate when at least 1 phase is under 16mA current (approximately 2.5 MVA load @ 230kV) and at least 1 phase is higher than 200mA (approximately 32 MVA load @ 230kV). SONGS total reserve auxiliary transformer loading in each unit is between 2 to 3 MW and this kind of loading will not be detected by this relay. Since this relay is alarm only, no tripping will occur if the relay operates. Under heavy loading (greater than 32 MVA), a single phase open circuit condition during this loading will cause an alarm to occur.

4. 487 – Bus (HV circuit) Differential Relay – G.E. PVD11C

These differential voltage relays monitor each phase and provide differential protection for the transmission line from the switchyard to the incoming section of all three reserve auxiliary transformers. The setting for the 87L unit is 300 volts and the setting for the 87H unit is 6 amps. These settings are determined based on the maximum fault current.

For single phase open circuit detection, a break in the line from either side (switchyard or transformer primary side) would have to create a bolted fault condition to generate sufficient differential current. Since this relay primarily operates for fault conditions, it does not provide 100% single phase open circuit detection.

5. 487 – Transformer Differential Relay – ABB HU-1

These differential relays provide protection against heavy faults internal to the zone of the transformer for the reserve auxiliary transformers. The tap setting on the relay for the 230kV side is set at 2.9A and the tap setting on the relay for the 4.16kV side is set at 5A. The relay will operate according to the trip curve in the relay vendor manual. The tap settings are selected based on the relay current ratio of 1.714. Since the taps on the relay are 5A and 2.9A, 5A/2.9A = 1.724, the tap ratio of 1.724 is acceptable since it is approximately equivalent to the relay current ratio of 1.714.

6. 151N – MV Ground Overcurrent Relay – Westinghouse CO-9

The relays are set to detect ground fault current on the transformer secondary side neutral ground circuits and protect the neutral grounding resistors which are rated at 1000A for 10 seconds. For the 4.16kV system, the tap is set at 2.5A with a time dial approximately 1.2 seconds @ 12A. The CT ratio is 400A/5A or 80. Therefore, the primary current required to actuate the relay would be 2.5Ax80 = 200A.

7. 127D – Degraded Grid Voltage Relays for ESF Buses – ABB 27N

The degraded grid voltage relays are provided on all the ESF 4.16kV buses. The relays are connected phase to phase and provide complete monitoring of all phase-phase combinations. Each ESF 4.16kV bus has 4 degraded grid voltage relays. A 2-out-of-4 logic is required for the degraded grid voltage protection scheme to operate. The individual relays will operate in the range of 4,100 to 4,160V when one or more phases of the bus voltage drops below 4,160V. When the DGV relay setpoint is met, a timer is started before the bus is removed from the degraded voltage source. If the timer meets its time setpoint of approximately 112 seconds, a Sustained Degraded Grid Voltage Signal (SDVS) is generated and the respective emergency diesel generator is started. The SDVS will attempt to transfer the bus to the alternate preferred power source. If the alternate preferred power source is unavailable or Engineered Safety Features Actuation is actuated, it will transfer to the standby power source. Under light and no load conditions, a single phase open circuit may not cause the phase-phase voltage to degrade down to the DGV setpoint, therefore, 100% detection and automatically respond to single phase open circuit is not possible.

8. 127F – Loss of Voltage Relays for ESF Buses – BE1-27

The LOV relays are provided on both Non-ESF and ESF 4.16kV buses. The main focus of this evaluation will be on the LOV relays on the ESF 4.16kV buses. Each ESF 4.16kV bus has 4 LOV relays. The relays are connected phase-to-phase and provide complete monitoring of all phase-phase voltage combinations. A 2-out-of-4 logic is required for the loss of voltage protection scheme to operate. The individual relays will operated when any one or more phases of the bus voltage drops to 3,644V or below. When a LOV is detected, the ESF 4.16kV bus is tripped from the supply source. A start signal is sent to the respective emergency diesel generator. The ESF 4.16kV bus is then transferred to the alternate preferred power source if available and after the residual voltage relays have sensed voltage decay to 25% of nominal 4.16kV bus voltage. If the transfer is unsuccessful, the loads are stripped from the bus with the exception of the ESF loadcenters and the high pressure safety injection pumps, if running, and then sequenced onto the respective emergency diesel generator. If LOV is detected along with SIAS, the ESF buses transfer to the emergency diesel generators and loads are sequenced. For no load and light loading conditions, for a single phase open circuit condition, the voltage degradation will not be severe enough to enter into a loss of voltage condition, therefore 100% detection and automatic response to a single phase open circuit cannot be provided with this protection scheme.

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.

RESPONSE:

Not applicable - ESF buses are normally 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?

RESPONSE:

Consistent with the current licensing basis and GDC 17, monitoring of all the phases is not required and the existing design provides only one phase voltmeter in the control room. Operating procedures do not specifically call for verification of all three phases of the ESF bus.

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.***

RESPONSE:

Under heavy loading, the loads would create enough of a voltage imbalance to be detected and create sufficient fault current to be sensed by the protective devices.

The installed protection 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. The main difference between a loaded and unloaded condition while connected to the offsite source, is the ability to adequately detect the single open phase condition. As concluded in EPRI report 1025772 (reference 15), under no load to normal load (lightly loaded), the current drawn during these loading conditions may not be sufficient to cause a severe system voltage imbalance and provide enough current to actuate protective devices in the event of a single open phase or high impedance ground condition.
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.***

RESPONSE:

SONGS did not credit, in the Current Licensing Basis (CLB), that the Class 1E protection scheme (for the 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 normal preferred power source for each unit is its reserve auxiliary transformers, which feed the onsite Class 1E 4.16 kV AC distribution system for each unit as shown in Attachment 1. The alternate preferred power source is the companion unit's reserve auxiliary transformers or the companion unit's unit auxiliary transformer through the train oriented 4.16kV ESF bus cross-ties between the units. The ESF buses use two-out-of-four logic on each bus for detecting a degraded or loss of offsite power source.

Since the SONGS design and licensing basis does not include open phase detection, the design basis calculations and design documents do not 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 SONGS specific response is that these are generic assessments and cannot be formally credited as a basis for an accurate response. 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 SONGS specific Class 1E power distribution system.

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. Both ESF 4.16kV buses are normally fed from its reserve auxiliary transformer connected to the switchyard by single circuit. Major Class 1E running loads are listed in Attachment 3.

With a single phase open circuit to ground from the transformer bank primary side, the voltages at the ESF 4.16 kV busses will be sufficiently below the loss of voltage relay setpoint of approximately 3,644 V. Per analysis (using actual transformer data from ABB and PSCAD/EMTDC with UMEC 3 winding transformer model), the approximate voltage degradation is 2.52 kV, which is well below the 3,644 V setpoint, therefore, entry into the loss of voltage protection scheme will occur and mitigate the single open phase scenario if it occurs on any phase. The amount of loading at the inception of the single open phase does not pose a significant contribution to the voltage degradation. The Loss of Voltage protection scheme for a single phase open circuit to ground will work for all offsite power source alignments. Based on studies performed by the EPRI (reference 15) and the Advanced Technologies group from Southern California Edison (reference 14), it was determined that the existing detection and protection system is vulnerable to not detecting a single open phase during certain loading conditions (particularly no load and light load conditions) only if the open phase conductor does not create low impedance ground fault.

Routine monitoring of the switchyard is covered under operating instruction procedures SO23-6-6 – Reserve Auxiliary Transformer Operation and SO23-6-30 – Switchyard Inspection and Operation. Section 6.1.1.2 of Operating Instruction SO23-6-6 has routine operator monitoring of the reserve auxiliary transformers primary neutral current by the control room ammeters 2(3)II-1761, 2(3)II-1762 and 2(3)II-1763 for 2(3)XR1, 2(3)XR2 and 2(3)XR3 respectively to be equal to zero. The operators are trained to be vigilant of concerns of INPO IER L2-12-14 and the NRC Bulletin 2012-01. Modified operator rounds, operator training and enhanced operating procedures will increase operator awareness of the single phase open circuit conditions per the steps listed in procedures SO23-6-6 REV 21 and SO23-6-30 REV 35.

SONGS offsite power circuits use flexible cables and shatter-proof polyester insulators as compared to Byron's use of rigid conductors and porcelain insulators. Therefore, SONGS design is much more robust and is not vulnerable to the same failure mechanisms as occurred at Byron.

> ***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.***

RESPONSE:

Consistent with the Current Licensing Basis and GDC 17, protective circuitry will separate the ESF 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. Detection of a single-open phase circuit is beyond the approved design and licensing basis of the plant. No calculations for this scenario have been performed. Consistent with the current station design bases, protective circuitry will provide protection from a ground fault condition with all three phases intact.

A single-phase open circuit or high impedance ground fault condition could adversely affect redundant ESF buses. Each unit has two trains A and B, to provide redundant safe shutdown capability. The incoming lines from the switchyard are common to all the reserve auxiliary transformers of each unit. Therefore a potential single-phase open circuit or high impedance ground fault condition could impact both trains.

However, due to the physical design of the switchyard, the phase conductors will have a high probability of grounding or creating a high fault short circuit. There are sufficient conductive structures and perpendicular conductors running directly beneath the incoming transformer phase conductors to provide assurance that a failed conductor will come in contact with another conductor or ground thereby initiating protective circuitry. Recently modified operator rounds, operator training and enhanced procedures will increase operator vigilance to be aware of a potential single phase open circuit condition.

References

1. DBD-SO23-120 – 6.9KV, 4.16KV & 480V Electrical Systems
2. SD-SO23-110 – 220 KV Switchyard System
3. SAP Notification 202077569 Task 6 – ESF Load List
4. SONGS Updated Final Safety Analysis Section 8.3 – Offsite Power Systems
5. Unit 2 and 3 Technical Specifications 3.8.1
6. General Design Criterion (GDC) 17 – "Electric Power Systems"
7. Proposed Change Number (PCN) 429
8. E4C-134 – Relay Setting Calculation for Main Gen., Main Transf., Unit Aux. Transf., and Reserve Aux. Transf.
9. E4C-130 – TLU Calc for Undervoltage Relay Circuits at Class 1E 4kV Switchgear
10. E4C-015 – TLU Calc for Loss of Voltage Relays at Class 1E 4.16 kV Switchgear
11. OD43 – 04-5123 – SONGS 450 Relay Setting
12. OD43 – 99-5123 – SONGS 461 Relay Setting
13. OD43 – 79-5305 – SONGS 487 Relay Setting
14. Open Phase Study by SCE Advanced Technologies
15. EPRI 1025772 – Analysis of Station Auxiliary Transformer Response to Open Phase Conditions
16. 30101 - One Line Diagram Main Auxiliary Power System
17. SO23-6-6 REV 21 – Reserve Auxiliary Transformer Operation
18. SO23-6-30 REV 35 – Switchyard Inspection and Operation
19. SONGS Updated Final Safety Analysis Section 8.2 – Onsite Power Systems
20. 5292935 – One Line for Construction Position 1 Thru 6
21. 5145396 – Elementary Diagram Unit 2 Reserve Aux. Tr. Prot. Pos. 4 AC CKTS.
22. 30103 – U2 One Line Diagram Reserve Auxiliary Transformer Protection
23. 32103 – U3 One Line Diagram Reserve Auxiliary Transformer Protection

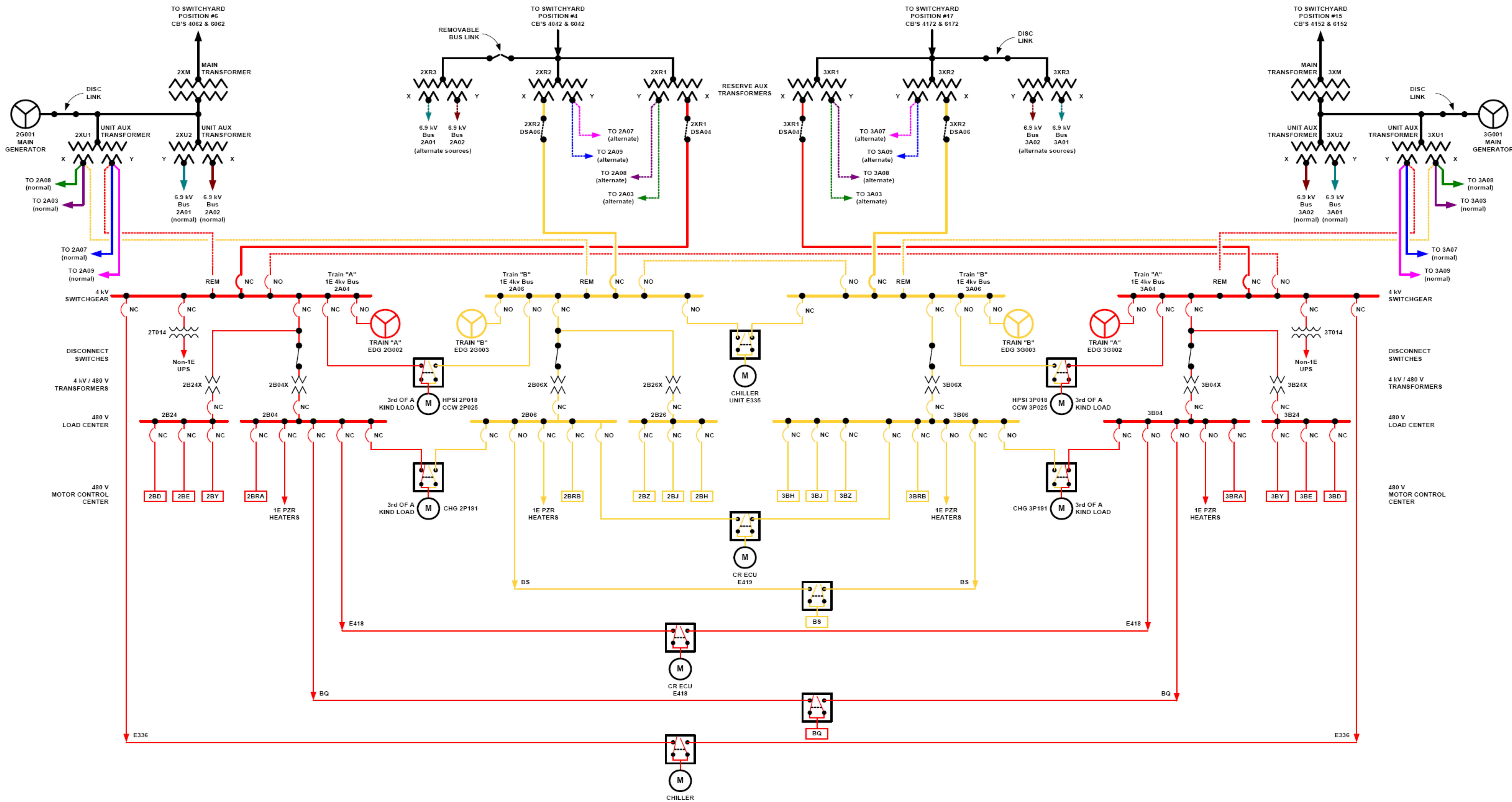
Attachments

1. Simplified Plant Electrical Overview

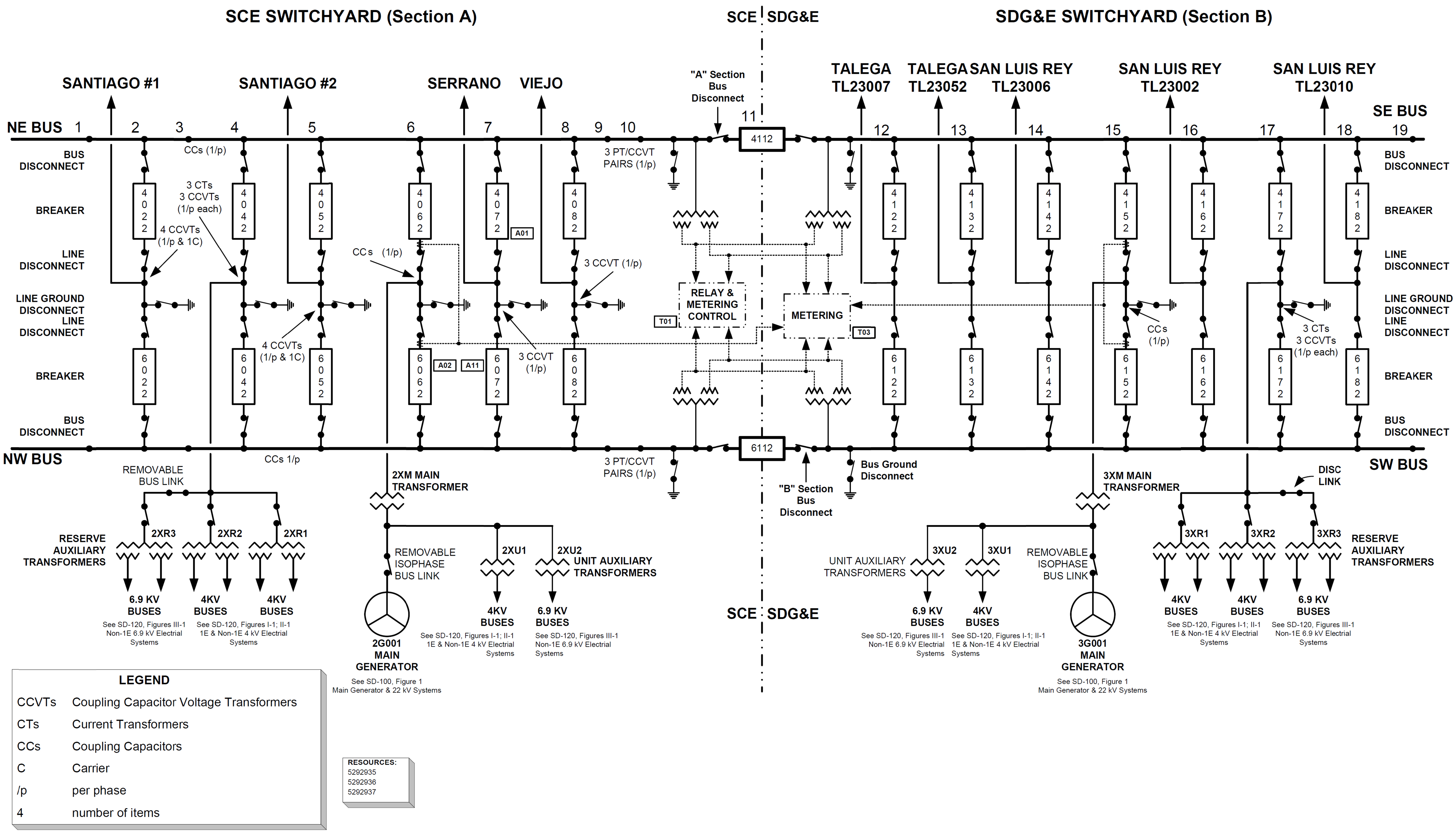
2. Simplified Switchyard Diagram

3. List Of Major Class 1E Running Loads

Attachment 1 Simplified Plant Electrical Overview



Attachment 2 Simplified Switchyard Diagram



Attachment 3 List of Major Class 1E Running Loads

The major loads for unit 2 are listed below and these are typically the same for unit 3.

4.16kV ESF Switchgear Panel 2A04	Ref. 30107	Normally Running (Mode 1-4)	Equipment HP / KVA
2A0401	Switchgear 2A04 Second Point Control Cubicle	N/A	N/A
2A0402	Switchgear 2A04 Equipped Cubicle with Spare Breaker	N/A	N/A
2A0403	Containment Spray Pump 2P012 Feeder Breaker	NO – Can be used for Shutdown Cooling	500 HP
2A0404	Aux. Feedwater Pump 2P141 Feeder Breaker	NO – AFW Pump Run during Heat-up and cool down	800 HP
2A0405	Component Cooling Water Pump 2P024 Feeder Breaker	YES – One Per Train	600 HP
2A0406	Component Cooling Water Pump 2P025 Feeder Breaker	YES – One Per Train	600 HP
2A0407	Low Pressure Safety Injection Pump 2P015 Feeder Breaker	NO – Can be used for Shutdown Cooling	500 HP
2A0408	High Pressure Safety Injection Pump 2P017 Feeder Breaker	NO	600 HP
2A0409	High Pressure Safety Injection Pump 2P018	NO	600 HP
2A0410	Salt Water Cooling Pump 2P112 Feeder Breaker	YES – One Per Train	400 HP
2A0411	Salt Water Cooling Pump 2P307 Feeder Breaker	YES – One Per Train	400 HP
2A0412	Aux. Building Emergency Chiller ME336 Feeder Breaker	NO	581 HP
2A0413	Emergency Diesel Generator 2G002 Feeder Breaker	N/A	N/A
2A0414	Diesel Generator 2G002 Aux. Cubicle	N/A	N/A
2A0415	Switchgear 2A04 Metering/Bus Tie and Bus PT Cubicle	N/A	N/A
2A0416	Bus A04 Non-1E UPS Normal Feeder	YES	500 KVA
2A0417	Switchgear 2A04 Bus Tie to 3A04 Feeder Breaker	N/A	N/A
2A0418	Reserve Aux. Transformer 2XR1 Supply Breaker	N/A	N/A
2A0419	Unit Aux. Transformer 2XU1 Supply Breaker	N/A	N/A
2A0420	Combined Loadcenter Transformer 2B04X Feeder Breaker, Loadcenter 2B24X Feeder Breaker	YES	N/A
2A0421	Switchgear 2A04 Sync Master Control Breaker/PT Cubicle	N/A	N/A

480V ESF Loadcenter 2B04	Ref. 30118	Normally Running (Mode 1-4)	Equipment HP / KVA
2B0401	Loadcenter 2B04 Supply Breaker	YES	N/A
2B0402	200 KW Pressurizer Heater (Backup Group) E615-E618 and Alt. Power to Eq. Hatch	NO	210 KW
2B0403	Motor Control Center 2BRA Feeder Breaker	YES	N/A
2B0405	2P191 Train 'A' Feeder Breaker (Swing Charging Pump)	YES – Normally one running but number of pumps running varies	100 HP
2B0406	Hydrogen Recombiner 2E145 (2D003) Power Panel 2L180 Feeder	NO	75 KVA
2B0407	Spare	N/A	N/A
2B0409	Upper Dome Air Circulator 2A071 Feeder Breaker	YES – One of four in service	60 HP
2B0410	Containment Emergency Fan 2E399 Feeder Breaker	NO	100 HP
2B0411	Containment Emergency Fan 2E401 Feeder Breaker	NO	100 HP
2B0413	Charging Pump 2P190 Feeder Breaker	YES – Normally one running but number of pumps running varies	100 HP
2B0414	Equipped Space	N/A	N/A
2B0415	Equipped Space	N/A	N/A
2B0417	Motor Control Center BQ Feeder Breaker	YES	N/A
2B0418	Control Bldg. Control Room Emergency AC Unit E418 Feeder Breaker	NO	150 HP
2B0419	Standby Upper Dome Air Circulator A074 Feeder Breaker	YES – One of four in service	60 HP

480V ESF Loadcenter 2B24	Ref. 39002	Normally Running (Mode 1-4)	Equipment HP / KVA
2B2401	Loadcenter 2B24 Supply Breaker	YES	N/A
2B2402	Motor Control Center 2BD Feeder Breaker	YES	N/A
2B2403	Motor Control Center 2BE Feeder Breaker	YES	N/A
2B2404	Motor Control Center 2BY Feeder Breaker	YES	N/A
2B2405	Equipped Space	N/A	N/A
2B2406	Spare	N/A	N/A

4.16kV ESF Switchgear Panel 2A06	Ref. 30109	Normally Running (Mode 1-4)	Equipment HP / KVA
2A0601	Switchgear 2A06 Second Point Control Cubicle	N/A	N/A
2A0602	Switchgear 2A06 Equipped Cubicle	N/A	N/A
2A0603	Aux. Feedwater Pump 2P504 Feeder Breaker	NO – AFW pump run during heat-up and cool down	800 HP
2A0604	Containment Spray Pump 2P013 Feeder Breaker	NO – Can be used for shutdown cooling	500 HP
2A0605	Component Cooling Water Pump 2P026 Feeder Breaker	YES – One per Train	600 HP
2A0606	Component Cooling Water Pump 2P025 Feeder Breaker	YES – One per Train	600 HP
2A0607	Low Pressure Safety Injection Pump 2P016 Feeder Breaker	NO – Can be used for shutdown cooling	500 HP
2A0608	High Pressure Safety Injection Pump 2P019 Feeder Breaker	NO	600 HP
2A0609	High Pressure Safety Injection Pump 2P018	NO	600 HP
2A0610	Salt Water Cooling Pump 2P113 Feeder Breaker	YES – One per Train	400 HP
2A0611	Salt Water Cooling Pump 2P114 Feeder Breaker	Yes – One per Train	400 HP
2A0612	Aux. Building Emergency Chiller E335 Feeder Breaker	NO	581 HP
2A0613	Diesel Generator 2G003 Feeder Breaker	N/A	N/A
2A0614	Diesel Generator 2B003 Aux. Cubicle	N/A	N/A
2A0615	Switchgear 2A06 Bus PT/Bus Tie	N/A	N/A
2A0616	Unit Aux. Transformer 2XU1 Supply Breaker	N/A	N/A
2A0617	Switchgear 2A06 Sync Cubicle/PT Cubicle	N/A	N/A
2A0618	Reserve Aux. Transformer 2XR2 Supply Breaker	N/A	N/A
2A0619	Switchgear 2A06 Bus Tie to 3A06 Feeder Breaker	N/A	N/A
2A0620	Loadcenter Transformer 2B06X/2B26 Feeder Breaker	YES	N/A

480V ESF Loadcenter 2B06	Ref. 30120	Normally Running (Mode 1-4)	Equipment HP / KVA
2B0601	Loadcenter 2B06 Supply Breaker	YES	N/A
2B0602	Pressurizer Heater Bank 2E129 and Alt. Power. to Eq. Hatch	NO	210 KW
2B0603	Motor Control Center 2BRB Feeder Breaker	YES	NA
2B0605	Equipped Space	N/A	N/A
2B0606	Spare	N/A	N/A
2B0607	Equipped Space	N/A	N/A
2B0609	Upper Dome Air Circulator A072 Feeder Breaker	YES –One of four in service	60 HP
2B0610	Containment Emergency Fan 2E400 Feeder Breaker	NO	100 HP
2B0611	Containment Emergency Fan 2E402 Feeder Breaker	NO	100 HP
2B0613	Charging Pump 2P192 Feeder Breaker	YES – Normally one running but number of pumps running varies	100 HP
2B0614	Equipped Space	N/A	N/A
2B0615	Control Room Emergency AC Unit E419 Feeder Breaker	NO	150 HP
2B0617	2P191 Train 'B' Feeder Breaker (Swing Charging Pump)	YES – Normally one running but number of pumps running varies	100 HP
2B0618	Motor Control Center BS Feeder Breaker	YES	N/A
2B0619	Standby Upper Dome Air Circulator 2A073 Feeder Breaker	YES – One of four in service	60 HP

480V ESF Loadcenter 2B26	Ref. 39002	Normally Running (Mode 1-4)	Equipment HP / KVA
2B2601	Loadcenter 2B26 Supply Breaker	YES	N/A
2B2602	Motor Control Center 2BH Feeder Breaker	YES	N/A
2B2603	Motor Control Center 2BJ Feeder Breaker	YES	N/A
2B2604	Motor Control Center 2BZ Feeder Breaker	YES	N/A
2B2605	Equipped Space	N/A	N/A
2B2606	Equipped Space	N/A	N/A