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# CERTIFICATION OF ENGINEERING CALCULATION

STATION AND UNIT NUMBER Oconee Nuclear 1, 2, 3

TITLE OF CALCULATION 10CFR 50.59 Evaluation for PT/0/A/0610/21 "Degraded Grid and Switchyard Isolation Functional Test"

CALCULATION NUMBER OSC - 5337

ORIGINALLY CONSISTING OF:

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THESE ENGINEERING CALCULATIONS COVER QA CONDITION 1 ITEMS. IN ACCORDANCE WITH ESTABLISHED PROCEDURES, THE QUALITY HAS BEEN ASSURED AND I CERTIFY THAT THE ABOVE CALCULATION HAS BEEN ORIGINATED, CHECKED OR APPROVED AS NOTED BELOW:

ORIGINATED BY [signature] DATE 5-3-93

CHECKED BY H J Grant DATE 5-3-93

APPROVED BY TA Smith DATE 5-3-93

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**PURPOSE**

The purpose of this evaluation is to determine if any unreviewed safety questions (USQ) are involved with procedure PT/0/A/0610/21, "Degraded Grid and Switchyard Isolation Functional Test". The criteria of 10CFR50.59 a(2) will be used to make this determination. This evaluation is QA Condition 1 because it determines the presence or absence of a USQ.

**DESCRIPTION:**

The Degraded Grid Protection System (DGPS) monitors supply voltage at each unit start-up transformer and is one of two systems that provides a switchyard isolate function. The External Grid Trouble Protection System (EGTPS) can also initiate the switchyard isolate signal. Switchyard isolation is a feature of the Oconee Electrical System that removes offsite power from all three units startup transformers. Switchyard isolation is accomplished by opening and closing selected switchyard Power Circuit Breakers (PCBs) and ultimately resulting in the isolation of the 230KV switchyard yellow bus from the Duke grid. It also provides an automatic path from one of the Keowee Hydro units to the three start-up transformers through the isolated yellow bus. [References 1,2,3,4, & 10]

The degraded grid protection system will initiate a switchyard isolation upon receipt of a Channel 1 or 2 ES signal in any of the three Oconee units in conjunction with an undervoltage signal sustained for more than 9 seconds at any two out of the three start-up transformers. [References 4,10, & 11]

One of the purposes of this test is to demonstrate in an integrated manner the operability of the switchyard isolation feature with one Keowee unit realignment from grid generation to power the overhead path and the other Keowee unit providing power to transformer CT4 through the underground feeder. The switchyard isolation is initiated during this test by inserting an ES test signal from the load shed module from Oconee Unit 2 and tripping Units 1 and 2 degraded grid protection system start-up transformer undervoltage relays. Proper operation of ACB1 or 2 and PCB9 will be verified through this test. The Keowee emergency start signal will cause the overhead unit to separate from the grid and continue to run on standby until needed. Once the yellow bus is isolated from the switchyard, the switchyard isolate complete signal will reclose the overhead unit ACB and PCB9 after a set time delay (approximately 4 seconds for PCB9 and ACB2, approximately 6.5 sec for ACB1). The keowee underground unit will emergency start and energize CT4. [References 3,4,10, & 13]

Another part of the test (covered by a restricted change to the switchyard isolate test procedure) will be to start an uncoupled

Unit 2 Reactor Coolant Pump (RCP) motor from the isolated yellow bus being powered by the Keowee overhead unit. The purpose of this test segment is to record data associated with motor starting and generator block loading transients which can then be used in dynamic transients analysis for the overhead path. Refs [4, 10]

This test will be performed with Unit 2 in a refueling shutdown and Unit 1 and 3 operating or shutdown. The Electrical Power System for all 3 units will be placed in various alignments during the performance of this test. These alignments can be categorized by three distinct stages. These stages are:

1) All 4KV and 7KV transfer switches placed in manual, for all 3 units, prior to and during switchyard isolate.

2) Once the switchyard isolated signal is reset and the system grid re-aligned to Units 1 and 3 start-up transformers, the 4KV and 7KV transfer switches for Unit 1 and Unit 3 are placed in the automatic position. The Unit 1 and 3 startup transformers and all three unit's Main step up transformers will be connected to the grid through the red bus tie breakers only. Unit 2 4KV auxiliaries will remain back-charged through the main step-up transformer. One 7KV bus will be tied to the isolated yellow bus through the startup transformer.

3) When the RCP motor start test is complete, the 230KV yellow bus will be disconnected from the overhead Keowee unit and re-energized from the grid. This restores normal configuration.

## SAFETY REVIEW

Normally on an Oconee unit trip, a rapid bus transfer will occur such that unit loads are transferred to the respective startup transformer (CT1, 2, or 3) normally powered from the preferred offsite power source through one or both buses in the 230KV switchyard. If certain PCBs are open prior to unit trip, the transfer between the normal sources and the start-up sources would be a one second time delay transfer. Power seeking transfer logic would direct the 4KV auxiliary power system to various other sources such as the underground feeder from Keowee through the standby buses, the overhead path from Keowee through an isolated yellow bus, or manually aligning CT5 from central switchyard or one of the Lee combustion turbines. Various other alignments and time durations associated with transfers are discussed in detail in the 4KV and 230KV Switchyard DBDs. Transfer of 4KV auxiliaries is accomplished via the Emergency Power Switching Logic channels (for ES events) or the Main Feeder Bus Monitor Panels (NON-ES events). [References 1,2,3,4,10,11,12 & 13]

The Electrical Power System under the alignments described above will be examined from unit operability as well as accident mitigation perspective.

The following is a discussion of each alignment.

**STAGE 1:** All 4KV and 7KV transfer switches are placed in manual prior to and during switchyard isolate. During this period of the test, the normal rapid bus transfer for the 7KV and the 4KV busses for all 3 units will be defeated. Automatic time delayed bus transfer for the 4KV distribution system will, however, be maintained. This will be accomplished by the load shed signal that will be generated by the transfer logic. This signal will automatically close the E breakers even if selector switches are in manual. A separate permissive in each 'E' breaker is provided from a separate load shed channel to account for single failure. Load shed signals will be generated through either the Emergency Power Switching Logic channels or the Main Feeder Bus Monitor channels.

During this portion of the test, placing the units in this alignment would essentially remove the preferred offsite power source from the startup transformers. The overhead path from Keowee would, however, continue to be automatically available through the startup transformers. The risk involved with this alignment would be less than that associated with other alignments allowed by Technical Specifications such as the startup transformer being out of service, where neither the preferred offsite source nor the overhead Keowee unit is available.

During this portion of the test, 230KV offsite power source will not be automatically available to the startup transformers. This is a support system for the startup transformers. Therefore, all 3 units will be in an LCO (Tech Spec 3.7.2.I) for startup transformers inoperable for test. Because this condition is allowed by Technical Specifications, which are reviewed by the NRC, it is within the Licensing Basis of the SAR. The offsite source will be capable of being manually aligned to the start-up transformers. [Reference 2]

A Lee combustion turbine will be aligned to feed the standby buses through a dedicated line. This alignment is provided as a conservative measure and will provide a third automatically available source in addition to the Keowee overhead and the underground power paths. In addition, the turbine driven emergency feedwater pumps for Units 1 & 3, and the Standby Shutdown Facility are required to be operable during the test.

During this portion of the test the electrical power system for all 3 units would be essentially in an alignment that is already addressed in Technical Specifications. Under this alignment the consequences and methodology for mitigating various accidents described in the FSAR would be as follows:

1) **LOCA** - During this portion of the test, if a LOCA occurs in Unit 1 or 3 an ES signal would be generated. Upon unit trip, with the 'N', 'E' breakers open and Main Feeder Buses deenergized, the presence of an ES signal would generate a load shed signal after a one second time delay. A load shed signal would provide a permissive to automatically close the 'E' breakers and provide power from the overhead path.

The 7KV portion of the system would not, however, transfer to the startup transformer. Tripping off the RCP breakers will not have an adverse impact on the capability to mitigate a LOCA transient since the reactor coolant system inventory depletion would be reduced without RCPs.

The Keowee hydro units will startup and accelerate to full speed in 23 seconds. For much of the test, the Keowee units would already be running. If a Keowee overhead unit is already running power would be provided to the Main Feeder Buses of the LOCA unit in approximately one second, as described above.

In the event of a failure of the overhead path, switching logic will transfer the unit to the standby buses (which is powered by Lee combustion turbines for the test), in 11 seconds. If a Lee combustion turbine failure is postulated, the SL breakers would trip and the SK breakers would close as soon as voltage decays on the standby buses. Failure of one SL breaker to trip would actuate the breaker failure circuit for that breaker and would result in locking out of the associated standby bus. The SK breaker associated with the other standby bus would then be capable of closing and powering one main feeder bus for any of the 3 units. Failure of one SK breaker would have the same consequences as described above. Other failure consequences, in the transfer logic or within the Electrical Distribution System would be unchanged as a result of this alignment.

2) **LOOP** - During this portion of the test, with the Electrical System in the alignment described above if a Loss Of Offsite power occurs with subsequent trip of operating units, both Keowee units would emergency start.

The Keowee emergency start signal would be generated by the switchyard isolate signal. For much of this portion of the test both Keowee units would already be running in the emergency mode. After a 20 second time delay provided by the Main Feeder Bus Monitor Panel (MFBMP) relays, and one additional second (total 21 seconds) load shed signal would be initiated. This signal will permit the closure of the E1 and E2 (4KV system) breakers which allows power to be provided to the auxiliaries of the LOOP units from the Keowee overhead unit via the yellow bus. This will take place regardless of whether Keowee happens to be running or not, prior to this portion of the test. If failure of both redundant channels of the MFBMP is postulated, operator action per the applicable AP is relied upon to restore power. Detailed evaluation of the MFBMP is documented in the 4KV Auxiliary Power DBD. [Reference 12]

One channel of load shed for Unit 2 would occur in approximately 1 second since an ES test signal exists during this portion of the test. This would allow Unit 2 to receive power from the overhead path through one 'E' breaker prior to the other two units. [Reference 14]

In the event of a failure of the overhead path, switching logic will transfer the LOOP units to the standby bus, which will be powered by a Lee combustion turbine, after a 10 second additional time delay. If a Lee combustion turbine failure is postulated the SL breakers would trip and the SK breakers would close. Considerations for failures of SL breakers to trip or SK breakers to close, would have the same consequences as those described under the LOCA scenario.

The 7KV portion of the auxiliary power system will not transfer to the startup transformer. The impact of this on a non-LOCA unit is analyzed and fully bounded by the loss of all station power scenario. For this transient, the RCPs are not operating, and the reactor coolant system flow decays without fuel damage. [Reference 1]

3) **LOCA/LOOP** - During this portion of the test with the electrical system in the alignment described, if a LOCA/LOOP occurs the 4KV system of Oconee Unit 2 (which is in refueling shutdown) and the LOCA Unit (1 or 3) would receive power from the overhead path after load shed (approximately 1 second) if Keowee is running. If the overhead Keowee unit is not running, the 4KV auxiliary system for Oconee unit 2 and the LOCA unit will transfer to the standby bus in 10 additional seconds which would be powered from a Lee combustion turbine.

Failure of the combustion turbine would result in the SL breaker trip and allowing the SK breakers to close. Failures of the SL breakers or SK breakers would have the same consequences as described in the LOCA scenario. The LOOP unit response would be the same as that described in the LOOP scenario above.

4) **UNIT TRIP** - During this portion of the test with the electrical system in the alignment described above, if a unit trip occurs the 'N' breakers would trip, a rapid bus transfer to the 'E' breakers would not take place due to the transfer switches being in manual. After a 20 second time delay for the Main Feeder Bus monitor relaying and one additional second (total of 21 seconds) for load shed, the startup breakers E1 and E2 (4KV) would close and power would be provided to the Main Feeder Buses from the Keowee overhead path through the isolated yellow bus. If the overhead path fails the switching logic will provide power to the affected unit in a similar manner to that described under the LOCA scenario.

The 7KV portion of the auxiliary power system will not transfer to the start-up transformer. Consequence is the same as that described above in the LOOP scenario.

**SUMMARY FOR STAGE 1**

The electrical power system can receive power from the various available sources with multiple failures considered in a consistent manner to that already analyzed. The maximum electrical emergency power needed is equivalent to one unit LOCA loads plus two units LOOP loads. This load is well within the capabilities of the available generators, i.e. Keowee units and the Lee combustion turbines and is within the loading capability of the available sources as examined in calculations for the Keowee underground unit and the Lee combustion turbines. [References 7,8] Adequacy of transient loading of the 4KV non-load shed loads for a LOCA unit and Unit 2 cold shutdown loads on the standby bus is enveloped by the calculation that documents adequacy of simultaneous transients loading of one LOCA unit and one LOOP unit on CT4. [Reference 9]

The loading profile from the overhead path is enveloped by the analysis performed for the underground path. [Reference 3,7] The transfer logic would provide power to the LOCA unit in such a manner that would allow the LOCA unit loads to start and accelerate to rated speed prior to LOOP units loads arriving to that source. This is consistent with the loading profile analyzed in the calculations referenced above. Power would be provided to the LOCA unit such that HPI/LPI are in full operation within 48 seconds (assumes single failure) as analyzed in the FSAR. The results of an accident are the same as those previously reviewed by the NRC in the Technical Specification SER submittals.

**STAGE 2:** During this portion of the test, all 4 and 7 KV transfer switches for Units 1 and 3 are in automatic and Unit 2 switches are in manual with one 7KV switchgear being powered from the yellow bus. During this portion of the test the startup transformers for Units 1 and 3 will be reconnected to the grid by closing the red bus tie of the startup transformer. The yellow bus will continue to be isolated from the grid. For Unit 2 the startup transformer will be similar to that described under the previous stage except for one 7KV bus which will be aligned to receive power from the startup transformer.

This portion of the test is necessary to enable the start of one de-coupled reactor coolant pump motor from Keowee through the yellow bus in order to record needed data associated with motor starting and generator block loading transients that can be used in dynamic transient analysis.

For this alignment Units 1 and 3 will be an alignment such that the preferred offsite power source and both the overhead and the underground paths would be automatically available for these units. For Unit 2 the auxiliaries would be fed by back charging power through the main step-up transformer and the N breakers, except for one 7KV bus which would be connected to the yellow bus. The 4KV system would be aligned in a similar way to that described in the previous stage and therefore covered by the Technical Specification referenced in that section. The consequences of an accident covered in the FSAR are discussed below.

1) **LOCA** - During this portion of the test, if a LOCA occurs on Unit 1 or 3 an ES signal would be generated. The auxiliary power system (4KV and 7KV) would transfer via a rapid bus transfer to the startup transformer (CT1 or CT3). These transformers would be supplied through the preferred 230KV offsite power source. Analyses are in place that document adequacy of voltage from the 230KV yard to a LOCA unit. [References 5, 6] If that source becomes unavailable and voltage is removed from the Unit 1 or 3 startup transformer the transfer logic would transfer the unit auxiliaries to the standby bus powered by a Lee combustion turbine in 11 seconds. If a Lee combustion turbine failure is postulated the consequences would be the same as described in the LOCA scenario of the previous stage of the test.

2) **LOOP** - During this portion of the test with the electrical system in the alignment described above, if a LOOP occurs with subsequent trip of operating units, both

Keowee units would already be running with one on the yellow bus and supplying the de-coupled reactor coolant pump motor for Unit 2. The LOOP would result in actuation of the external grid trouble protection system. The switchyard isolate signal would be generated which will result in tripping PCB9. PCB9 will close back in 4 seconds. This time delay will allow the running RCP motor on Unit 2 to trip off prior to the Keowee unit reconnecting to the overhead path. Once the Keowee unit reconnects to the overhead path, voltage will become available on the startup transformers of the 3 units. The 4KV 'E' breakers of Units 1 and 3 will then close automatically. The Main Feeder Buses for Unit 2 will be deenergized for a total of 21 seconds until a load shed signal is generated. Once this signal is generated the 'E' breakers for that unit will automatically close and provide power from the Keowee overhead unit through the yellow bus. Transfer capabilities for failures associated with this alignment will be the same as those described under the LOOP scenario for the last segment of the test.

The 7KV portion of the auxiliary power system will transfer to the start-up transformer, but the reactor coolant pump motors will trip off prior to transfer due to undervoltage. Consequence is the same as described in the LOOP scenario for the last segment of the test.

3) **LOCA/LOOP** - During this portion of the test with the electrical system in the alignment described above, if a LOCA/LOOP occurs on any of the 3 units, the LOCA unit would generate an ES signal. With the 'N', 'E' breakers open and Main Feeder Buses deenergized, the presence of an ES signal would generate a load shed signal after a one second time delay. The LOOP would cause the actuation of the external grid trouble protection system. Switchyard isolate signal would be generated, this would trip open PCB9 and allow it to reclose four seconds after switchyard isolate complete signal has been generated. The four second time delay will allow the running reactor coolant pump on Unit 2 to trip off prior to the closing of PCB9. The 4KV E Breakers for the LOCA unit will automatically close and receive power from the overhead path. The 7KV portion of the system would transfer to the startup source, but the RCPs will trip off prior to transfer due to undervoltage. Tripping off the RCP breakers will not have an adverse impact on the capability to mitigate a LOCA transient, since the reactor coolant system inventory depletion would be reduced without RCPs. The LOOP unit response will be the same as described under the LOOP scenario above.

4) **UNIT TRIP** - During this portion of the test with the electrical system in the alignment described above, if a trip of Unit 1 or 3 occurs the unit auxiliaries (4KV and 7KV) would automatically transfer via the rapid bus transfer for Units 1 and 3 to their startup transformer which are powered from the preferred 230KV offsite power source. Failures and system transfer logic response would be the same as described under the LOOP scenario.

For Unit 2, a loss of power through the normal source would trip the N breakers, Load shed signal would be initiated through the Main Feeder Bus Monitor Panel in 21 seconds. This would automatically close the E breakers and provide power to Unit 2 from the Keowee overhead and the isolated yellow bus. One de-coupled RCP motor would continue to be powered through the yellow bus. The one 7KV bus that was being fed from the normal source would not transfer to the start-up source.

**SUMMARY FOR STAGE 2**

Similar to the previous stage, the electrical power system can receive power from the various available sources with multiple failures considered in a consistent manner to that already analyzed. The maximum electrical emergency power needed continued to be equivalent to one unit LOCA loads plus two units LOOP loads. This is well within the capabilities of the available generators and is within the loading capability of the available sources as examined in engineering calculations. [References 7, 8]

The loading profile from the overhead path is enveloped by the analysis performed for the underground path. The transfer logic continues to provide power to the LOCA unit in such a manner consistent with the loading profile analyzed in the calculations. [References 5,6,7,8, & 9] Power would be provided to the LOCA unit such that HPI/LPI are in full operation within 48 seconds (assumes single failure) as analyzed in the FSAR. The results of an accident are the same as those previously reviewed by the NRC in the Technical Specification SER submittals.

The capability of the Keowee unit to block load a de-coupled RCP motor was examined by dynamically simulating both the Keowee generator and the RCP motor. The dynamic simulation was performed using an uncertified "CYME" computer model. Results indicate the Keowee unit is well capable of block loading the motor (which is more that the equivalent load of a LOCA unit). Data obtained from this test will be used to certify this model. There are no Reactivity Management concerns with the restarting of a de-coupled RCP motor.

**STAGE 3:** During this portion of the test, all 4KV and 7KV transfer switches for Units 1 and 3 will be in Automatic. The overhead path would be re-energized from the grid and the start-up transformers for all 3 units are connected to the 230KV preferred offsite power source. The 4KV and 7KV transfer switches for Unit 2 will be in manual with the unit back-charged through the main step-up transformer.

This is considered a normal alignment for the electrical power system. The system would respond to accidents transients as described in the FSAR.

**USQ EVALUATION**

As a result of the item to which this evaluation is applicable:

1. **May the probability of an accident previously evaluated in the FSAR be increased?**

   No. The FSAR Loss of Electric Power accident assumes two types of events: (1) Loss of load (unit trip) and (2) Loss of all system and station power. This test does not increase the likelihood of a unit trip or loss of all system and station power.

   Switchyard isolate logic does not interfere with the red bus breakers, red bus tie breakers, or associated transmission lines. Unit generation would continue through the red bus tie breakers, Unit 3 through the 525KV switchyard. Unit 2 would continue to back charge through the Main Step-up Transformer.

   For portions of the test, the 230KV offsite power source will not be automatically available to the startup transformers. This is a support system for the start-up transformers therefore, the start-up transformer for each unit would be considered inoperable for testing. The probability of an accident evaluated in the FSAR (LOOP, LOCA, and LOCA/LOOP) will not be increased beyond what's already been evaluated under Technical Specifications for a start-up transformer being out of service.

2. **May the consequences of an accident previously evaluated in the FSAR be increased?**

   No. The effects of FSAR accidents LOOP, LOCA, and LOCA/LOOP can still be mitigated as described in the FSAR. Both Keowee units and emergency power paths will be available and the standby bus will be energized from a Lee Gas Turbine. The loss of all station power accident analysis assumptions are still valid. This test does not affect the ability to go into natural circulation. The turbine driven emergency feedwater pumps for Units 1 & 3, and the Standby Shutdown Facility are required to be operable for the test.

   For the LOCA and LOCA/LOOP scenarios, both Low Pressure (LPI) and High Pressure Injection (HPI) can still be in full operation within committed time specified in the FSAR.

3. **May the possibility of an accident which is different than any already evaluated in the FSAR be created?**

   No. The Electrical Power System alignment during the test is an alignment addressed by Technical Specifications. The

emergency power systems will remain operable and available to mitigate accidents. No new failure modes are postulated.

4. **May the probability of a malfunction of equipment important to safety previously evaluated in the FSAR be increased?**

No. No functions of any safety related or emergency power systems/components will be degraded beyond what is presently allowed by Technical Specifications. Furthermore, placing the 4KV S/U MFB feeder breaker in manual, does not prevent them from closing in an emergency situation.

5. **May the consequences of a malfunction of equipment important to safety previously evaluated in the FSAR be increased?**

No. The electrical power system will be in an alignment addressed in Technical Specifications. The consequences of a unit trip will not be worse than with the start-up transformer completely inoperable as allowed by Technical Specifications. The impact is analyzed and well bounded by the loss of all station power scenario. Impact of equipment malfunction on accident mitigation is addressed in detail under the safety review portion of this document.

6. **May the possibility of malfunctions of equipment important to safety different than any already evaluated in the FSAR be created?**

No new failure modes are postulated.

7. **Will the margin of safety as defined in the bases to any Technical Specification be reduced?**

No. No safety or design limits are adversely effected, so margins of safety as defined in the bases to any Technical specifications are not reduced as a result of this test.

**CONCLUSION**

Based on the preceding discussion, this test involves no safety concerns or USQs. No FSAR changes or Technical specification changes are necessary.

**REFERENCES**

[1] Oconee Final Safety Analysis Report, Sections 6.3.3.3, 6.3.3.4, 8.1, 8.2, 8.3, 8.4, 15.8, 15.14, 1991 Update

[2] Oconee Technical Specifications, Sections 3.1, 3.7, 4.6, 1-27-93 Update

[3] Keowee Emergency Power Design Basis Document, Rev 1, dated 12-3-92

[4] Personal Communication between Jim Lee (Operations Support), Jeff Rowell (Systems Engineering), and Ed Price (MONE) on 4-1-93 reviewing the reasons for and test methodology of PT/0/A/0610/21

[5] Engineering Calculation OSC-2059, Rev 1, "Oconee Nuclear Station Unit 1, Voltage and Load Study"

[6] Engineering Calculation OSC-2061, Rev 1, "Oconee Nuclear Station Unit 3, Voltage and Load Study"

[7] Engineering Calculation OSC-2444, Rev 4, " Voltage Study for Oconee Auxiliary Power Systems When Fed from Keowee via Underground Circuits & CT-4 Transformer"

[8] Engineering Calculation OSC-3290, Rev 2, " Voltage Study for Oconee Auxiliary Power Systems When Fed from Lee Combustion Turbine via CT-5 Transformer"

[9] Engineering Calculation OSC-3696, Rev 1, " One Unit LOCA and One Unit LOOP Simultaneous Start When Fed from Keowee via Underground Circuits & CT-4 Transformer"

[10] Personal Communication between Jim Lee (Operations Support), Jeff Rowell (Systems Engineering), Dhiaa Jamil (Electrical Engineering) and Ed Price (MONE) on 4-5-93 to discuss and further clarify test methodology.

[11] 230KV Switchyard Design Basis Document, Rev 1, dated 1-18-93

[12] 4KV Essential Auxiliary Power System Design Basis Document, Rev 2, dated 1-18-93

[13] Design Basis Specification for the 230KV Switchyard and Emergency Overhead Power Path Structures, Rev 1, dated 1-11-91

[14] Electrical Elementary Diagrams, Series OEE-76, 117, 217, 317, & 120.

[15] Engineering Calculation OSC-3918, Rev 0, " Single Failure Analysis of the 230 KV Switchyard"

[16] Engineering Calculation OSC-3851, Rev 0, " PIR-089-0193 - Operability Evaluation Concerning Postulated Spurious Switchyard Isolation Events"