Duke Energy®

T. PRESTON GILLESPIE, JR.
Vice President
Oconee Nuclear Station

Duke Energy
ONO1VP / 7800 Rochester Hwy.
Seneca, SC 29672

864-873-4478
864-873-4208 fax
T.Gillespie@duke-energy.com

10 CFR 50.90

July 11, 2012

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

Subject: Duke Energy Carolinas, LLC
Oconee Nuclear Station, Units 1, 2, and 3
Docket Numbers 50-269, 50-270, and 50-287,
Renewed Operating Licenses DPR-38, DPR-47, and DPR-55
Licensing Basis for the Protected Service Water System - Responses to Request for Additional Information

Reference:

Letter from John Boska, Senior Project Manager, Division of Operating Reactor Licensing, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, to T. Preston Gillespie, Vice President, Oconee Nuclear Station, Duke Energy Carolinas, LLC, "Request for Additional Information (RAI) Regarding the License Amendment Requests (LARs) for the Licensing Basis for the Protected Service Water System," June 11, 2012.

By letter dated June 11, 2012, Duke Energy Carolinas, LLC (Duke Energy) formally received a Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) (Reference) associated with the design and licensing bases for the proposed Protected Service Water (PSW) system.

The Enclosure contains Duke Energy's responses to the RAI dated June 11, 2012. Due to the complexities associated with several of the questions and ongoing interactions with the NRC staff, additional time will be necessary to complete RAI items 125, 128, 139, 140, 141, 142, 144, 145, 147, 148, 160, and 162. Duke Energy anticipates the submission of these remaining responses by July 20, 2012.

If you have any questions in regard to this letter, please contact Stephen C. Newman, Regulatory Compliance Senior Engineer, Oconee Nuclear Station, at (864) 873-4388.

A001
NRR

I declare under penalty of perjury that the foregoing is true and correct. Executed on July 11, 2012.

Sincerely,

TPGillespie

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

Enclosure, Responses to RAI Items
Attachment 1, RAI Item Supplemental Information
Attachment 2, Regulatory Commitment Table

cc: (w/enclosure/attachments)

Mr. John P. Boska, Project Manager
U. S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
11555 Rockville Pike
Rockville, MD 20852

Mr. Victor M. McCree, Administrator, Region II
U.S. Nuclear Regulatory Commission
Marquis One Tower
245 Peachtree Center Ave., NE, Suite 1200
Atlanta, GA 30303-1257

Mr. Andrew T. Sabisch
NRC Senior Resident Inspector
Oconee Nuclear Station

Ms. Susan E. Jenkins, Manager
Radioactive & Infectious Waste Management
SC Dept. of Health and Environmental Control
2600 Bull St.
Columbia, SC 29201

Enclosure

Responses to RAI Items

RAI 110 [EEEB1]

The staff's review of letters dated December 16, 2011, and March 16, 2012, found that the licensee did not include all the PSW System electrical system design basis information in proposed Updated Final Safety Analysis Report (UFSAR) Section 9.7.1.2.2, specifically, the design basis information for the PSW System electrical equipment included in proposed Technical Specification (TS) Section 3.7. Provide a copy of the revised UFSAR pages reflecting the design basis information related to TS 3.7 for the PSW System electrical equipment as discussed above.

Duke Energy Response:

The Protected Service Water (PSW) UFSAR page 9.7-3 was revised to correspond with the electrical information contained in PSW TSB, page B3.7.10-4. Additionally, an error was identified in PSW UFSAR Section 9.7.1.2.2 "Electrical." In the 1st paragraph of that section, the reference to "Class 1E" was changed to "QA-1." The marked-up PSW UFSAR page is located in the RAI #110 section of Attachment 1.

RAI 111 [EEEB2]

The staff's review of the Oconee Nuclear Station (ONS) TS Section 3.7.10 amendment request indicated that it included TS Surveillance Requirements (SR) for the service tests or modified performance tests on the PSW batteries. Provide a summary of the load profiles for the PSW batteries based on which the TS required service tests will be performed.

Duke Energy Response:

Below is a summary of the PSW battery load profile for the PSW TS service test.

PSW Battery Service Test Load Profile				
Load Block	**Time (Min.)**	**Duration (Min.)**	**Load (Amps)**	**Remarks**
1	0-60	60	87	Continuous loads
2	60-61	1	152	Continuous loads 13.8 kV breaker operation (PSW power transfers) 4.16 kV breaker operation (start 200 HP and 2000 HP motors)
3	61-80	19	87	Continuous loads
4	80-81	1	135	Continuous loads 4.16 kV breaker operation (start HPI pumps)
5	81-239	158	87	Continuous loads
6	239-240	1	196	Continuous loads 600 VAC breaker operations (energizer pressurizer heaters and repowering PSW MCC XPSW) Random loads (4.16 kV breaker operations)

RAI 112 [EEEB3]

In its letter dated January 20, 2012, related to the ONS TS Amendment Request for TS SR 3.7.10 acceptance criterion, the licensee stated that the PSW battery terminal voltage is ~ 125 V

DC on float charge. Provide the technical basis for the proposed PSW battery terminal voltage acceptance criterion.

Duke Energy Response:

PSW TS SR 3.7.10.1 relates to battery terminal float voltage which is dependent upon the number of cells in the battery bank. The PSW DC system is designed for a nominal 60 cells with sufficient margin such that up two cells can be jumpered out and the design load profile will still be met.

Rather than have TS SR battery terminal voltages for a 60, 59 or 58 cell bank, Duke Energy proposes that PSW TS SR 3.7.10 be reworded as follows with a 7 day frequency:

Verify battery terminal voltage is greater than or equal to the minimum established float voltage.

This wording and frequency are in accordance with NUREG-1430 Vol. 1 Rev. 3.0 (Standard Technical Specifications Babcock and Wilcox Plants). The marked-up PSW TS page is located in the RAI #112 section of Attachment 1.

RAI 113 [EEEB4]

In its letter dated January 20, 2012, related to the ONS TS Amendment Request for the TS Limiting Condition of Operation (LCO) 3.7.10a, ACTIONS, Condition B, the licensee is required to verify one battery on one train with float current limit of > 2 ampere (amp). Provide the technical basis for the proposed PSW battery float current limit of > 2 amp.

Duke Energy Response:

Reduction in battery charging current is an indication of the battery state of charge.

As discussed in IEEE 450-2010 Annex A.2, as the battery cells approach a full charge, the battery voltage increases to approach the charger output voltage and the charging current decreases. When the charging current has stabilized at the charging voltage for three consecutive hourly measurements, the battery is near full charge. The expected charging current range applicable to each model may be verified by test or in consultation with the manufacturer.

Per C&D, the PSW battery supplier, the LCY-39 PSW battery cells have been recharged to at least 95% of their capacity when the charging current is at 2 amps. Therefore, a charging current of 2 amps is sufficient since the PSW batteries have been designed to meet the design basis load profile at 80% capacity.

RAI 114 [EEEB5]

In its letter dated January 20, 2012, related to the ONS TS Amendment Request for TS SR 3.7.10a.2, the licensee is required to verify the battery pilot cell voltage limit of ≥ -2.07 V which appears to have a typographical error (i.e. negative sign). Provide the technical basis for voltage limit above and a corrected TS mark up with corrected value as discussed above.

Duke Energy Response:

The negative sign is a typographical error and should read ≥ 2.07 V. The technical basis for this value is as follows:

For flooded lead-acid cells with a nominal specific gravity 1.215, the open circuit voltage (OCV) is 2.063 V per cell which is then rounded up to 2.07 V. The 2.063 V value is provided by the C&D Standby Battery Vented Cell Installation and Operating Instructions for the PSW LCY-39 cells.

Additionally, Annex A.3 from IEEE 450-2010 (IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications) states that a fully charged lead-acid cell has an OCV in the range of 2.05 to 2.15 V and the relationship of OCV to specific gravity is OCV ≈ specific gravity + 0.845 therefore 1.215 + 0.845 = 2.060 V which closely agrees with the C&D value.

Normally, the PSW batteries will be maintained on float voltage and the TS cell voltage readings are taken under non-OCV conditions. C&D, the PSW battery supplier, was consulted to provide clarification on applying the 2.07 voltage criteria to battery cells operating under float conditions.

Per C&D, the OCV of cells with nominal 1.215 specific gravity electrolyte is approximately 2.07 volts. With the battery on float voltage, voltage readings above 2.07 V indicate that the cell is receiving charge. If the cell is below 2.07 V, the cell has undergone degradation (e.g. internal shorts, sulfation etc.) and is discharging since the applied float voltage is not capable of maintaining the cell in a fully charged state.

The mark-up PSW TS page is located in the RAI #114 section of Attachment 1.

RAI 115 [EEEB6]

Confirm that the rated voltage of all DC equipment and components in the PSW system exceed the battery equalizing voltage.

Duke Energy Response:

The PSW battery equalizing float voltage will not exceed the voltage ratings of the equipment and components connected to the PSW DC system. Oconee's practice (including the PSW DC system) is to perform off-line battery equalization. During battery equalization, the PSW battery charger providing equalization voltage to the battery will be isolated from all PSW DC loads by isolation breakers on the 125 VDC distribution center. The DC voltage rating of the isolation breakers exceed the battery charger equalization voltage.

RAI 116 [EEEB7]

In its letter dated January 20, 2012, related to the ONS TS Amendment Request for the proposed TS SR 3.7.10.2 NOTE, the licensee is required to verify the "KHU underground alignment" which appears to be an incomplete sentence or missing words. Provide a corrected markup of the TS SR 3.7.10.2 NOTE.

Duke Energy Response:

The corrected TS SR 3.7.10.2 should read "Verify that the KHU underground *path* can be aligned to and power the PSW electrical system." The marked-up PSW TS page is located in the RAI #112 supplemental information section of Attachment 1.

RAI 117 [EEEB8]

Confirm that a failure of the electrical components identified as non QA-1, due to the postulated environmental conditions of the PSW System, would not adversely affect the safety functions of the PSW QA-1 safety-related components.

Duke Energy Response:

The PSW electrical system is being designed such that failure of non QA-1 PSW components due to postulated environmental conditions will not adversely affect the function of QA-1 PSW components. The PSW system is not single failure proof. Isolation is provided such that failure of non-QA PSW electrical components will not result in loss of upstream QA-1 components such as motor control centers, load centers and switchgear. This isolation will be accomplished through the use of QA-1 fuses, breakers and protective relaying to provide an electrical isolation boundary between non-QA-1 and QA-1 PSW equipment.

RAI 118 [EEEB9]

The staffs review of ONS UFSAR Section 9.7.1.2.2 did not find a licensee evaluation demonstrating that all PSW electrical equipment and components are rated for the worst-case temperature and moisture of the PSW building to ensure that the equipment and components will be able to perform their expected design functions when subjected to the worst-case temperature and or moisture of the PSW building. Provide a summary of the analysis confirming that all electrical equipment and components are rated for the worst-case temperatures and moisture in the PSW building.

Duke Energy Response:

The PSW HVAC system that is to be installed in the PSW Building is designed to maintain the following temperatures in the Transformer area and the Battery Rooms (Refs: Calculations OSC-9236 Rev. 0, "PSW Facility Battery Room HVAC" and OSC-9237 Rev. 1, "PSW Facility Equipment Area HVAC"):

1) The minimum temperature is to be maintained at 60°F and this is accomplished using QA-1 electrical resistance heaters and associated fans.
2) The maximum temperature is to be maintained at 120°F. The PSW Building Transformer area and Battery Rooms cooling is accomplished using QA-1 exhaust fans and associated equipment to exhaust heated air from the building.
3) Under normal conditions (non PSW event conditions), the temperature inside the Transformer area and Battery Rooms will be maintained at a nominal temperature of 75°F through the use of non-safety related Air Conditioning (AC) units and QA-1 heaters.

The procurement specifications for electrical equipment and components in the PSW Building (Transformer area and Battery Rooms) require that equipment and/or components are to be qualified to the service conditions, provided in the specifications. These conditions are as follows:

Ambient Temperature Range:	60°F to 90°F
Abnormal Temperature:	≤ 130°F (for a maximum of 30 days)
Relative Humidity:	20% to 100%

This specified environmental condition allows the equipment and components to perform their design functions under worst-case temperature and moisture in the PSW building.

RAI 119 [EEEB10]

In its response dated December 16, 2011, to the staff's RAI 62, the licensee stated that the PSW heating, ventilation, and air-conditioning (HVAC) system is designed to maintain the PSW transformer space (main equipment area) and the battery rooms within their design temperature ratings. However, the licensee did not discuss the design details such as temperature ranges and how the PSW HVAC system will maintain the main equipment area and the battery rooms within their design temperature ratings. Provide a summary of the design basis information such as the PSW main equipment area and the battery rooms equipment temperature ranges, equipment ratings, and the PSW HVAC temperature controls to demonstrate that all equipment will operate within their design temperature ranges.

Duke Energy Response:

The PSW HVAC system that is to be installed in the PSW Building is designed to maintain the following temperatures in the Transformer area and the Battery Rooms (References: Calculations OSC-9236, Rev. 0, "PSW Facility Battery Room HVAC", and OSC-9237, Rev. 1, "PSW Facility Equipment Area HVAC"):

1) The minimum temperature is to be maintained at 60°F and this is accomplished using QA-1 electrical resistance heaters and associated fans.
2) The maximum temperature is to be maintained at 120°F. The PSW Building Transformer area and Battery Rooms cooling is accomplished using a QA-1 exhaust fans and associated equipment to exhaust heated air from the building.
3) Under normal conditions (non PSW event conditions), the temperature inside the Transformer area and Battery Rooms will be maintained at a nominal temperature of 75°F through the use of non-safety related Air Conditioning (AC) units and QA-1 heaters.

The procurement specifications for electrical equipment and components in the PSW Building (Transformer area and Battery Rooms) require that equipment and/ or components are to be qualified to the service conditions, provided in the specifications. These conditions are as follows:

Ambient Temperature Range:	60°F to 90°F
Abnormal Temperature:	≤ 130°F (for a maximum of 30 days)
Relative Humidity:	20% to 100%

Based on the above, the PSW Building design temperature range is therefore within the service conditions that electrical equipment is qualified to in the Transformer area and Battery Rooms. This ensures that equipment will be able to perform their design functions under worst-case temperature and moisture in the PSW building.

The normal (long term) acceptable temperature range for the PSW building electrical equipment (transformer space) and the batteries is 60 to 90 deg F. The PSW building electrical equipment (transformer space) and the batteries are also qualified for up to 30 days at a temperature of ≤ 130 deg F (PSW event). The non-QA Air Conditioning system for the PSW Building is designed to maintain the temperature of the PSW Building Transformer Space and Battery Rooms at a nominal 75 deg F under normal stand-by (non-PSW event) conditions. The temperature in the PSW Building transformer area and battery rooms is monitored and there are three (3) analog OAC points added, one for each battery room and one for the transformer space, to provide alarms when the temperatures exceed the normal levels. Alarm Hi is 80 deg

F, Alarm Hi-Hi is 100 deg F. These alarms will allow the station to take necessary action to restore building cooling in the event of a loss of the non-QA Air Conditioning system for the PSW Building.

RAI 120 [EEEB11]

In a letter dated December 16, 2011, Enclosure 3, Tab 2, in response to the staff's RAI 48, the licensee referenced its submittal dated August 31, 2010. In its August letter, the licensee stated that each 13.8 kilovolt (kV) underground cable will be routed in a combination of precast concrete trench boxes, duct banks and manholes. The Keowee underground path to the PSW switchgear will be designed to preclude water entry that could wet the cable. The concrete trenches will have drains. The new duct bank conduits will be sloped towards manhole drains. Periodic inspections will be performed on the Keowee to PSW underground path to evaluate the condition of the trenches, duct banks, manholes, and drainage system. However, the staff did not find any Regulatory Commitment for the periodic inspections on the Keowee to PSW underground path to evaluate the condition of the trenches, duct banks, manholes, and drainage system in enclosure 2, "Updated Tornado and HELB Regulatory Commitments," in the LAR dated December 16, 2011. Provide a Regulatory Commitment for the periodic inspections of the Keowee to PSW underground path to evaluate the condition of the trenches, duct banks, manholes, cables and the drainage system.

Duke Energy Response:

Duke Energy commits to performing periodic condition inspections of the cable trenches, duct banks, manholes and drainage systems associated with the Keowee to PSW building underground path. Duke Energy also commits to include the Keowee to PSW underground path cables in the Oconee Cable Aging Management program. These commitments have been captured in Attachment 2.

RAI 121 [EEEB12]

In a letter dated December 16, 2011, Enclosure 3, Tab 2, in response to RAI 43, the licensee referenced its submittal dated August 31, 2010. In its August letter, the licensee provided a summary of the ONS calculation OSC-9370, Revision 0, "PSW AC Power System Voltage and Short Circuit Analyses." However, the staff's review did not find any discussion regarding disposition of open items in the calculation. Provide a summary of the open items identified in the above calculation and how they were resolved.

Duke Energy Response:

Provided in Attachment 1 for RAI #121 is a listing of Open Items as reflected in Revision 0 of calculation OSC-9370 - U1/2/3 PSW AC Power System Voltage & Short Circuit Analyses.

The Duke Energy QA Program (specifically section 101.4.3 of revision 16 of "EDM-101: Engineering Calculations/Analyses") states in part that QA Condition Calculations and revisions for SSCs shall be reviewed and approved before relying on the item to perform its function and before its installation becomes irreversible. The subject calculation is a QA-1 calculation. With unresolved Open Items documented in the calculation, as shown the RAI #121 section of Attachment 1, the calculation is neither complete nor adequate to support use of the PSW System. As required by the Duke Energy QA program, the listed Open Items will be resolved before the PSW AC Power System is placed in service and relied upon to perform its intended

function. The process of resolving these Open Items is on-going as of the time of development of this RAI response.

RAI 122 [EEEB13]

In a letter dated December 16, 2011, enclosure 3, tab 2, in response to RAI 43, the licensee referenced its submittal dated August 31, 2010. In its August letter, the licensee stated that the 4.16 kV AC switchgear is rated at 4.16 kV AC maximum voltage. However, Page A 10 in Appendix A of the licensee's calculation OSC-9370, Revision 0, shows an overvoltage rating of 114.4% (4.76 kV). Provide detailed justification for the 4.16 kV AC switchgear's ability to withstand the overvoltage.

Duke Energy Response:

In the letter dated 8/31/10, Duke Energy's Response to RAI 2-27 page 2 Item #1 fourth paragraph stated that the 4.16kV switchgear is rated at 4.16kV maximum. The 4.16kV switchgear has a maximum rating of 4.76kV as described below. The value of 4.16 kV versus 4.76 kV is considered to be a typographical error.

Revision 0 of Calculation OSC-9370: U1/2/3 PSW AC Power System Voltage & Short Circuit Analyses, Section 7.4, page A10 identifies the B6T/B7T bus with a nominal voltage of 4.16kV and an overvoltage rating of 114.4% (4.76kV), and page D4 identifies bus B6T/B7T with a minimum required steady state voltage of 114.4%.

Revision 0 to calculation OSC-9831 - Protective Relay Settings Associated with PSW Switchgear, Section 7.32, page 46, establishes the overvoltage relay element pick up set point at 130V, or approximately 114.2% of the nominal voltage, with a time dial setting of 2 seconds.

Revision 4 of Vendor Instruction Manual OM 302.A--0080.001: PSW Installation and Operation Manual for PSW 15 KV & 5KV SQ D Switchgear W/TYPE VR Vacuum Circuit Breaker, Attachment II page 1, 4, and 34 indicate that the maximum voltage rating for the 4.16kV Masterclad Metal-Clad Indoor Switchgear is 4.76kV.

Therefore, the 4.16kV switchgear is properly rated for use with an overvoltage of 4.76kV.

RAI 123 [EEEB14]

In a letter dated December 16, 2011, Enclosure 3, Tab 2, in response to RAI 43, the licensee referenced its submittal dated August 31, 2010, and a previous RAI 2-34. In its August letter, the licensee provided a summary of ONS Calculation OSC-9832, "PSW AC Power System ETAP Model Base File." However, the staff's review did not find any discussion regarding the conclusion, critical assumptions used and disposition of open items in the calculation. Provide a summary of open items and how they were resolved, the conclusion, and critical assumptions.

Duke Energy Response:

Provided in Attachment 1 for RAI #123 is a listing of Open Items and assumptions as reflected in Revision 0 of calculation OSC-9832: U1/2/3, PSW AC Power System - ETAP Model Base File. This calculation documents input information entered into the ETAP program model for the PSW System being designed to support development of the PSW AC Power System output calculation. As such, there is no conclusion information in this input calculation.

The Duke Energy QA Program (specifically section 101.4.3 of revision 16 of "EDM-101: Engineering Calculations/Analyses") states in part that QA Condition Calculations and revisions for SSCs shall be reviewed and approved before relying on the item to perform its function and before its installation becomes irreversible. The subject calculation is a QA-1 calculation. With unresolved Open Items and assumptions documented in the calculation, as shown in the RAI #123 section of Attachment 1, the calculation is neither complete nor adequate to support station use of the PSW System. As required by the Duke Energy QA program, the listed Open Items and assumptions will be resolved/dispositioned as appropriate before the PSW AC Power System is placed in service and relied upon to perform its intended function. This process is on-going as of the time of development of this RAI response.

RAI 124 [EEEB15]

In its March 16, 2012, letter, the licensee provided an updated version of UFSAR Section 9.7.1.2.2 for the PSW System electrical equipment design basis. In UFSAR Section 9.7.1.2.2, the licensee states, "Additionally, the AC and DC power systems and equipment required for the PSW essential functions have been designed and installed consistent with the ONS QA program for Class 1E equipment." In a letter dated December 16, 2011, enclosure 3, tab 2, in response to RAI 25, the licensee indicated that the PSW electrical equipment are QA-1 and not Class 1E. The staff understands that the PSW System is a single train system and does not have redundancy as required for Class 1E equipment. Explain how the QA-1 AC and DC equipment were designed and installed consistent with the ONS QA-1 for Class 1E equipment as described in the above UFSAR Section 9.7.1.2.2.

Duke Energy Response:

UFSAR Section 9.7.1.2.2, first paragraph, last sentence; has been revised to now state: "Additionally, the AC and DC power systems and equipment required for the PSW essential functions have been designed and installed consistent with the ONS QA program for QA Condition 1 (QA-1) equipment.

The "Class 1E" terminology has been removed.

The PSW QA-1 AC and DC equipment are designed and installed in conformance with Duke Energy UFSAR Section 3.1.1.1, the Duke Energy QA Topical Report and supporting Duke Energy Nuclear System Directives, Engineering Directives, Engineering Criteria and other functional area processes and procedures for equipment designated as QA-1.

A Duke Energy review of the RAI item 25 response from the December 16, 2011, submittal confirmed the categorization of PSW electrical equipment listed in RAI item 25 response as being designed and installed as QA-1 equipment. The marked-up PSW UFSAR pages are located in the RAI #110/#124 section of Attachment 1.

RAI 125 [EEEB16]

In a letter dated December 16, 2011, enclosure 3, tab 2, in response to RAI 43, the licensee referenced its submittal dated August 31, 2010, and a previous RAI 2-27. In its August letter, the licensee stated that the loading on the PSW transformer, switchgears, and load centers will be answered in a future RAI response submittal. However, the staff's review of the licensee's responses dated December 7, 2010, December 16, 2011, and January 20, 2012, did not find any discussion regarding equipment loading. Provide a table showing the PSW system worst case electrical loadings at 13.9 kV, 4.16 kV, and 600 V buses, and all equipment, bus, and

breaker design ratings demonstrating that the worst-case loadings are within the design rating of the associated equipment/bus/breaker.

Duke Energy Response:

To be provided by July 20, 2012.

RAI 126 [EEEB17]

In its response to the staff's RAI 2-28 by letter dated August 31, 2010, the licensee states, "The analysis used for selecting the PSW battery size was performed by analysis using The Institute of Electrical and Electronics Engineers (IEEE) Standard (Std.) 485-1997 (R2003) methodology." Provide clarification regarding which revision of the IEEE Std. 485 was used for the sizing the PSW battery.

Duke Energy Response:

The PSW batteries were sized using IEEE 485-1997 (R2003). This IEEE Standard was approved on March 20, 1997 and Reaffirmed on September 11, 2003, by the IEEE Standards Board.

RAI 127 [EEEB18]

In its letter dated December 16, 2011, in response to the staff's RAI 72, the licensee stated that the electrical equipment for the PSW system is designed, installed, and tested in accordance with the Duke Energy Topical Report which is contained in Chapter 17 of the ONS UFSAR. However, the staff's review of ONS UFSAR Chapter 17 did not find the Duke Energy Topical Report related to the design, installation, and testing of the PSW electrical equipment. Provide a copy of the applicable pages of Duke Energy Topical Report and Chapter 17 of the ONS UFSAR related to the design, installation and testing of the PSW electrical equipment for the staff's review.

Duke Energy Response:

The Duke Energy Quality Assurance Program (QAP) Topical Report (QAPTR) describes the overall quality assurance program requirements of the Duke Energy nuclear fleet. The purpose of the QAP is to assure that the Duke Energy nuclear plants are designed, constructed, tested, and operated in conformance with good engineering practices, applicable regulatory requirements, and design bases to insure that public health and safety are protected. Since the document provides the overall program description, it is not specific to changes or modifications made to a specific plant, like the PSW system for the Oconee Nuclear Station (ONS) and as such, the QAP does not contain this level of detail in its description. As an example, in QAPTR Table 17-1, "Conformance of DEC's Program to Quality Assurance Standards, Requirements and Guides," it is noted that each station must conform to Regulatory Guide 1.28 (Rev. 2) for design and construction, and Regulatory Guide 1.30 (Rev. 0) for testing of electrical equipment; however, specific SSCs are not listed from each station.

The Duke Energy QAPTR (through Amendment 39) can be obtained by the NRC via ADAMS (ML11304A135).

RAI 128 [EEEB19]

In its letter dated December 16, 2011, in response to the staff's RAI 63, the licensee referenced calculation OSC-9190, Revision 0, "PSW 125 V DC Power System Analysis." Provide a summary table showing all DC loads, required minimum voltage, maximum rated voltage, and the calculated available voltages at the equipment terminal demonstrating that in all cases, the calculated voltages are bounded by the minimum and maximum rated voltage.

Duke Energy Response:

To be provided by July 20, 2012.

RAI 129 [EEEB20]

In its letter dated December 16, 2011, in response to the staff's RAIs 67 and 68, the licensee discussed the relay protection and coordination conclusion in its Calculation OSC-9831, "Protective Relay Settings Associated with PSW Switchgear." Provide an executive summary of the calculation. Discuss the following:

- Types of downstream loads (motors, panels etc.) supplied by the 600 V AC Load Center (LC) LXPX 13.
- Provide relay/breaker protection curves for the 600 V AC loads (200 ampere (A) and 225 A) on the PSW LC LXPX13 demonstrating these loads are adequately protected from the upstream breakers/relays.
- In its response to the staff's RAI 67, the licensee states, "In other cases at the 600 V level, in order to coordinate with the pickup of the largest load breaker in an MCC, the feeder can't be set to protect the cable for overload. The maximum loading of these MCCs are reviewed to ensure the cable will not be overloaded." However, if the load (such as a motor or motor operated valve) experiences unexpected overloads (such as motor bearing malfunctions etc.) during its operation, the associated cable may not be protected from overloads. Provide justification for not providing overload protection for the cables at the 600 V level.
- Discuss in detail the overcurrent relay and breaker coordination for the PSW 600 V AC MCC 1XKMCC demonstrating adequate coordination between the upstream and the downstream relay and breakers.

Duke Energy Response:

The purpose of calculation OSC-9831 is to set all 600 V Load Center Breakers, 600 V XPSW MCC, 4.16 kV Relays and 13.8 kV Relays associated with the Oconee Main PSW Switchgear 13.8 / 4.16 kV system. The 600 V breaker of the alternate feed to the XPSW MCC (RW2 Cub 4D) is also set in this calculation. The following bulleted items sequentially address the items from the RAI above.

- The 600VAC Load Center LXPX13 feeds either PSW MCCs or transfer switches that feed existing pressurizer heater MCCs. These include MCCs XPSW, 1XPSW, 2XPSW, 3XPSW, Unit 1 MCCs 1XJ, 1XK, Unit 2 MCCs 2XI, 2XJ, 2XK and Unit 3 MCCs 3XI, 3XJ, 3XK. The loads on these MCCs include motors, MOVs, panelboards, pressurizer heaters, etc.
- Relay/breaker protection curves for the 600 V AC loads (200A and 225A) fed from PSW LC LXPX13 demonstrating these loads are adequately protected are provided as part of

this RAI response. Refer to the 200A and 225A curves given as pages 1 through 7 (of 8) in Attachment 1 for RAI #129.

- The only case where the feeder cannot be set to protect the cable for overload is MCC 3XK. The maximum loading of the MCC is 168kW when fed from PSW. Since the MCC loads are entirely resistive, an increase in loading due to motor malfunction cannot occur. If MCC loading is changed, the breaker settings will be reviewed. The MCC feeder cable is protected from faults.
- The MCC feeder cable for 1XK MCC consists of 3/C 500 kcmil cable. The optimal ampacity according to the ETAP analysis for this feed is 280A. MCC 1XK loading is 168kW. There is no MCC Main Breaker. The largest load breaker is a 200A, type TFJ breaker. The load center feeder breaker pickup is set to 0.625 x (250A primary) to provide overload protection to the cable. The other settings are set to coordinate with the largest load breaker on the MCC. The coordination and the protection provided by the phase elements are illustrated on page 3 of 8 of Attachment 1 for RAI #129. Breaker pickup is less than cable ampacity above 1000 seconds as shown on the vendor trip curve (Refer to page 8 of 8 in Attachment 1 for RAI #129).

RAI 130 [EEEB21]

In its letter dated March 1, 2012, in response to the staff's RAI 76, the licensee stated that it identified certain equipment failures in its calculations OSC-10008, Revision 1, "Failure Modes and Effects Analysis, Protected Service Water (PSW) System -Electrical and Mechanical Equipment," and OSC-9510, Revision 1, "Failure Modes and Effects Analysis, Standby Shutdown Facility (SSF) System," that are important to PSW operation. Provide the following:

1. ONS Calculation OSC-10008, Revision 1, has identified several potential weaknesses, equipment failures, and recommendations for the PSW System. Provide an evaluation of the identified potential failures, weaknesses, and recommendations in the calculation and provide a Regulatory Commitment to address and resolve all deficiencies.
2. ONS Calculation OSC-9510, Revision 1, Section 7.0, Conclusion has identified potential equipment failures and recommendations for the Standby SSF System. Provide an evaluation of the identified potential failures and recommendations in the above calculation and provide a Regulatory Commitment to address and resolve all deficiencies.

Duke Energy Response:

Pursuant to the Duke Energy modification process (Revision 15 of EDM-601: Engineering Change (EC) Manual), when a Failure Modes and Effects Analysis (FMEA) calculation is performed for a major engineering change project such as the Protected Service Water (PSW) system, it becomes one of several sources for items that may require further evaluation and/or corrective action. Items from such a FMEA analysis are added, as appropriate, to an EDM-601 Appendix "U" (Pre-Implementation Issues Resolution List). This list is used to perform an evaluation of each item by appropriate station project stakeholder groups to decide what action(s) are needed to resolve each item to ensure potential adverse impacts to the station are adequately addressed. Once this process is complete and the Appendix "U" issues list actions are finalized, the results are entered into Duke Energy's Corrective Action Program. This process has been completed for the two PSW system related FMEA calculations.

From revision 1 of these two FMEA calculations and revision 0 of a third FMEA calculation for the Keowee Hydro Station portion of the PSW Project (KC-2190: Failure Mode and Effects Analysis (FMEA) for the Keowee 13.8kV Switchgear (KPF); a total of 21 items for further evaluation and/or action were added to the Appendix "U" list. A series of meetings were then held with the various stakeholder groups (Operations, Plant Engineering, and Oconee Major Projects) to decide how best to resolve each listed item. Of the 21 total items placed on the list, 7 items were evaluated to not require further action; 11 items were evaluated to require non-modification related action(s); 2 were evaluated to require modification-deficiency related actions; and 1 item was evaluated to require modification enhancement and non-modification related actions.

The two deficiencies were related to the designs of the 4 KV SSF and 13.8 KV Keowee distribution feeder circuits. Duke Energy commits to correct, and is in the process of correcting these deficiencies with EC revisions as part of the PSW project. The modification actions to correct these deficiencies along with all other required actions as discussed are being performed per the Duke Energy corrective action program. A brief problem description for each deficiency and a scope description for the EC revision to resolve are provided below.

SSF Related Deficiency: Unintentional, simultaneous powering of the OTS1 switchgear from both the PSW and SSF 4KV power sources is possible on a spurious closure (i.e. failure) of breaker OTS1-0 with OTS1 aligned to an SSF source OR on spurious closure (i.e. failure) of breaker OTS1-1 or OTS1-4 with OTS1 aligned to the PSW source. In either case, significant equipment damage and/or personnel injury could result when the 2 unsynchronized 4 KV power sources were closed in on one another due to the failure. To correct the deficiency, an EC will be performed to provide for control capability for PSW 4 KV breaker B7T-4 in the PSW Building from a new control switch to be installed in the SSF Control Room. This will support the normal position of this breaker changing from normally closed to normally open, thereby eliminating the failure modes concern.

Keowee Related Deficiency: The original intent was to operate the new PSW-related Keowee KPF 9 and 10 breakers normally open and 11 and 12 normally closed. Should accident response be required with power to be provided from KHU1, the KPF 9 breaker would be closed and power would flow from KHU1 through KPF breakers 9 and 11 to PSW. Should accident response be required with power to be provided from KHU2, KPF breaker 10 would be closed and power would flow from KHU2 through KPF breakers 10 and 12 to PSW. The problem with this operational scenario is failure to the closed position of the fourth KPF breaker. If this occurred with the other (non-accident response) Keowee running, then KHU1 and KHU2 would be closed in on one another in an unsynchronized manner resulting in potentially serious equipment damage and/or personnel injury. If the other (non-accident response) Keowee unit were not running, then this opposite unit would potentially be operated as a motor by the operating unit, again resulting in potential equipment damage and/or personnel injury. To correct this deficiency, an EC will be performed to modify the KPF breaker control circuitry such that the close breaker charging springs are maintained discharged until the breaker is commanded to close. The intent of this modification is to change the single active failure of the breaker into a passive failure.

RAI 131 [EEEB22]

In its letter dated December 16, 2011, in response to the staff's RAI 65 related to the PSW battery room ventilation, the licensee stated that the HVAC systems shall maintain Battery Room temperatures between 60 ^{O}F and 120 ^{O}F with a nominal temperature of 70 ^{O}F. It further states the battery room fans are sized to maintain the Battery Rooms at or below a maximum of

120 °F by ventilating the rooms with outside air. However, the IEEE Std. 450-2002 Figure H.1 shows that a battery operating at elevated temperatures (higher than 77 °F) for long periods will have a significant reduction in the battery expected design life (typically 20 years). Discuss in detail the measures that will be implemented to control the PSW Battery Room temperature to ensure no adverse impact on the battery expected design life.

Duke Energy Response:

The PSW battery procurement specification requires a 20 year battery design life which includes operation at normal and abnormal temperatures.

The specified normal temperature range is 60°F - 90°F which is accordance with the recommended temperature range provided in vendor (C&D Technologies Incorporated) installation and operating instructions. Per the vendor, this temperature range includes a yearly average temperature of 77°F.

For abnormal temperatures, the specification has two temperature ranges with duration restrictions, 90°F - 100°F for a maximum of 30 days per year and ≤ 130°F for a maximum of 30 days over the life of the battery. These abnormal temperatures are the result of loss of battery room cooling due to equipment maintenance or failure.

Prolonged operation at greater than 77°F will result in battery design life reduction; conversely, operation below 77°F results in battery design life gain. Equal operation at the minimum and maximum normal temperature ranges negates the aging effects at operating above 77°F. As previously stated in the Duke Energy December 16, 2011, submittal under RAI 65, the PSW battery room nominal temperature is expected to be maintained less than 77°F which tends to improve the 20 year qualified life.

The vendor has evaluated the effects of these temperature excursions for various scenarios and has concluded that the LCY-39 PSW batteries have sufficient design margin to meet the normal (yearly 77°F average temperature) and abnormal temperature service conditions for a 20 year qualified life.

Reduction of battery capacity and planning for battery replacement due to normal aging effects, operation above 77°F or other aging mechanisms, will be monitored and trended by periodic capacity tests and periodic service tests performed in accordance with proposed PSW TS SR 3.7.10.4 as provided in Duke Energy's January 20, 2012, submittal of Supplemental Responses to Request for Additional Information (RAI) Nos. 61, 62 and 107.

The normal (long term) acceptable temperature range for the PSW building electrical equipment (transformer space) and the batteries is 60 to 90 °F. The PSW building electrical equipment (transformer space) and the batteries are also qualified for up to 30 days at a temperature of ≤ 130 °F (PSW event). The non-QA Air Conditioning system for the PSW Building is designed to maintain the temperature of the PSW Building Transformer Space and Battery Rooms at a nominal 75 °F under normal stand-by (non-PSW event) conditions. The temperature in the PSW Building transformer area and battery rooms is monitored and there are three (3) analog OAC points added, one for each battery room and one for the transformer space, to provide alarms when the temperatures exceed the normal levels. Alarm Hi is 80 °F, Alarm Hi-Hi is 100 °F. These alarms will allow the station to take necessary action to restore building cooling in the event of a loss of the non-QA Air Conditioning system for the PSW Building.

RAI 132 [EEEB23]

In its letter dated December 16, 2011, in response to staff RAI 68, the licensee stated, "At the dropout point of the degraded grid voltage relays, the OTS 1 voltage is 99% of the rated bus voltage, which is required for the SSF pressurizer heaters. This is the most limiting equipment considered for the degraded grid relay setting." This SSF supply to the pressurizer heaters may be needed to maintain required reactor coolant system (RCS) pressure during safe shutdown conditions. Explain how minimum required voltage will be ensured at the SSF pressurizer heater terminals when supplied from the PSW System alternate power supply to achieve and maintain required RCS pressure during safe shutdown.

Duke Energy Response:

The relay is set to drop out at 99%=108.9V. This setting is about 95.7% of line nominal. If the voltage of the 13.8 kV incoming line from Fant drops to 95.7% of nominal, an alarm is sent to station operators. This alarm tells operators that the voltage requirements for the OTS1 4.16kV bus (99% voltage) and 600V MCCs fed from OTS1 are no longer being met. Operator action is needed to assure proper operation of pressurizer heaters fed from the OTS1 bus. Voltage regulators on the PSW Fant line substation should ensure voltage transients are minimized. If the problem persists, Operations can start Keowee to power PSW to maintain safe shutdown conditions.

RAI 133 [EEEB24]

In its letter dated December 16, 2011, in response to staff RAI 66, the licensee stated, "Calculation OSC-9370 *(U1/2/3* PSW AC Power Systems Voltage and Short Circuit Analyses) performs evaluations to demonstrate the capability of the PSW electrical system to function under postulated scenarios by comparing the analysis results with the equipment ratings for undervoltage, overvoltage, short circuit and cable ampacity." The licensee's RAI response did not include the results of its evaluation of Calculation OSC-9370 based on comparison of the analysis results with the equipment ratings for undervoltage, overvoltage, short circuit, and cable ampacity. Provide a table showing analyzed values of under voltage, overvoltage, short circuit, cable ampacity and design ratings of the PSW System electrical equipment demonstrating that the design ratings bound the analyzed values and a summary of evaluation of the Calculation OSC-9370. The following tables in the calculation have items of interest:

Tables on Appendix C, Pages 1, C6.
Tables 01, 02, 03, 04, 05.
Section 3.4 Table on page E7.
Table F1, Pages F10 through F25.
Table F2, Pages F28 through F37.

Duke Energy Response:

The requested information is shown in the data tables provided in Attachment 1 for RAI #133. The data in the tables is based on current PSW design information. While some of the values may change minimally with design completion, the Duke Energy QA Program and associated design processes ensure that potential nonconformances with equipment design ratings will be resolved prior to placing the equipment in service.

RAI 134 [EEEB25]

In its letter dated January 20, 2012, the licensee referenced the Institute of Electrical and Electronics Engineers (IEEE) Standard (Std.) 323-1974 and 323-1983, "Standards for Qualifying Class 1E equipment for Nuclear Power Generating Stations," and noted that these standards were used in the design of electrical equipment for the PSW System. The staff review noted that the design of some of the PSW System electrical equipment are based on the IEEE Std. 323-1974 while others are based on the IEEE Std. 323-1983. The NRC has not endorsed the IEEE Std. 323-1983 for satisfying the EQ requirements of 10 CFR 50.49. Explain how and why the IEEE Std. 323-1983 was applied, in lieu of the IEEE Std. 323-1974, in the design of the PSW System electrical equipment.

Duke Energy Response:

Background:

For the different versions of the IEEE Standard 323 (1974 vs. 1983), Duke Energy's Environmental Qualification (EQ) Program is established in accordance with IEEE 323-1974 at fleet level as outlined in Duke Energy Nuclear System Directive (NSD) 303 (Environmental Qualification Program - Rev. 5) for the EQ Program in compliance with the NRC EQ Regulation, 10CFR50.49. This is to remain in alignment with the NRC endorsement of that version as noted in Regulatory Guide 1.89 Revision 1.

Oconee Specific Applications Related To This RAI Response:

All new electrical equipment procured for the Oconee Nuclear Station (ONS) Protected Service Water (PSW) System and project was purchased via procurement specifications that referenced IEEE 323-1974 as the basis to be used for environmental qualification. This was completed in the original Revision 0 of procurement specifications which required an EQ inspection and sign-off, and technical requirements documents (TRDs) which elected to have an EQ inspection and sign-off. Following the issuance of these procurement documents at Revision 0 and selection of various equipment vendors, several vendors responded via deviation / exception requests to Duke Energy's referenced requirement of using IEEE 323-1974 for environmental qualification. They stated a justification for the use IEEE 323-1983 based on various factors including the specified environmental conditions (EQ MILD versus HARSH), radiation levels, etc. In each of these deviation / exception requests, Duke Energy reviewed, documented, and processed approval for the use of the 1983 standard. These reviews were documented and tracked to completion via a revision to the referenced procurement specification or TRD to reflect this reference change. Each deviation allowing the use of IEEE 323-1983 versus the 1974 version was reviewed and inspected by EQ personnel. For equipment that remained specified and qualified in accordance with IEEE 323-1974, there are no additional documentation requirements with respect to this RAI response.

The ONS PSW project has elected to conservatively add the new 5.0KV Manual Disconnect Switches and 5.0KV Motor Operated Disconnect Switches to the EQ Program and these switches were qualified by the vendor in accordance with IEEE 323-1983. The switches are located in the Auxiliary Building at Elevation 771' and provide connection to High Pressure Injection (HPI) system for PSW. These additions were processed via the Duke Energy Engineering Change Program with appropriate EQ reviews. The switches were added due to a radiation requirement total integrated dose (TID) utilizing a 40.0 year normal dose plus one year accident (Design Basis Event) dose of 1.6E3 RADs. The normal dose is 1.0E3 RADs, and the one year accident dose is 5.5E2 RADs, but the switches would not be required to operate under the listed one year accident dose. The test reports for these switches have qualified the

switches via testing and analysis for the worst case radiation values plus the elevated temperature testing for abnormal temperature considerations.

Generic Considerations On The Use Of Different Versions Of IEEE 323 Related To This RAI Response:

With respect to the actual differences between the 1974 version and the 1983 version of IEEE 323, there were no new requirements established under the 1983 version as compared to the 1974 version. The same qualification testing and analysis elements are in both versions. The following is noted in the foreword of IEEE 323-1983:

"This revision to IEEE 323-1974 was made to clarify its requirements and imposes no additional requirements for qualifying Class 1E equipment."

This has been reviewed on multiple occasions internal to Duke Energy's EQ Program along with various industry meeting discussions. It is further documented via industry documents such as EPRI Report TR-100516 "Nuclear Power Plant Equipment Qualification Reference Manual". Key clarifications included in IEEE 323-1983 are the considerations for MILD environment qualification and documentation, extending methods for qualified life evaluations, extrapolation of qualification via similarity analysis, and clarifications on accident environments and profiles for Loss of Coolant Accidents (LOCAs) and High Energy Line Breaks (HELBs).

Summary:

Duke Energy has originally specified IEEE 323-1974 as the reference and basis for qualifying the new electrical equipment for the Oconee PSW System. Over the course of procuring and testing this new electrical equipment, it has been requested to perform the qualification testing in accordance with IEEE 323-1983 versus the 1974 version on certain PSW System equipment. A majority of these requests were supplied by the equipment vendors to take advantage of the MILD environment guidance that is provided via IEEE 323-1983. Since there are no new requirements established by the 1983 version, it was determined there were no concerns with different standards for the above listed reasons.

RAI 135 [EEEB26]

In its analysis of HELBs outside of containment provided in the ONDS-351, Revision 2, the licensee stated that some of the breaks in the high energy systems may affect cabling associated with the emergency power distribution system. The bounding postulated HELB interaction would be the loss of ONS 230 kilovolt (kV) Switchyard, as well as the loss of both Standby Buses. The result would be a loss of all alternating current (AC) power to Units 1, 2, and 3 (i.e., station blackout (SBO)). Due to the postulation of HELBs in the common TB for Units 1, 2, and 3 resulting in an SBO (i.e., loss of all AC power including loss of both Keowee Hydro Units (KHUs)), the KHU power supply may not be available to supply power to the proposed PSW system. The staff understands that in such a case the proposed power supply from the 100 kV Central Substation is aligned to power the PSW system.

1. Demonstrate that the HELB induced loss of all AC power (i.e., loss of all three generators and KHU units) resulting in SBO will not adversely impact the stability of the transmission grid.

2. Confirm that a loss of all three generators as a result of a HELB induced SBO will not result in adverse voltages on the PSW System Safe Shutdown equipment when powered from the power supply from the 100 kV Central Substation.

Duke Energy Response:

The HELB report identified cases where all AC power could be lost to one unit, two units, or all three units. The loss of AC power cases were described as unit blackout, multi-unit blackout, station blackout, or blackout conditions. Within the context of the report, the term blackout was used to describe the loss of the 4kV power distribution systems located inside the Turbine Building for one, two or all three units. The Keowee Hydro units are expected to remain available to supply power to the PSW electrical distribution system following a postulated HELB. Keowee is a credited source of power to the PSW electrical distribution system.

The Keowee power pathway to the PSW electrical distribution will not be lost due to a fault in the 4kV Main Feeder Buses (MFBs) or the 4kV Switchgear assemblies located inside the Turbine Building. Should a failure occur in the 4kV Main Feeder Buses or the 4kV Switchgears due to a postulated HELB inside the Turbine Building, overcurrent protection is provided by overcurrent relays in the "SK" breakers (Standby Bus Supply from Keowee) located in the Unit 1&2 Blockhouse and overcurrent relays at Keowee for ACB-3 and ACB-4 (Keowee Supply to the underground path).

The 100kV power supply from the Central Substation is the normal power source for the PSW electrical distribution system. If the transmission grid is adversely impacted by a HELB induced loss of the 230kV Switchyard, protective relaying is provided on the 13.8 kV incoming lines for the PSW electrical distribution system to protect against overvoltage and undervoltage conditions.

RAI 136 [EMCB1]

Please confirm that drawings and all structural calculations/analyses for systems, structures and components (SSCs), including piping, credited to and/or affected by the proposed PSW system are approved and final; and controlled documentation exists which finds the applicable SSCs structurally adequate to perform their intended design functions. This confirmation is only required for safety-related and/or seismically qualified or seismic category two over one SSCs.

Duke Energy Response:

Drawings and calculations have been completed and approved for the design and implementation of all systems, structures, and components (SSCs) associated with the PSW Project with the exclusion of: portions of the Engineering Change (EC) for the PSW Pipe Header (EC91877), portions of the Engineering Change for the PSW Pump (EC91878) and the Engineering Change for the Unit 1 Pressurizer Heater and Vital Battery Charger (EC91826) which are not yet released from engineering. The ECs associated with portions of the PSW Pipe Header (EC91877) and the PSW pumps (EC91878) include scope that can only be implemented following removal of the existing station Auxiliary Service Water system and its associated electrical switchgear. Design of these ECs is nearing completion; however, since the PSW system includes changes to the facility as described in the Oconee Nuclear Station (ONS) Updated Final Safety Analysis Report (UFSAR) that do not meet 10CFR50.59 criteria for licensee self approval, as well as additions to the Technical Specifications, issuance of the NRC safety evaluation regarding the associated ONS UFSAR changes and PSW Technical Specifications is necessary prior to final issuance of the ECs.

Approved design documentation exists for all of the following Engineering Changes, which released work for construction and implementation. Incorporation of approved design changes resulting from field changes is documented in the Duke Energy system with final as-built

calculation and drawing revisions occurring as an ongoing process while construction and implementation activities progress.

PSW Project Engineering Changes approved for implementation and construction are:

EC91829	Unit 1 Vital I&C Cable Re-routes
EC91830	Unit 1 Main Control Board Additions
EC91832	Underground Commodity Relocation
EC91833	PSW Building (Electrical)
EC91834	Unit 1 PSW Power to HPI
EC91849	Unit 2 Pressurizer Heater & Vital Battery Chargers
EC91850	Unit 2 CCW Minimum Flow Line
EC91851	Unit 2 Vital I&C Cable Re-routes
EC91852	Unit 2 Main Control Board Additions (Outage)
EC91853	Unit 2 Main Control Board Additions
EC91856	PSW Building (HVAC)
EC91857	Unit 2 PSW Power to HPI (Outage)
EC91858	Unit 2 PSW Power to HPI
EC91859	Unit 3 Pressurizer Heater & Vital Battery Chargers
EC91860	Unit 3 Condensate Test Line
EC91861	Unit 3 Vital I&C Cable Re-routes
EC91863	Unit 3 Main Control Board Additions
EC91866	Unit 3 Main Control Board Additions (Outage)
EC91868	Unit 3 PSW Power to HPI (Outage)
EC91869	Unit 3 PSW Power to HPI
EC91870	PSW Building Erection
EC91871	PSW Building (Structural Attachments)
EC91873	Keowee Cable Tie-ins
EC91874	100kV Alternate Power Supply
EC91875	Keowee ACB Installation
EC91876	SSF Back-up Power
EC91879	Auxiliary Building Cable Tray
EC91880	Keowee Emergency Cable Re-route
EC91881	PSW Ductbank
EC91884	Unit 1 Steam Generator Valve Replacement
EC91885	Unit 2 Steam Generator Valve Replacement
EC91887	Unit 3 Steam Generator Valve Replacement
EC92519	Keowee Demolition (Depressed Air System)
EC93524	Keowee Pipe Removal
EC95601	ASW In-Plant Demolition
EC106349	Keowee AC Power Supply Mechanical Interface
EC106526	Pump Tie-in Cable Package

RAI 137 [EMCB2]

Please verify that the structural design of piping and piping modifications is in accordance with the 1967 Edition of USAS B31.1, which is specified in the current licensing basis (CLB) of the Oconee Nuclear Station (ONS). Also verify that the structural design of pipe supports is in accordance with the AISC Manual of Steel Construction, 6^{th} edition, which is also specified in the CLB of the ONS.

Duke Energy Response:

Structural design of piping and piping modifications for the PSW project is in accordance with USAS B31.1, 1967 Edition per OSS-0292.00-00-0001, "Specification for Design and Implementation Support of the Protected Service Water System," Revision 2, Attachment 2, "Tornado-HELB Protected Service Water System Mechanical/Civil Design Criteria," Section II, and UFSAR Chapter 3.

Structural Design of Pipe Supports for the PSW project is in accordance with AISC Manual of Steel Construction, 6th Edition per Oconee UFSAR Section 3.9.3.4.2 (See section 3.9.3.4.2.1.1, Note 1 for specific reference to the AISC Manual of Steel Construction, 6th Edition). Analysis utilizes GTStrudl for qualification of the members using the AISC Manual of Steel Construction, 7th Edition. The equations used from the 7th edition have been reconciled with the 6th edition. Equation 1.6-2 of the 7th Edition was reconciled with Formula 6, Section 1.6.1 of the AISC 6th Edition. While the two equations are not identical, they were found to give the same results. Section 1.8.4 of the 7th Edition has identical requirements to 1.8.4 of the AISC 6th Edition.

RAI 138 [EMCB3]

Please identify the codes and code edition utilized for the structural design of the heating, ventilation and air-conditioning (HVAC) system components and component supports, ducts and duct supports and whether these codes are in the ONS CLB or current design basis (CDB). If these codes are not in the ONS CLB or CDB, please provide the basis for justifying use of these codes.

Duke Energy Response:

Heating, Ventilation, and Air Conditioning (HVAC) supports (all locations) and ducts affected by the PSW project are designed in accordance with Duke Energy Design specification OSS-0235.00-00-0015, Design Specification for HVAC Supports and Restraints. HVAC supports within the PSW Building and Auxiliary Building are designed to the AISC Steel Construction Manual 6th edition in accordance with this specification. For more specific information on the design process of HVAC supports, see the response to RAI 139 (planned for submittal by 7-20-2012).

HVAC ductwork is designed in accordance with Duke Energy design specification OSS-0235.00-00-0015, Design Specification for HVAC Supports and Restraints, Duke Energy specifications OSS-0235.00-00-0026, Procurement Specification for the Auxiliary Building Protected Service Water Pump Room QA-1 Ventilation System, and Duke Energy specification OSS-0235.00-00-0013, Procurement Specification for the QA-1 Heating and Ventilation System of the Protected Service Water Building. These specifications reference SMACNA, HVAC Duct Construction Standards – Metal and Flexible, 2005, for the design of HVAC ducts.

Specifications referenced in this response are existing Oconee Nuclear Station design basis specifications. For details on the codes and editions used for the qualification of HVAC equipment, see the response to RAI 160 (planned for submittal by 7-20-2012).

RAI 139 [EMCB4]

In addition to the seismic analysis discussion included in Section 9.7.1.2.5.2 of the March 16, 2012 letter, for the proposed PSW system credited piping and pipe supports; HVAC system components and component supports, ducts and duct supports; which are important to safety and/or need to be seismically qualified, please provide technical evaluation discussions which

address the structural analyses or evaluations performed and include, but not limited to, the following.

a) Structural analysis methodology, validated assumptions and criteria.

b) Structural design inputs which as minimum include loads and load combinations utilized in the structural analyses.

   The response to RAI EMCB-4(b) should include guidance and criteria utilized such as whether the design response spectra is developed in accordance with RG 1.6 and RG 1.92 for combining modal responses; whether RG 1.61 is used for damping ratios; other regulatory guidance, FSAR or SRP sections.

   In addition, please discuss guidance and criteria for monitoring of piping vibration levels during startup testing mentioned in UFSAR Section 9.7.1.2.5.3 of the March 16, 2012 letter and whether it is in accordance with ASME OM-SG Part 3, UFSAR or other approved guidance. Also discuss monitoring of piping thermal motion to verify adequate clearance and restriction of movements.

c) Discussion of the results of the structural analyses and evaluations. Please include quantitative summaries of maximum stresses with a comparison to code of record allowable stresses. Include only maximum stresses and data at critical locations (i.e. pipe anchors, equipment nozzles, penetrations, component connections, tie-ins to existing piping, etc). For penetrations and equipment nozzles provide a summary of loads compared to specific allowable values for the penetrations and nozzles.

d) Describe the method and criteria used for the interface between piping which is required to be seismically qualified and non-seismically qualified piping.

e) Describe how the interaction between seismic and non-seismic PSW SSCs (including piping) has been considered.

Duke Energy Response:

To be provided by July 20, 2012.

RAI 140 [EMCB5]

Section 3.2.1.1.1 of the Oconee Nuclear Station (ONS) Updated Final Safety Analysis Report (UFSAR) describes Class 1 structures as those structures, systems and components (SSCs) which prevent uncontrolled release of radioactivity and are designed to withstand all loadings without loss of function. According to the ONS UFSAR mark-up included in the licensee's letter dated March 16, 2012, the protected service water (PSW) building has a seismic classification of Category 1 and it is designated as a Class 1 structure.

a) Provide a detailed description of the design criteria and load combinations for structural design and stability analysis of the PSW building and demonstrate compliance with Section 3.1.2 of the ONS UFSAR;

b) Provide a detailed description of the type of foundation(s) and supporting rock/soil/backfill strata, as applicable, used in the design of the PSW building;

c) Provide further information relative to the design features and mitigative measures that have been incorporated in the design and construction of the PSW building to control groundwater infiltration;

d) Provide a detailed explanation of the load path from the PSW building superstructure to the foundation elements and to the subgrade;

e) Provide the factor of safety against overturning, sliding and floatation and associated acceptance criteria for all applicable design loading conditions; and

f) Provide the maximum soil bearing pressure and the associated allowable limits for all applicable design loading conditions.

Duke Energy Response:

To be provided by July 20, 2012.

RAI 141 [EMCB6]

According to the licensee's letter dated March 16, 2012, the ONS UFSAR mark-up included Section 9.7.1.2.5.1 which states the following:

"The design response spectra for the new structures correspond to the expected maximum bedrock acceleration of 0.1g (MHE). The design response spectra were developed in accordance with Regulatory Guide 1.122 (Reference 15). The dynamic analysis is made using the STAAD-PRO computer program. The structure is built on structural fill. A ground motion time history was developed based on the soil properties and amplified response spectra generated at elevations of significant nodal mass."

Provide the following:

a) Considering that the PSW building is described as founded on the structural fill, provide a detailed description of rock motion, anchoring point for the input motion, and material properties of soil profile(s) overlaying bedrock (thickness, shear wave velocity, and other relevant material properties.) Also, discuss the response amplification calculation process that was used to determine the free-field horizontal and vertical ground motion at the PSW building.
b) Provide a detailed description of the procedures used for the seismic analysis of the PSW building and to develop the in-structure response spectra (floor design response spectra). If different from the methods and acceptance criteria outlined in the NRC standard review plan (SRP) 3.7.1 and 3.7.2, identify those differences and provide justification that the PSW building is adequately designed, using these alternative methods, to withstand the effects of earthquake loads.
c) Confirm and provide further information that STAAD-PRO and all features of this software related to the dynamic response analysis and static analysis have been verified and validated by its provider in compliance with 10 CFR Part 50, Appendix 8 and 10 CFR Part 21. Also, provide documentation which demonstrates that the software provider has been audited and approved as an Appendix 8 supplier.
d) Describe the method of combination of modal responses and spatial components used in the PSW building seismic response analysis. If different from the methods outlined in

the NRC Regulatory Guide (RG) 1.92, identify those differences and discuss how these alternative methods provide assurance that the PSW building is adequately designed to withstand the effects of earthquake loads.

Duke Energy Response:

To be provided by July 20, 2012.

RAI 142 [EMCB7]

The ONS UFSAR mark-up, included in the licensee's letter dated March 16, 2012, includes American National Standard Institute (ANSI)I American Institute of Steel Construction (AISC) N690-1984 and American Concrete Institute (ACI) 349-97 as the design codes for the PSW building structural steel and reinforced concrete elements, respectively.

The current RG 1.142 (revision 2) endorses ACI 349-97 with exceptions. The SRP 3.8.4 references the 1994 edition of ANSI/AISC N690 including Supplement 2 (2004) for the design of safety-related steel structures. Provide discussion and further information relative to the following:

a) Demonstrate compliance with the provisions of the 1994 edition of ANSIIAISC N690 including Supplement 2 (2004) or identify the differences between two editions and provide a reconciliation to demonstrate the acceptability of using ANSI/AISC N6901984.

b) Confirm that ACI 349-97 have been followed in its entirety, where applicable, and all applicable regulatory positions in RG 1.142 have been incorporated in the design and construction of the PSW building.

Duke Energy Response:

To be provided by July 20, 2012.

RAI 143 [EMCB8]

The ONS UFSAR mark-up, included in the licensee's letter dated March 16, 2012, references AISC Manual of Steel Construction, 13th edition and ANSI/AISC N690 among those codes that were used for the design of the PSW building.

As ANSIIAISC N690 covers the design provisions for safety-related steel structures, provide further information to clarify the extent of the use of AISC 13th edition in the design of the PSW building.

Duke Energy Response:

The AISC Steel Construction Manual, 13th Edition was used exclusively for the selection of member sizes and member properties within structural steel calculations related to the PSW Building. The code used to design PSW Building is ANSI/AISC N690-1984 in accordance with SRP 3.8.4, DRAFT Revision 2 (see response to RAI 142(a), planned for submittal by 7-20-2012)).

RAI 144 [EMCB9]

The ONS UFSAR mark-up, included in the licensee's letter dated March 16, 2012, describes the underground conduit duct banks associated with the PSW building. It specifically states that a second reinforced concrete duct bank/elevated raceway connects the PSW building to the Unit 3 auxiliary building. It also states that these structures are seismically qualified to the maximum hypothetical earthquake and designed to withstand missiles, wind and differential pressure associated with a tornado event.

Provide further information relative to the following:

a) The structural design criteria used for the design of the reinforced concrete duct banks and demonstrate compliance with Section 3.1.2 of the ONS UFSAR;

b) The procedures used for the analysis and design of the reinforced concrete duct banks for seismic and tornado missile load conditions and confirm that these duct banks have been designed for the relative movement at the locations where they enter and exit the respective structures; and

c) The method of protection against tornado wind and tornado missiles for the elevated (above ground) electrical raceway connecting the PSW building to the Unit 3 auxiliary building.

Duke Energy Response:

To be provided by July 20, 2012.

RAI 145 [EMCB10]

Provide further information relative to the evaluation of the existing underground commodities (if any) for the additional loads exerted by the PSW building foundation footprint to demonstrate that there will be no adverse effects on the existing underground utilities for all applicable design loading conditions.

Duke Energy Response:

To be provided by July 20, 2012.

RAI 146 [EMCB11]

Provide a detailed explanation of how settlement (including static or dynamic differential settlement) was considered in the design of the PSW building and the commodities at the entry points into this structure that could be adversely affected by the settlement of the PSW building.

Duke Energy Response:

The following commodities that enter the PSW Building are non-safety related (Non-QA): 6-inch diameter High Pressure Service Water (HPSW) pipe for the two fire hose station, 3-inch diameter Plant Drinking Water (PDW) pipe for the two eyewash stations, power cables from the Radwaste Facility, communication cable from the Radwaste Facility to the Reactor Coolant Pump Motor Refurb Shop, power cables for external non-safety related HVAC equipment and drain pipes for the battery room and cable spreading area. The safety related (QA-1) power and control cables that enter and exit the PSW Building via reinforced concrete ductbanks will be addressed under the response to RAI 144 (planned for submittal by 7-20-2012).

The PSW Building is founded on compacted backfill and is supported by a continuous perimeter spread footing to minimize any differential settlement. Backfill material and compaction were provided and performed in accordance with Duke Energy Specification OSS-0009.00-00-0002, "(Civil) Backfill for QA Condition 1,2,4 and Non-QA Structures and Appurtenances," Rev. 6, as indicated on drawing O-398-A2-100, "PSW Building, General Notes & Reference Drawings," Rev. D .

The maximum short term settlement for the PSW Building under static loading is less than 0.75-inch as indicated in Duke Energy Calculation OSC-9227, "Report of Geotechnical Exploration for Protected Service Water System and Natural Phenomenon Barrier System Projects," Rev. 0, Section 7.4, Summary and Conclusion. As stated in the calculation; the initial settlement occurred within the first 4 months of the application of static loads, with long term settlement of 0.5 to 1-inch occurring within 10 years. The schedule for construction of the PSW Building had the structure of the building, foundation, walls, roof, interior walls and slabs erected and in place months before any commodities were run into the building. Therefore, initial settlement of the building occurred prior to running any commodities into the building or connecting any drain lines to the stormwater (yard drain) system.

In addition, Duke Energy Calculation OSC-9227, Section 7.10, concluded that computed static short term, long term, and differential settlements are acceptable, and no hazard from earthquake induced soil liquefaction or settlement exists, per criterion established from accepted geotechnical engineering practice based upon published industry research, methodologies, and guidance from ASCE 4-98, as supported by laboratory consolidation and compaction testing in accordance with ASTM Standards.

The report contained in Duke Energy Calculation OSC-9227 was specified by Duke Energy document OSR-0292.00-00-0001, "Technical Requirements for Geotechnical Investigation Services for Protected Service Water System and Natural Phenomenon Barrier System Projects", which cited Chapter 2 of the Oconee "Updated Final Safety Analysis Report", December, 2005, and NUREG-0800, Standard Review Plan, Section 3.8.4, as references. In addition, numerous ASTM Standards related to laboratory and field methods were specified, including, but not limited to: ASTM D698 (Standard Proctor), ASTM D420 (Site Characterization for Engineering Design and Construction), ASTM D2435 Consolidation), and ASTM D4767 (Consolidated-Undrained Triaxial Testing).

For the two locations where the High Pressure Service Water (HPSW) system pipe penetrates the PSW Building east foundation wall, 12-inch diameter pipe sleeves were embedded in the foundation wall at locations indicated on drawing O-398-A2-402, "PSW Building, Exterior Wall Elevations North and East," Rev. C. Link seals are used to provide a flexible seal between the 6-inch diameter HPSW pipe and the wall sleeve providing more than enough clearance to allow for settlement. For the PDW pipe a 5-inch diameter sleeve was embedded in the south end of the west exterior foundation wall of the PSW Building, at the location indicated on drawing O-398-A2-402A, to accommodate the 3-inch diameter PDW pipe, see drawing O-448J-2, "Piping Layout, Radwaste Embedded Piping, Yard Plan," Rev. 4B. For cables entering and exiting the PSW Building rigid conduit sleeves were installed in the east and west walls and connected to conduit runs after the PSW Building shell was erected. Sufficient flexibility exists within the conduit to accommodate any long term settlement effects.

Similarly, the battery room drain pipe and cable spread area drain pipe have sufficient flexibility to accommodate any long term building settlement effects. The communication cable and an alternate power supply cable enter the PSW Building near the north end of the west exterior foundation wall by means of 5-inch diameter conduit through 6-inch diameter core holes. These cables are sealed within the conduits with flexible sealant material, in accordance with Duke

Energy specification OSS-282.00-00-0001 “Design Specification for Mechanical and Electrical Penetration Fire, Flood, and Pressure Seals,” Rev. 5, and the conduits are sealed within the core holes with RTV foam as indicated on design documents. Sufficient flexibility exists within the conduit and connection to the PSW Building to accommodate any long term settlement affects.

RAI 147 [EMCB12]

Provide further information relative to the procedures used in calculating the dynamic lateral soil pressure for the design of below grade walls of the PSW building.

Duke Energy Response:

To be provided by July 20, 2012.

RAI 148 [EMCB13]

Provide further information whether there are any existing SSCs, in the vicinity of the PSW building, that could have an adverse interaction with the PSW building.

Duke Energy Response:

To be provided by July 20, 2012.

RAI 149 [EMCB14]

As noted in Section 3.2.1.1 of the ONS UFSAR:

> "From the license renewal review, it was determined that Class 1 civil structures are included in the scope for license renewal."

Furthermore, the ONS UFSAR mark-up, included in the licensee's letter dated March 16, *2012,* does not include a revision to Section 18.3.13 "Inspection Program for Civil Engineering Structures and Components" for the PSW building.

Provide further information and confirm that the PSW building will be incorporated into Oconee Nuclear Station's aging management program.

Duke Energy Response:

The Protected Service Water (PSW) Building is a Class 1 Structure and, as such, will be included in the Duke Energy “Inspection Program for Civil Engineering Structures and Components” (EDM-410), when the PSW Building becomes functional. The EDM-410 Program is applicable in meeting the regulatory requirements of 10 CFR 50.65 (Maintenance Rule). By including the PSW Building into the EDM-410 Program, the PSW Building is incorporated into the Oconee Nuclear Station (ONS) aging management program for civil structures. Also, the inclusion of the PSW Building into the EDM-410 Program assures that the PSW Building will be adequately managed such that there is no loss of intended function throughout the Period of Extended Operation.

Systems, Structures, and Components (SSC) that are plant additions or modification installed after the renewed license is issued, are not subject to the provisions of 10CFR54.37 (b). The PSW Building is a new structure (e.g., not newly identified) with its construction during the 2009

– 2011 time periods. As such, no change to Section 18.3.13 of the ONS UFSAR is required. The PSW Building will be included in Section 3.2.1.1.1 of the ONS UFSAR.

(Refer to proposed UFSAR change page given in Attachment 1 for RAI #149).

RAI 150 [SBPB1]

In the response to RAI 107, the licensee provided the proposed technical specifications for the Protected Service Water (PSW) system. The completion time of Condition C would allow 30 days to recover operability when the PSW and Standby Shutdown Facility (SSF) were inoperable concurrently for maintenance.

Provide a list of maintenance activities that would be expected to result in concurrent inoperability or unavailability of the PSW and SSF systems. For previous instances when these maintenances were performed, dating back to the installation of the SSF, provide the duration of each maintenance performance. In addition, provide the total time that the SSF was inoperable or unavailable during each maintenance performance.

Duke Energy Response:

At this time, the only identified maintenance evolution that can result in concurrent inoperability or unavailability (sufficient inventory not maintained to provide the required suction pressure for the SSF Auxiliary Service Water (ASW) and Protected Service Water (PSW) Pumps) of the PSW and Standby Shutdown Facility (SSF) Systems, is the Unit 2 Condenser Circulating Water (CCW) unwatering maintenance evolution and associated activities. During a Unit 2 CCW unwatering, the capability to maintain the SSF operable and available is dependent upon the compensatory actions put in place, relative to the CCW maintenance actives being performed. The duration of past CCW unwatering evolutions on Unit 2 were as follows:

Year	Outage	U2 CCW Inlet Piping Condition	U2 CCW Maintenance Duration (Hours)	SSF Available?	SSF Unavailability (Hours)
1998	2EC17	Unwatered	324	No	316
2001	2EC18	Unwatered	115	No	148
2002	2EC19	Unwatered	389	Yes	0
2004	2EC20	Unwatered	423	No	200
2005	2EC21	Unwatered	245	No	334
2008	2EC23	Unwatered	408	Yes	0

Note: When the CCW system was partially unwatered in 2002 and 2008, compensatory actions were used to keep the SSF operable/available.

Data was obtained and verified from various sources including ProjectView, AutoLog, Operator Aid Computer (OAC), and engineering records. The SSF was installed in the mid-1980s, but reliable records [ProjectView (work control)] could only be retrieved back to 1990.

RAI 151 [SBPB2]

During periods of concurrent PSW and SSF inoperability as a result of maintenance there may still be a demand for these systems. Provide a description of Oconee's capability for backing out of the maintenance activities and the time frame for restoring the PSW and SSF to operability.

Duke Energy Response:

The ability to back out of a Unit 2 Condenser Cooling Water (CCW) system unwatering maintenance evolution is dependent upon the volume and complexity of work being performed. Duke Energy has established processes in accordance with 10CFR50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," subpart a(4) to assess and manage the risk associated with maintenance activities. Duke Energy Processes defined in Nuclear System Directive (NSD) 403 "Shutdown Risk Management", Work Process Manual (WPM) 602 "Outage Management", and WPM608 "Outage Risk Assessment Utilizing Electronic Risk Assessment Tool (ERAT)" allow the station to assess and manage risk during outage maintenance evolutions. Implementing Defense-In-Depth (DID) strategies and using the Probabilistic Risk Assessment (PRA) and Electronic Risk Assessment Tool (ERAT) allows the station to properly assess and manage risk.

A CCW system unwatering Critical Activity Plan (CAP) is used to control the activities and must be reviewed and approved by the Station Plant Operational Review Committee (PORC) prior to beginning work. Some examples of the measures taken to manage risk are protecting equipment, compensatory actions, developing risk management plans, proper scheduling and bundling of work, and proper control of outage scope.

Dependent on the scope of the CCW maintenance activities associated with the unwatering of the CCW system, some specific examples used to manage risk and to restore the system, if needed, include:

- Maintaining Keowee lake level below the level of the CCW inlet piping at the intake to prevent potential water intrusion into the Turbine Building.
- Conducting an assessment each shift to evaluate work progress and risk to the extent that they affected the projected unavailability. Outage management is notified of any potential negative impacts.
- Establishing protected equipment to minimize the possibility of plant system failures or malfunctions. This includes the following: Unit 1 and 3 A & B Emergency Feedwater (EFW) trains, Unit 1 and 3 turbine-driven EFW pumps, A & B Low Pressure Service Water (LPSW) pumps, Unit 1 and Unit 3 High Pressure Injection (HPI) trains, and the Keowee Underground power path.
- Assigning higher priority to scheduled tasks to help avoid extending the duration of the work. Any emergent tasks would be given high priority. Risk assessments would be performed daily. An outage manager is assigned to track work progress and ensure appropriate priorities are established for the work tasks.
- Positioning dedicated personnel to monitor portable sump pumps and the water level in the CCW inlet piping at all times. Preparations are in place to quickly install blank flanges upon reaching pre-defined action levels.

These measures are captured in previous correspondence with the Staff as part of a Station Auxiliary Service Water (ASW) system outage report dated December 9, 2008.

Using the processes contained in the aforementioned NSD and WPMs, the station is able to develop recovery plans and actions that have a time frame commensurate with the maintenance activities being performed and associated station risk.

RAI 152 [SRXB1]

Please list the design basis high energy line breaks that establish the performance requirements for the PSW system.

Duke Energy Response:

The PSW system is relied upon to mitigate postulated HELBs, where pipe whip or jet impingement interactions can result in the loss of main steam system integrity and the loss of the 4160 VAC Essential Power system located inside the Turbine Building.

Secondly, the PSW system is relied upon to mitigate a postulated Feedwater Line Break inside the Turbine Building, which can result in the loss of all AC power to the affected unit, and a loss of the Turbine-Driven EFW pump on the affected unit. This scenario results in a complete loss of normal and emergency feedwater necessary for secondary system decay heat removal.

In addition, the PSW system is relied upon to mitigate postulated HELBs that can result in a loss of the low pressure service water (LPSW) and EFW pumps located in the Turbine Building basement due to flooding.

RAI 153 [SRXB2]

For the events, the analyses for which are discussed in Sections 7.1.1.2 and 7.2.1 of ONDS-351, Revision 2, please provide the following information:

Describe the acceptance criteria, the model used for the analysis, the initial and boundary conditions used for the analysis, summarize the core kinetics, and provide a detailed discussion of the results. Please also include transient plots of the key reactor coolant and main steam system thermal-hydraulic parameters.

Duke Energy Response:

Note: The table and figures discussed in the following response are provided in the RAI #153 supplemental information section of Attachment 1.

Section 7.1.1.2 of ONDS-351, Revision 2

Section 7.1.1.2 of ONDS-351, Revision 2, describes an analysis of a Double Main Steam Line Break (MSLB), with loss of the 4160VAC Essential Power System and without automatic closure of the Main Steam Isolation Valves (MSIVs). The transient analysis of the plant response to this postulated event was performed using the RETRAN-3D computer code as described in Duke Energy's Methodology Report DPC-NE-3000-PA, which has been approved by the NRC [see ADAMS Accession No. ML032670816].

As noted in Section 7.1 of ONDS-351, Rev. 2, HELB interactions with the Main Steam system are evaluated for possible safety consequences on the reactor core (potential for return-to-criticality and unacceptable DNBR). The acceptance criterion for these analyses is that the minimum DNBR be maintained above previously established limits.

The scenario described in Section 7.1.1.2 of ONDS-351, Rev. 2 assumes that the resultant steam releases from the pipe ruptures damage the 4kV Essential Power System, making unavailable all equipment powered by this system. This includes the Low Pressure Injection (LPI) pumps, High Pressure Injection (HPI) pumps, Motor-Driven Emergency Feedwater (EFW) pumps, Hotwell pumps, and Condensate Booster pumps. Even though the Main Feedwater (MFW) pumps trip off due to the loss of the Hotwell pumps and Condensate Booster pumps, flashing of hot MFW inventory as the steam generators blow down provides the motive force for reactor coolant system (RCS) overcooling. It is assumed that the MFW control valves fail as is, allowing for additional inventory upstream of these valves to flash during this event. With the HPI pumps disabled, borated water injection is only available via core flood tank (CFT) injection. Offsite power remains available, with reactor coolant pumps running to maximize the primary system cooldown. The only credible single failure considered for this case is in the EFW system.

Two transient analysis cases are performed for this scenario to evaluate whether a reactor coolant pump (RCP) trip on loss of subcooling margin is limiting. The first case assumed the RCPs were left on throughout the transient analysis. The second case assumed the operators stopped the RCPs following a loss of indicated subcooled margin (SCM). A discussion of the results of the transient analysis was previously provided in Section 7.1.1.2 of ONDS-351, Rev. 2. Table 1 identifies the significant parameters and initial conditions for this scenario. See Figures 1-14 for plots of significant parameters for this scenario (refer to the RAI #153 section of Attachment 1) . These plots include a 5 second null transient prior to the Double MSLB initiating event.

Section 7.2.1 of ONDS-351, Revision 2

Section 7.2.1 of ONDS-351, Revision 2, describes the plant response to a postulated Feedwater Line Break inside the Turbine Building, which can result in the loss of all AC power to the affected unit, and a loss of the Turbine-Driven EFW pump on the affected unit. This scenario results in a complete loss of normal and emergency feedwater necessary for secondary system decay heat removal. As noted in Section 7.2.1 of ONDS-351, Rev. 2, the acceptance criterion for Loss of Main Feedwater events is that RCS pressure be maintained below the safety limit, ≤ 2750 psig, as stated in Oconee UFSAR Section 10.4.7.3.

Previous analysis documented in Duke Energy Calculation OSC-2310 [see response to RAI 157 for complete reference] evaluated the plant response to a complete loss of normal and emergency feedwater scenario, crediting the Standby Shutdown Facility (SSF) for event mitigation. This analysis was performed using the RETRAN-02 code, as described in Duke Energy's Methodology Report DPC-NE-3000-PA, and predates Duke Energy's migration to RETRAN-3D for use in transient analysis of UFSAR Chapter 15 events. The purpose of the analysis is to demonstrate the SSF can maintain natural circulation in the primary system and therefore removal of decay heat through the steam generators via the SSF-Auxiliary Service Water (ASW) system. OSC-2310 modeled the original steam generators. Replacement steam generators were installed at Oconee circa 2003, and are very similar to the original SGs in terms of thermal performance. A conservatively high value of 15% SG tube plugging was assumed in OSC-2310 to minimize primary-to-secondary heat transfer. This is a bounding value, much greater than the 5% value used in current non-LOCA transient analyses where the replacement SGs are modeled. Since the SSF analysis does not represent a design basis event as described in Oconee UFSAR Chapter 15, nominal initial conditions are generally employed in the analysis. The pressurizer pilot-operated relief valve (PORV) is modeled in the analysis. The important parameter for consideration in the analysis is core decay heat. This is maximized by assuming an initial power level of 102% of 2568 MWt, and modeling of high end

of cycle (EOC) decay heat. Table 2 identifies the significant parameters and initial conditions for this scenario (refer to the RAI #153 section of Attachment 1).

This transient begins with a loss of all feedwater, which results in an anticipatory reactor trip. Operators diagnose the need to use the SSF, and trip the RCPs prior to leaving the control room (modeled at 3 minutes after event initiation). The SSF RC makeup pump and SSF-ASW pump are locally started, and operators control SSF- ASW pump flow to return the RCS to typical post-trip conditions. Natural circulation levels are then achieved in the SGs to promote long-term natural circulation in the RCS. A hot standby condition (> 1% subcritical with RCS Tavg ~550 °F) is achieved in the RCS with decay heat being removed by SSF-ASW flow via natural circulation in the primary system, RCS temperature controlled by the lowest lifting main steam relief valves (MSRVs), and RCS pressure controlled by both throttling SSF letdown and utilizing the SSF powered pressurizer heater elements with a steam bubble present in the pressurizer.

The transient response for the SSF analysis is shown in Figures 15-33 (refer to the RAI #153 section of Attachment 1) and discussed below. Certain figures are expanded to show the first 30 minutes of the transient, which covers the time frame of interest before, and shortly after, SSF-ASW is placed into service.

After the reactor trips, reactor power (Figure 15) rapidly decreases to typical post-trip decay heat levels, and drops below 1% of its full power level by the end of the transient. After SSF-ASW flow is established, decay heat is removed by the SGs for the remainder of the transient.

Figures 16 and 17 show the RCS pressure response for this case. Following reactor trip and the normal post-trip shrinkage and depressurization seen in the primary system, RCS pressure begins to rapidly increase as all secondary inventory is boiled off. The pressurizer PORV begins cycling in approximately 6 minutes, and continues to do so until SSF-ASW flow begins entering the SGs at 900 seconds. Following the initiation of SSF-ASW flow, RCS pressure decreases as the RCS is cooled down to a typical post-trip condition. Operators have been instructed to return the RCS to a nominal post-trip condition while attempting to maintain a relatively steady RCS pressure and pressurizer level using SSF-ASW. Due to the limited makeup capacity of the SSF RC makeup pump, this results in a very slow cooldown rate. To make this a bounding analysis with respect to subcooling margin, a more rapid cooldown of 4°F/hr was simulated. This results in some volumetric shrinkage and RCS depressurization. By the time the cooldown is terminated (~52000 seconds), RCS pressure has decreased to ~1600 psig. At this time, operators could open the SSF letdown line. Since RCS pressure is so low in this simulation at this point in time, this action is not modeled. This results in a small mass addition to the RCS, which results in a gradual repressurization. This continues to the end of the simulation.

Pressurizer level (Figures 18 and 19) initially decreases following reactor trip due to post-trip shrinkage, then rapidly increases as the RCS heats up from the loss of all feedwater. After operators start the SSF support systems, level steadily decreases to ~175 inches by the time the cooldown is complete. As discussed before, operators would actually maintain pressurizer level approximately constant during the cooldown by reducing the cooldown rate. Again, this simulation assumes a more rapid cooldown rate to provide a bounding analysis. After the cooldown is complete, level steadily increases as the SSF RC makeup pump continues to provide mass addition to the RCS.

RCS temperatures (Figures 20 through 23) initially trend in the same manner as pressurizer level until the RCS is cooled to normal post-trip conditions. Peak RCS temperatures of 620-630°F are reached prior to actuation of the SSF-ASW pump. After cooling the RCS down to ~550°F, RCS T-cold is controlled to the saturated temperature associated with the lowest lifting

MSRV setpoint. During the course of the transient, the ΔT across the core region decreases from an initial value of ~20°F to ~10°F by the end of the transient due to the decrease in decay heat.

After operators trip off the RCPs at 3 minutes, RCS flow (Figures 24 and 25) decreases to ~3% of nominal until the cooldown begins. Due to the increased heat removal occurring in the SGs during the cooldown, an increase in the natural circulation flow to ~4% is seen during this time. Once the cooldown ends, flow decreases again to ~3%, then gradually drops to ~2.5% by the end of the transient as decay heat drops off. It should be noted that after the RCPs are tripped off, the reactor vessel vent valves open. These valves allow for recirculation flow within the reactor vessel whenever the pressure differential between the reactor vessel upper plenum region and the reactor vessel downcomer region becomes positive.

Figure 26 shows the RCS subcooled margin as a function of time. The minimum subcooled margin seen during this simulation is ~20°F, which indicates that no voiding occurred in the RCS.

RCS letdown (Figure 27) is initially at ~70 gpm, then varies with RCS pressure until operators isolate it at 1200 seconds (20 minutes). It is assumed that operators start the SSF RC makeup pump (Figure 28) at 1200 seconds, at which time the RCP seal return block valves are isolated. Since the SSF RC makeup pump is a positive displacement pump, a constant flow over all RCS pressures is seen.

Steam generator pressure (Figures 29 and 30) is controlled by the MSRVs during this event. After the initial lift and boiloff of SG mass, SG pressure cycles from ~980-1050 psig on the lowest lifting MSRVs. This is the cause of the cyclic behavior seen in all the plots for this analysis.

SG levels (Figure 31) rapidly decrease after the loss of all feedwater. By the time SSF-ASW flow begins at 900 seconds, the SGs have almost reached a dry condition. During the cooldown to a normal post-trip condition, all of the SSF ASW flow boils off until RCS temperatures decrease to within a few degrees of the SG saturation temperature. It can be seen in Figures 32 and 33 that a SSF-ASW flowrate of ~75 gpm/SG is required to maintain the cooldown rate assumed in this analysis (~4°F). After this condition is achieved at ~52,000 seconds, SG levels are then increased up to their typical natural circulation level of ~240 inches.

The results shown in Figure 17 demonstrate that peak RCS pressure would be maintained below 2750 psig, with margins in excess of 250 psig. Although the pressurizer PORV is modeled in this analysis, this conclusion would remain applicable, even if the pressurizer PORV was not modeled, as the pressurizer safety valves would open to relieve RCS pressure. The PSVs have a higher relief flow capacity than the PORV, per Section 2.1.2.6 of DPC-NE-3000-PA. The PSV opening setpoint is 2500 psig, versus 2450 psig for the PORV. This difference is well within the peak pressure margins shown in Figure 17.

DNBR is not a concern for this evaluation, as the core power drops with the reactor trip. The limited nature of the RCS cooldown prevents any significant positive reactivity insertion due to moderator feedback effects. As such, no explicit DNBR calculations are performed for the complete loss of feedwater scenario.

As described in ONDS-351, Revision 2, Section 3.2, the PSW capability is functionally equal to, or greater than, the SSF, in terms of feed flow to the SGs and RCS makeup flow. Therefore, the SSF analysis per OSC-2310 can be used as a surrogate for an analysis that explicitly models this event crediting the PSW systems capabilities. Furthermore, the analysis described here models the original once through steam generators and not the replacement OTSGs. The generators are functionally equivalent and the conclusions will not change, but Duke Energy

does intend on updating the analysis to model the ROTSGs. During the planned revision, the actual characteristics of the PSW system (e.g., flow rates) will also be modeled.

RAI 154 [SRXB3]

If the initial conditions for the events discussed above are not conservatively bounding of instrumentation uncertainties of system and operating parameters, please justify the use of the more realistic analytic treatment.

Duke Energy Response:

For the double steam line break without MSIV closure described in Section 7.1.1.2 of ONDS-351, the analysis was performed assuming initial conditions error adjusted in the conservative direction. Therefore, no further discussion is provided for this event.

The feedwater line break in the turbine building analysis described in Section 7.2.1 of ONDS-351, the loss of all feedwater analysis, with SSF credited for mitigation, was performed assuming best-estimate initial conditions with the exception of reactor power which was adjusted to 102% of nominal to account for instrument error, as discussed in response to RAI 153. Reactor power, and the subsequent decay heat associated with it, is the dominant initial condition driving the plant response until the time the SSF-ASW (or PSW) is actuated. Error adjusting pressure may result in a time shift on the order of seconds on when the pressurizer PORV or safety valve will lift and reseat, but will not change the expected long-term response. Error adjusting pressurizer level will not result in the pressurizer going off scale. Error adjusting RCS temperatures high will result in slightly hotter structural metal and consequently slightly more energy removal requirements, but it is expected that RCS ambient heat losses (not modeled) would more than offset any increase in metal temperatures. Error adjusting RCS flow is not significant since reactor coolant pumps trip off three minutes after initiation of the event. Therefore, it is acceptable to assume nominal initial conditions since reactor power and decay heat are adjusted conservatively high.

RAI 155 [SRXB4]

For the events described above, please clarify the analytic treatment of plant and reactor protection systems. If a trip is assumed at the event initiation, for example, please justify this assumption.

Duke Energy Response:

The event discussed in Sections 7.1.1.2 of ONDS-351, Revision 2 describes the consequences of a double main steam line break with a loss of the 4160VAC power distribution system located inside the Turbine Building. A unit trip is assumed at the event initiation. An immediate reactor trip provides a conservative assumption in analyzing the effects of the resultant overcooling.

The event discussed in Section 7.2.1 of ONDS-351, Revision 2, describes the main feedwater line breaks inside the Turbine Building that result in a complete loss of electrical power to the affected unit. A reactor trip was assumed 1 second after the event initiation. The reactor protection system (RPS) monitors various parameters to ensure that the reactor is operating within acceptable limits. If electrical power is lost to the reactor coolant pumps (RCPs), the RPS will initiate a reactor trip within 1 second of the loss of power to the RCPs. In addition, the RPS monitors the operation of the main turbine and the main feedwater pumps. If either the main turbine has tripped or the main feedwater pumps have tripped, an anticipatory reactor trip signal

would be generated within the RPS. If a loss of electrical power is experienced on Units 1 and 2, the control rods on both units will drop without delay due to the loss of power to the Control Rod Drive (CRD) system. If a loss of electrical power is also experienced by Unit 3 coupled with the loss of power to Unit 2, the control rods on Unit 3 will also drop without delay.

RAI 156 [SRXB5]

If a particular acceptance criterion is dispositioned by comparison to a more limiting event that was explicitly analyzed, please provide a summary of the limiting event and plots of key parameters for the more limiting event.

Duke Energy Response:

Note: The table and figures discussed in the following response are provided in the RAI #156 section of Attachment 1.

As noted in Section 7.1 of ONDS-351, Rev. 2, HELB interactions with the Main Steam system are evaluated for possible safety consequences on the reactor core (potential for return-to-criticality and unacceptable DNBR). The acceptance criterion for these analyses is that the minimum DNBR be maintained above previously established limits. The analysis described in Section 7.1.1.2 does not assume a coincident Loss of Offsite Power (LOOP), and therefore the RCPs continue to operate for some duration of the event. No return to power is predicted for that analysis, and sufficient margin to core criticality has been demonstrated.

The most limiting Double MSLB event for DNBR considerations is the scenario where a LOOP is postulated to occur coincident with the breaks. This event is described in Section 7.1.3 of ONDS-351, Rev. 2. With respect to initial conditions and boundary conditions, this case is nearly identical to the single main steam line break without offsite power analysis as described in USFAR Section 15.13.3. The primary difference is that a double steam line break is modeled rather than a single steam line break, and the event is assumed to occur at 100% of rated thermal power, per the Statistical Core Design (SCD) methodology described in Duke Energy's Methodology Report DPC-NE-2005-PA, which has been approved by the NRC [see ADAMS Accession No. ML082800408]. No credible single failure is modeled for this case. Figure 34 (see Attachment 1 for RAI # 156) shows the normalized forcing functions obtained from the RETRAN-3D analyses that were used in the VIPRE evaluation for minimum DNBR.

To accommodate a potential Measurement Uncertainty Recapture (MUR) uprate, the normalized forcing functions from the RETRAN-3D analysis are also applied to an initial core heat flux value that corresponds to 102% of 2568 MWt for use in the VIPRE model. The VIPRE model includes the necessary mixed core modeling for a Mk-B11 / Mk-BHTP mixed core. A full core of Mk-BHTP fuel is also modeled. Table 3 identifies the significant parameters and initial conditions for this evaluation, and also shows the VIPRE results. For all cases, the minimum DNBR is greater than the applicable statistical DNBR design limit of 1.41 for the Mk-BHTP correlation.

RAI 157 [SRXB6]

If the analyses for these events are obtained from living calculation files, please provide reference information and revision numbers for the calculation files.

Duke Energy Response:

The analysis presented in Section 7.1.1.2 of ONDS-351 is documented in OSC-9352, Rev. 2, "ROTSG Double Steam Line Break Evaluation", Duke Energy, April 2011.

The complete loss of normal and emergency feedwater analysis with SSF credited for mitigation is documented in OSC-2310, Rev. 23, "SSF Design Basis Evaluation", Duke Energy, September 2011. This analysis is provided as a surrogate for the plant response to a Main Feedwater line Break Inside the Turbine Building as described in Section 7.2.1 of ONDS-351, Rev. 2.

RAI 158 [SRXB7]

Please justify not including the PSW design basis events in UFSAR Chapter 15 as postulated accidents or anticipated operational occurrences.

Duke Energy Response:

The Chapter 15 events were established in our original licensing basis. The consideration of HELBs outside containment were not treated as design basis events nor were they required to be by Giambusso/Schwencer (ref. ONDS-351, Revision 2). The PSW system is replacing the Station Auxiliary Service Water system that had been credited in the mitigation of HELBs inside the Turbine Building. Duke Energy has improved the capabilities and the protection with the design and operation of the PSW system.

RAI 159 [EPTB]

10 CFR 50.55a(f), "Inservice Testing (IST) Requirements," requires, in part, that ASME Class 1, 2, and 3 components must meet the requirements of the ASME OM Code and applicable addenda. The applicable ASME OM Code for Oconee is the 1995 Edition through 1996 Addenda. Section ISTB 1.1, "Scope," of the OM Code covers pumps that are required in shutting down a reactor to the cold shutdown condition, maintaining the cold shutdown condition, or mitigating the consequences of an accident. The PSW portable pump, on loss of CCW siphon flow, is used to refill the CCW pipe which is the suction source for the PSW booster pump. Therefore, the PSW portable pump may be required to maintain the reactor in a cold shutdown condition following postulated accidents and per Section ISTB 1.1 the PSW portable pump should be included in the IST program and tested in accordance with ASME OM Code requirements.

Surveillance Requirement (SR) 3.7.10.3 requires that PSW primary and booster pumps be tested in accordance with the IST program, and therefore is in compliance with ASME OM Code requirements. However, SR 3.7.10.9 only requires that the PSW portable pump be tested on a 24 months frequency. The licensee notes that the portable pump will not be tested in accordance with the IST program and the specified frequency is based on the PSW portable pump not being designated QA-1 (safety-related) equipment by the licensee. Also, the licensee stated that operating experience has shown it usually passes the SR when performed at the 24 month frequency. Based on the above discussion, the following information is requested for the review of the proposed technical specification 3.7.10, "PSW System":

a) If the PSW portable pump performs certain safety-related functions as addressed above, the licensee is requested to provide additional discussion or substantiation for why the PSW portable pump is not required to be a QA-1 (safety-related) grade and tested in accordance with IST program. If the PSW portable pump is not required to be a QA-1

grade and not required to perform any safety-related functions, the licensee needs to explain why the PSW portable pump is required to be tested by SR 3.7.10.9.

b) Is the PSW portable pump an ASME Code Class component? If not, why not.

c) Provide the methods, related historical data and operating experiences that are used to demonstrate the adequacy of the 24-month test frequency for the type of PSW portable pump being installed at Oconee.

Duke Energy Response:

a. The Portable Pump is not directly credited for PSW design-mitigating functions; therefore, it's testing is not required to be accomplished in accordance with the provisions of ASME Section XI and Oconee Nuclear Station's (ONS's) In-Service Test (IST) program. The purpose of the PSW portable pump is to replenish the lake water contained in the Unit 2 CCW embedded piping for extended PSW operation. Specifically, a portable pump is utilized via operator actions, to pump water directly from Lake Keowee to the Unit 2 CCW embedded piping. The PSW portable pump is similar to the SSF submersible pump in both design and function. Neither pump has an initial event mitigation function and thus is not designed as QA-1. Although the pump is not QA-1 and not safety related (see response to "b" below), Duke Energy chose to perform a periodic surveillance similar to that performed for the SSF submersible pump. This surveillance requires that adequate flow capability is verified on a two (2) year frequency.

b. The PSW portable pump is not an ASME Code Class component. The PSW portable pump is similar to the SSF submersible pump in both design and function. Neither pump has an initial event mitigation function and thus is not designed as QA-1.

   As a matter of precedence, the NRC acknowledged the non-QA-1 pedigree of the SSF submersible pump as described in the May 11, 1992, SSF Technical Specifications Safety Evaluation Report (SER) that stated, *"The SSF Portable Pumping System is designed to provide a backup supply of water to the SSF in the event of loss of CCW and subsequent loss of CCW siphon flow. The SSF portable pumping system is not safety grade and is installed manually according to Emergency procedures."*

c. Similar to the SSF submersible pump, the PSW portable pump will be tested once every 2 years as required by the proposed PSW TS. Pump performance test results are required to meet test acceptance criteria limits for the pump. Pump performance data is periodically reviewed and if a trend of pump degradation is identified, maintenance is performed, as needed, to restore pump performance. ONS plans to use the spare SSF submersible pump, HALE pump(s), or other applicable pump to fulfill the role of the PSW portable pump.

   A review of four (4) years of test data (years 2006-2010) for the current SSF submersible pump and the spare SSF submersible pump, demonstrates that acceptance criteria was met and that no degradation was shown during this monitoring period. Based upon this actual data, the 2-year testing frequency for these pumps is deemed adequate.

RAI 160 [EMCB15]

In response to RAI-62, the licensee included, in its letter dated January 20, 2012, IEEE 344-1975 as one of the industry standards that is being used for the PSW system design. Discuss

the seismic qualification method(s) used for electrical and mechanical equipment credited for the PSW system. Provide a summary of the seismic qualification results to demonstrate that all equipment credited for the PSW system including their subcomponents (relays, contacts, breakers etc.) are capable to perform their intended design function in the event of a safe shutdown earthquake (SSE) after a number of postulated occurrences of the operating basis earthquake (OBE). The response to this RAI, as a minimum, should include the test response spectra (if applicable), the required response spectra, the method of mounting of equipment to the shake table, and the equipment mounting configuration in service condition. Also, discuss the methodology, the industry codes and standards, the level of earthquake, and the acceptance criteria used for the structural design of the PSW equipment mounting.

Duke Energy Response:

To be provided by July 20, 2012.

RAI 161 [EMCB16]

Discuss the method of seismic qualification of DC batteries associated with the PSW system and the supporting battery rack structure(s). Describe the procedures used to account for possible amplification of vibratory motion through the battery rack structure.

Duke Energy Response:

DC Batteries and Battery Racks for the PSW system are located in two adjacent Battery Rooms in the PSW building. The method of Seismic Qualification of electrical equipment will be discussed generically within the Duke Energy Response to RAI-160 (planned for submittal by 7-20-2012). The requirements for procurement of the Batteries and Battery Racks were documented in OSS-0320.00-00-0023 "Specification for the Design, Fabrication and Testing of the QA-1, 125 VDC Batteries for the Protected Service Water (PSW) System", Rev 1 with Deviations 1 and 2. The equipment vendor C&D Technologies (C&D), performed the seismic qualification and supplied both a Test Plan and Final Report per Deviation 2 in C&D Report QR-2312237 "Seismic & Environmental Qualification Report of 125 Volt DC LCY-39 Batteries & 2-Step Battery Racks", Rev 4 which was filed as an Oconee vendor manual. The vendor manual number is OM 320.--0239.001 "PSW - Seismic & Environmental Qualification Report of 125VDC LCY-39 Batteries & 2-Step Battery Racks", Rev 4.

Qualification was by similarity to previous shake table testing in accordance with IEEE 344-1975. The previous shake table test, performed by Wyle Laboratories and documented in Report 43450-1, "Seismic Simulation Test Program on a Battery Rack and Batteries", dated December 7, 1976, is contained in Attachment 2 of QR-2312237. This test used a similar 2-Step Battery Rack and was fully loaded with naturally aged, artificially aged and un-aged batteries of various ratings. Any test anomalies were documented and justified within the body of the 43450-1 report. Any differences between the previously tested batteries and battery racks and PSW production Batteries and Battery Racks were justified fully within the QR-2312237 report.

The in-structure response spectra for the PSW Battery Room were specified in Deviation 1 of OSS-0320.00-00-0023 Rev 1. C&D performed a comparison of the Test Response Spectrum (TRS) from the previous test in 43450-1 against this Required Response Spectrum (RRS), after adjusting for both the 10% margin required by IEEE 323-1974, and to account for a weight difference between the tested and supplied Batteries and Battery Racks. The TRS vs. RRS for the Safety Shutdown Earthquake (SSE) is shown in Figure 161.1 and Figure 161.2 (Note: Figures 161.1 and 161.2 provided in the RAI #161 supplemental information section of

Attachment 1). The small excursion in Figure 161.2 where the TRS did not fully envelope the RRS is justified within QR-2312237 as being acceptable as the batteries and battery racks are not dynamically responsive at low frequency.

The testing consisted of five Operational Basis Earthquake (OBE) tests followed by an SSE test. The battery cells were connected in series to a resistive load and monitored during all phases of the test program. The battery output voltage and current were recorded on an oscillograph recorder to determine electrical continuity, current and voltage levels, and to detect any spurious operation during seismic testing. There are no moving contacts in the batteries or battery racks that would necessitate chatter monitoring. The test program was conducted in two separate specimen orientations at 0 and 90 degrees due the bi-axial independent motion seismic table with phase in-coherent vertical and horizontal inputs.

The batteries and battery racks were subjected to pre- and post-seismic functional testing as well as monitoring during the shake table testing. A summary of the results is listed in Section 5.7 of QR-2312237.

RAI 162 [EMCB17]

Discuss the methodology, the industry codes and standards, the level of earthquake, and the acceptance criteria used for the structural design of the battery rack structure and its anchorages.

Duke Energy Response:

To be provided by July 20, 2012.

Attachment 1

RAI Item Supplemental Information

1. RAI #110/#124 - PSW UFSAR 9.7 Mark-Up (2 pages)
2. RAI #112/116 - PSW TS Mark-Up (1 page)
3. RAI #114 - PSW TS Mark-Up (1 page)
4. RAI #121 - Calculation OSC-9370 Open Items List (1 page)
5. RAI #123 - Calculation OSC-9832 Open Items List (5 pages)
6. RAI #129 - Pages from Calculation OSC-9831 (R1) (8 pages)
7. RAI #133 - Ratings of PSW Equipment Summary Tables (6 pages)
8. RAI #149 - UFSAR 3.2 Marked-Up Page (1 page)
9. RAI #153 - Accident Analysis I Table/Figures (19 pages)
10. RAI #156 - Accident Analysis II Table/Figures (2 pages)
11. RAI #161 - Seismic Result Figures (2 pages)

RAI #110 and #124 (page 1 of 2):

tested every two years to verify flow capability. A recirculation flow path and instrumentation is available for testing of the PSW Booster and PSW Primary Pumps. Active motor operated valves are included in the ONS GL 89-10 monitoring program.

9.7.1.2.2 Electrical

The PSW electrical system is designed to provide power to PSW mechanical and electrical components as well as other system components needed to establish and maintain a safe shutdown condition. The system is designed with adequate capacity and capability to supply the necessary loads and is electrically independent from the station electrical distribution system. Additionally, the AC and DC power systems and equipment required for the PSW essential functions have been designed and installed consistent with the ONS QA program for ~~Class 1E~~QA-1 equipment.

A separate PSW electrical equipment structure (PSW building) is provided for major PSW electrical equipment. Normal power is provided from the Central Tie Switchyard via a 100 kV transmission line to a 100/13.8 kV substation located adjacent to Oconee Nuclear Station (ONS) and then via a 13.8 kV feeder that enters an underground ductbank leading to the Protected Service Water building. This power path from the Central Tie Switchyard to the PSW Switchgear is non QA-1. Alternate power is provided from the KHUs via a tornado protected underground path. These external power sources provide power to transformers, switchgear, breakers, load centers, batteries, and battery chargers located in the PSW electrical equipment structure (PSW building). Refer to Figures 9-45 and 9-46 for more information.

The power system provides backup power to the following:

- 125 VDC Vital I&C Normal Battery Chargers
- One HPI pump (either "A" or "B") per unit
- HPI valves needed to align the HPI pumps to the Borated Water Storage Tanks
- HPI valves and instruments that support RCP seal injection and RCS makeup
- PSW booster pump that provides flow to an HPI pump motor cooler
- Pressurizer Heaters
- RCS and Reactor Vessel Head high point vent valves
- Portable pump (if not self-powered)
- Standby Shutdown Facility (SSF)
- PSW electrical system, from either the KHU underground or 13.8 kV power path from the Central Tie Switchyard.

9.7.1.2.2.1 Electrical Separation Criteria

The PSW electrical power distribution system has only one train. However, the PSW Primary and Booster Pump circuits, and the associated valve circuits in the PSW system are separate to the SSW ASW pump and valve circuits with one exception. The PSW 4.16 kV switchgear has a circuit that can repower the SSF 4.16 kV switchgear in the event the SSF electrical system is not available. This circuit is normally electrically isolated from the SSF switchgear. Whenever the PSW 4.16 kV switchgear is providing power to the SSF, there will no longer be electrical separation between the PSW and SSF electrical systems.

RAI #110 and #124 (page 2 of 2):

a. SSF reactor coolant emergency makeup piping and components

b. SSF auxiliary service water piping and components

c. SSF cooling water piping for the diesel generator and HVAC

Duke is taking the position that all per... Turbine Building flood shall be QA-1

6. The Control Rod Drive System AC brea...

7. The power supplies and position indica...

8. The equipment installed for the automa... 1.

9. The 230 kV Degraded Grid Protection S...

10. The suction source for the Low Pressure ...

Add: "17. The Protected Service Water (PSW) System is QA-1 with limited exceptions, e.g., fire detection components, some HVAC equipment, building lighting, etc. (Note: Components that receive backup power from PSW or systems that connect to PSW retain their existing seismic and quality classifications)".

a. Emergency Condenser Circulating Water System first siphon which provides suction to the Low Pressure Service Water System following a LOOP event. This includes the pressure boundary of the Condenser Circulating Water pumps, pump discharge valves and piping from the intake up to and including the 42 inch crossover header

b. Essential Siphon Vacuum System

11. The instrument tubing on the systems that comprise the ECCS are to be reclassified as QA-1.

12. The pressure transmitters, logic circuitry, and power sources for the Automatic Feedwater Isolation System (AFIS) and components used to terminate EFW flow to a faulted steam generator are QA-1.

13. The maintenance and test procedures for certain 6.9 kV and 4 kV switchgear breakers are QA-1. Components that are used in future maintenance on these breakers that may impact the ability to shed non-safety loads are also QA-1.

14. The hydrogen recombiner interfacing piping systems shall be QA-1

15. No regulatory commitment exists for Duke to treat Oconee Class F piping as QA-1 solely on the basis of its Class F designation. However, Duke has always and expects to continue to treat Oconee Class F piping as QA-1 in the future. This explicit clarification is noted here, for it has been the cause of some confusion both within Duke and for the NRC.

16. The LPSW RB Waterhammer Prevention System

3.1.2 Criterion 2 - Performance Standards (Category A)

Those systems and components of reactor facilities which are essential to the prevention of accidents which could affect the public health and safety or to mitigation of their consequences shall be designed, fabricated and erected to performance standards that will enable the facility to withstand, without loss of the capability to protect the public, the additional forces that might be imposed by natural phenomena such as earthquakes, tornadoes, flooding conditions, winds, ice, and other local site effects. The design bases so established shall reflect: a) appropriate consideration of the most severe of these natural phenomena that have been recorded for the site and the surrounding area and b) an appropriate margin for withstanding forces greater than those recorded to reflect uncertainties about the historical data and their suitability as a basis for design.

Discussion

1. Essential Systems and Components

RAI #112 and #116 (page 1 of 1):

PSW System
3.7.10

ACTIONS (continued)

D. Required Action and associated Completion Time of Condition C not met. OR Required Action and associated Completion Time of Condition A or B not met for reasons other than Condition C.	D.1 Be in MODE 3. AND D.2 Be in MODE 4.	12 hours 84 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.10.1	Verify battery terminal voltage is greater than or equal to the minimum established float voltage.~~Verify required PSW battery terminal voltage is ≥ 125 VDC on float charge.~~	7 days
SR 3.7.10.2	Verify that the KHU underground path can be aligned to and power the PSW electrical system.	92 days
SR 3.7.10.3	-------------NOTE------------- Not applicable to the PSW portable pump. --------------------------------- Verify that the developed head of the PSW pumps at the flow test point is greater than or equal to the required developed head.	In accordance with the Inservice Testing Program
SR 3.7.10.4	Verify battery capacity of required battery is adequate to supply, and maintain in OPERABLE status, the required emergency loads for the design duty cycle when subjected to a battery service test.	24 months

(continued)

RAI #114 (page 1 of 1):

PSW Battery Parameters
3.7.10a

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
F. Required Action and associated Completion Time of Condition A, B, C, D, or E not met. <u>OR</u> One battery on one train with one or more battery cells float voltage < 2.07 V and float current > 2 amps.	F.1 Declare associated battery inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.10a.1	-----------------------NOTE----------------------- Not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.7.10.1. --- Verify battery float current is ≤ 2 amps.	7 days
SR 3.7.10a.2	Verify battery pilot cell voltage is ≥~~>~~ 2.07 V.	31 days
SR 3.7.10a.3	Verify battery connected cell electrolyte level is greater than or equal to minimum established design limits.	31 days

(continued)

RAI #121 (page 1 of 1):

OSC-9370, "U1/2/3 PSW AC Power System Voltage & Short Circuit Analyses," Open Items List

No.	OSC-9370 Section	Open Item
1	5.2	OSS-0254.00-00-1053 (R.0), Design Basis Specification for the Protected Service Water System [OPEN ITEM]
2	8.2	UFSAR criteria are not included in this revision [OPEN ITEM].
3	8.3	PSW requirements are defined in OSC-9832, Appendix S [OPEN ITEM].
4	Appendix A, 6.1	Voltage requirements for the Submersible Pump Motor are assumed to comply with NEMA MG-1 suggestions since at the time of this revision no specification has been written [OPEN ITEM].
5	Appendix A, 6.2	Attachment 4 contains preliminary information and is tracked as [OPEN ITEM].
6	Appendix A, 7.1	0PSWMR0002 / 4000V -10%, +15%(Steady State Voltage) -20%(Starting Voltage) OSS-0314.00-00-0013(Ref/Comment) [OPEN ITEM]
7	Appendix A, 7.1	0PSWMR0001 / 4000V -10%, +15%(Steady State Voltage) -20%(Starting Voltage) OSS-0314.00-00-0012 (Ref./Comment) [OPEN ITEM]
8	Appendix A, 7.1	Submersible Pump Motor / 575V ±10%(Steady State Voltage) -20%(Starting Voltage) NEMA MG-1 (Ref./Comment) [OPEN ITEM]
9	Appendix A, 7.1	3 Ton Condenser A/B / 575V ±10% (Steady state)-20%(Starting Voltage) NEMA MG-1 (Ref./Comment)[OPEN ITEM]
10	Appendix A, 7.3.1	Vital Chargers 575V ± 15% Steady State limits OSS-0245.00-00-2006 (Reference) [OPEN ITEM]
11	Appendix A, 7.3.1	PSW Chargers 600V +10% - 15% Steady State Limits OSS-0320.00-00-0024 (Reference0 [OPEN ITEM]
12	Appendix A, 7.4	B6T / B7T 4.16 (Nominal Voltage) N/A % (Under Voltage) 114.4 % (4.76KV - Overvoltage) OPEN ITEM
13	Appendix A, 7.4	PSWLOLP1, 1/2/3KPSW 0.208/0.120 (Nominal Voltage KV) 90% (Under Voltage) 105% (218.4V- Over Voltage) OPEN ITEM
14	Appendix C, 6.1	It is assumed that Radwaste load center, RW2, is capable of supplying 92.9% of 600V when it feeds XPSW. Tracked as [OPEN ITEM].

RAI #123 (page 1 of 5):

OSC-9382 "U1/2/3, PSW AC Power System - ETAP Model Base File," Open Items and Assumptions List

No.	OSC-9832 Section	Open Items and Assumptions
1	Appendix B, 4.1	The assumption regarding Transformer Impedance and X/R Ratio listed as 'Open Item # 2' in Open Item List Tabulation of OSC-9832 R0
2	Appendix C, 4.1	Where Vendor documents do not contain 'Zero Sequence Impedance' and 'X/R Ratio' values, these values are assumed to be equal to their 'Positive sequence' counterparts.
3	Appendix C, 4.2	The assumption regarding Transformer Impedance and X/R Ratio listed as 'Open Item # 4' in Open Item List Tabulation of OSC-9832 R0
4	Appendix C, 4.3	The 10MVA, 5MVA, 45kVA and 15kVA transformers Data Assumptions are listed as 'Open Item 5' in the Open Item List Tabulation of OSC-9832 R0.
5	Appendix D, 4.1	The Assumptions for the Parameters of Buses in section 5 is listed as 'Open Item 6' in the open Item List Tabulation of OSC-9832 R0
6	Appendix D, 4.2	The continuous rating of the buses if not identified on site documents or vendor documents are Assumed equal to the rating of the incoming breaker.
7	Appendix D, 4.3	The minimum bus bracing of the switchgear. If not identified by the correct terminology (Symmetrical vs. Asymmetrical) on reference documents, is Assumed to be equal to the following: 1) Metal Enclosed Low voltage Switchgear - The short circuit interrupt rating of the smaller frame size breaker used in the assembly or 2) Metal Enclosed Switchgear the momentary (close & latch) rating of the breaker with the lowest momentary rating in the assembly.
8	Appendix F, 4.1	Cable Length estimates from the "Master Cable Database" are assumed with conservative approach of a 10% global tolerance and also listed as listed as 'Open Item 7' in the Open Item List Tabulation of OSC-9832 R0.
9	Appendix F, 4.2	The data Assumed per assumption 4.4 OSC-7608 (Plant ETAP Calculation)
10	Appendix F, 4.3	It is assumed that the previously used and referenced Okonite Bulletin 721.1 be used interchangeably with Okonite Bulletin EHB-98 "Engineering Data for Copper and Aluminum Conductor Electrical Cables", which contains the same data. (Ref. P5-10 of calculation attachment 6).

RAI #123 (page 2 of 5):

No.	OSC-9832 Section	Open Items and Assumptions
11	Appendix F, 4.4	For 2KV, 5KV and 15KV cables that are being run in the underground duct bank, certain parameters are needed in order for NEC accepted Neher-McGrath method to successful compute. These physical parameters, such as jacket thickness and complete outside diameter, have been taken (as explained in section 4.3) from Okonite product data sheets if the information is not available from the Oconee cable Database. The parameters shown in sections Appendix F, section 5.5-5.7 reference where data is obtained. This Item is listed as "open Item # 8" in the open Item List Tabulation.
12	Appendix F, 4.5	100KV Fant-Line, T/L, 100-13.8KV substation and 13.KV O/H Distribution Line 'system Impedance data' are assumed as unverified and is listed as 'Open Item # 9' in Open Item List Tabulation of OSC-9832 R0
13	Appendix F, 4.6	It is Assumed that the shield type /thickness from the 750 MCM cables (defined and referenced in Appendix F, section 5.7) is also applicable to the 8KV, (5KV @133%) cables of Appendix F, Section 5.6. The e-mail in attachment 6, P.41 identifies the requirement of this information for ALL medium voltage cables for the ampacity analysis.
14	Appendix G, 4.1	If it is not specified, breakers' ratings are assumed on a symmetrical basis and ANSI standard.
15	Appendix G, 4.2	Since PSW breakers are qualified to IEEE C37.010-1999 they have a voltage range factor (K factor) of 1.0. This implies that the interrupting rating and the maximum interrupting (based on constant KVA and different voltage) be the same. In cases where the interrupting and maximum interrupting rating both are not specified, then there are assumed that they are equal.
16	Appendix G, 4.3	Breakers parameters are assumed until there is an available Duke Energy design reference. This Data Assumption is listed as 'Open Item 11' in the Open Item List Tabulation of OSC-9832 R0.
17	Appendix H, 4.1	Breakers parameters are assumed until there is an available Duke Energy design reference. This Data Assumption is listed as 'Open Item 13' in the Open Item List Tabulation of OSC-9832 R0.
18	Appendix H, 4.2	Breakers are provided a model type name by manufacturer on vendor drawings. The name may not exactly match the ETAP Library for many different reasons. Typically the discrepancy is in a number that the prefixes or suffixes the model type. This assumption to be satisfactory if the method described in section 3 of Appendix H is implemented.

RAI #123 (page 3 of 5):

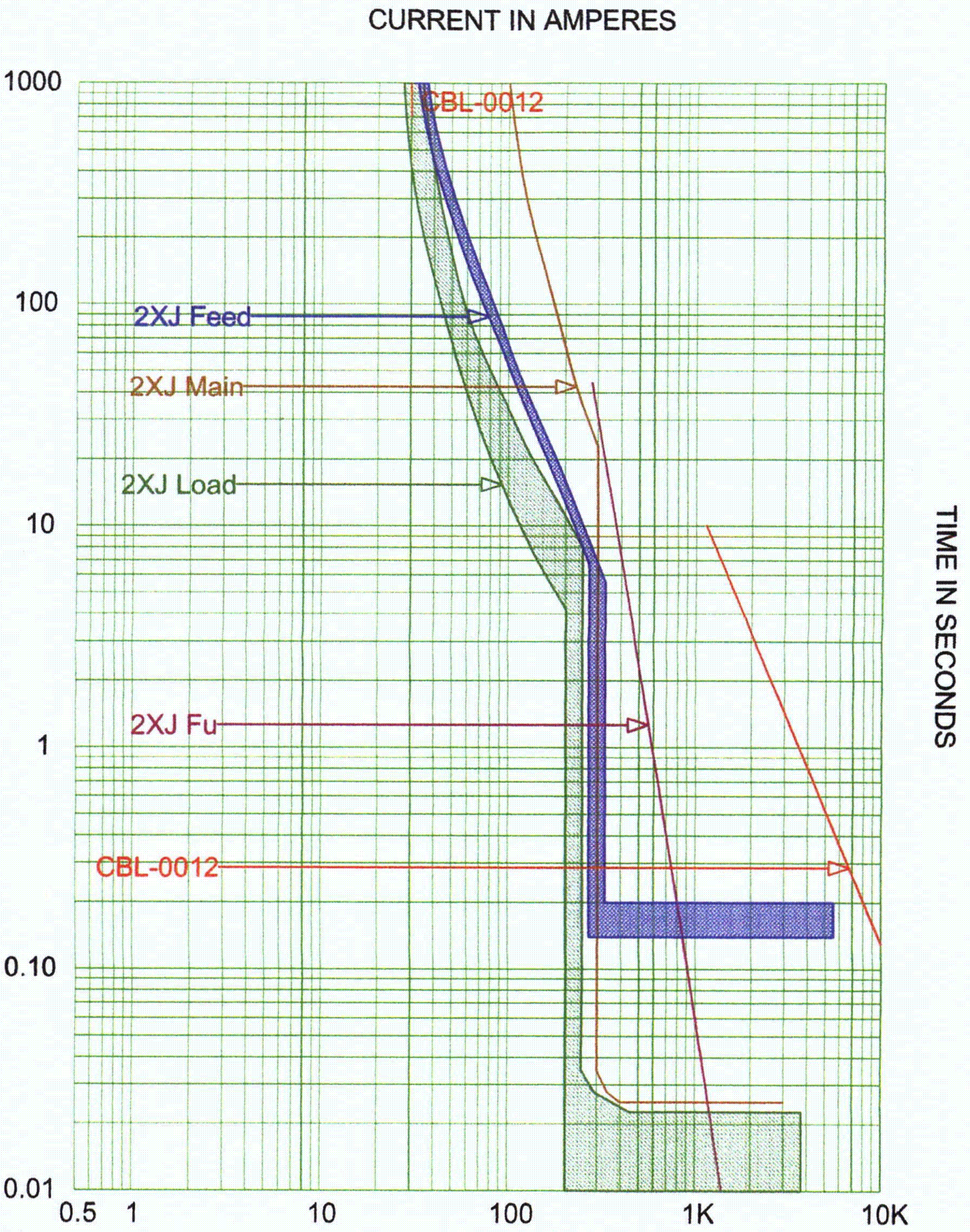
No.	OSC-9832 Section	Open Items and Assumptions
19	Appendix I, 4.1	The ETAP program uses two of the parameters (1) %PF @ 100% Load, (2) FLA, and (3) % EFF @ 100% Load, in order to calculate the third. See OSC-7608 Appendix I, Assumption 4.1
20	Appendix I, 4.2	Different values for a motor parameter are sometimes found within the various site documents. Generally there are test reports, vendor data sheets and calculations which hold the same potential information. See OSC-7608, Appendix I assumption 4.2 regarding the priority of such data.
21	Appendix I, 4.3	Where motor data sheets do not specify the NEMA design letter or no specific letter is applicable, 'B' is assumed / inputted. See OSC-7608, Assumption 4.5).
22	Appendix I, 4.4	Regarding the SSF ASW Motor and the Unit 1/2/3 HPI A/B motors it is assumed that if they are rewound the parameters have not significantly changed. See OSC-7608, Appendix I, Assumption 4.9
23	Appendix I, 4.5	Data on the PSW Booster Pump Motor is at a preliminary level. Data should be updated when test data (vendor or site) becomes available. The 'Motor Model' and 'CKT Model' are required to run Motor Starting Analyses so the CW-1 motor was temporarily selected from the existing library.
24	Appendix I, 4.6	The assumption regarding "Motor Performance Data" is listed as Open Item # 14 in Open Item List Tabulation of OSC-9832 R0.
25	Appendix J, 4.1	See OSC-7608, appendix J, section 4.2, 4.3, 4.5, 4.6, 4.7 and 4.8
26	Appendix J, 4.2	The 'Typical motor models developed in OSC-7608, Appendix J, Section 5.5, are assumed sufficient for the analyses the OSC-9370 performed and need not be updated when the actual vendor information is available. However voltage and HP ratings have yet to be confirmed and being tracked as an [OPEN ITEM]. This Item is listed as "Open Item # 21" in the Open Item List Tabulation.
27	Appendix J, 4.3	Voltage rating on 3 Ton compressor vendor data sheet (attachment 10, page 15) is assumed to be 600V versus 480V. Other motor parameters are assumed to change based on the 600V correction.
28	Appendix K, 4.1	The assumption regarding the Motors' Parameters is listed as Item # 25 in the Open List Tabulation of OSC-9831 R0.

RAI #123 (page 4 of 5):

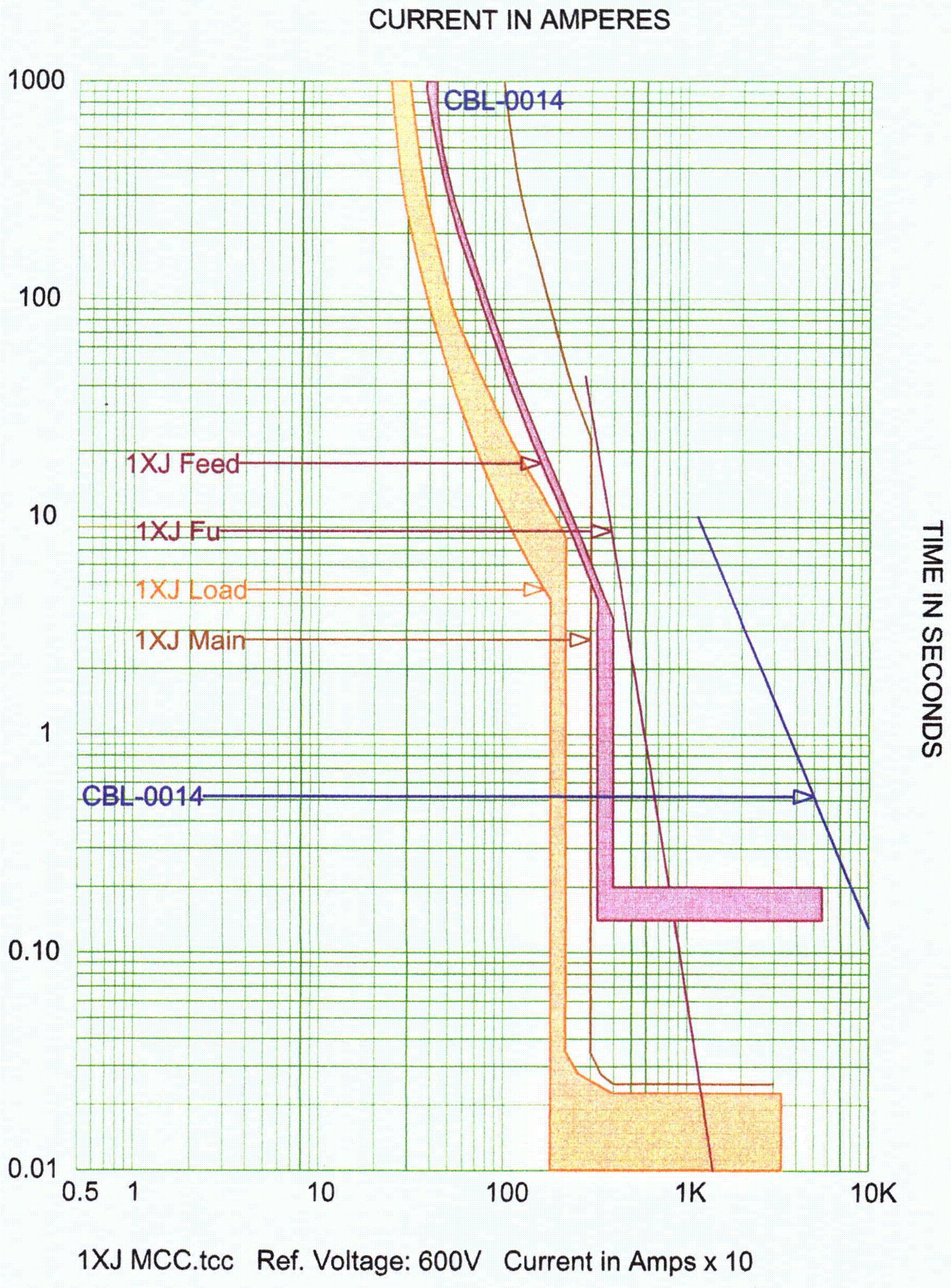
No.	OSC-9832 Section	Open Items and Assumptions
29	Appendix L, 4.1	OSC-7608, Appendix L assumption 4.1 is applicable.
30	Appendix L, 4.2	OSC-7608, Appendix L assumption 4.2 is applicable. Additionally, the following related information is also assumed: 1) Non-heater loads are modeled as lumped loads in this appendix and have an 85% (per non-heater loads in OSC-7608). Lumped loads are left at the ETAP default 80% motor/20% static which is assumed accurate with the system/ loads that they represent. 2) The static loads are assumed to have a % pf of 100%.
31	Appendix L, 4.3	The assumption regarding modeling of Lumped Loads of PSW non-heater loads (PSW HVAC) is listed as Item # 26 in the Open List Tabulation of OSC-9832 R0.
32	Appendix L, 4.4	SSF House Load MCC XSF' is provided as 38% of nominal load factor (at 4160V nominal OTS1) during lightly loaded scenarios per SSF field readings included as part of attachment 12. Lightly loaded scenarios are defined in Appendix S.
33 34 35	Appendix M, 4.1 Appendix M, 4.2 Appendix Q, 4.1	Attachment 3 contains an email that provides impedance values that are used in the modeling of the 'Fant Line' power grid. Since it is an email, this information is only assumed to be correct. Negative sequence %R and %X are assumed equal to the positive sequence %R and %X, as this information was not provided in reference 2.2. Assumptions relative to battery charger input parameters required by ETAP are noted within the table of battery charger input parameters. See assumption 4.1 of OSC-7608, appendix Q.
36 37	Appendix S, 4.1 Appendix S, 4.2	The assumption regarding 'PSW Electrical Power System Design & Analysis Requirement (used in the methodology and also, per Attachment 19) provides the preliminary OMP interpretation of PSW System required Design Basis. This assumption need to be verified once the PSW DBD is finalized. This item is listed as Item # 28 in the Open List Tabulation of OSC-9832 R0. Lightly loaded configurations are assumed based on a selection of loads expected to be operating at all times. Connections of the lightly loaded scenario are as shown in Table S1 (configurations 2, 4, 9 and 12): PSW House Loads are assumed to consist of battery chargers, safety related HVAC, and the power panel. The SSF House Loads consist of a single lumped load modeled per Appendix L.

RAI #123 (page 5 of 5):

No.	OSC-9832 Section	Open Items and Assumptions
38	Appendix S, 4.3	The assumption regarding the Portable Generator (requirement 12, Section 5.2) is Listed as open item # 29 in the Open List Item Tabulation of OSC-9831 R0.
39	Appendix T, 4.1	The assumption for the short-circuit and X/R of the Radwaste system (600V RW2 Switchgear supply) is listed as open Item # 31 in the Open List tabulation of OSC-9831 R0
40	Appendix U, 4.1	The assumption of switch parameters is listed as open item 32 in the Open Item List Tabulation of OSC-9831 R0.
41	Appendix V, 4.1	The information contained in OSC-7729 for RHO, ambient soil temperature and soil type for duct analysis is assumed accurate for this application as well. The ambient soil temperature is pushed up to 25 degrees C from 20 degrees C for conservative measures.
42	Appendix W, 4.1	The XPSW breakers and fuses together make an assumed interrupt rating of49kA per attachment 23.
43	Appendix X, 4.1	The assumption for the 208/120V Loads' values is listed as Open Item #33 in the Open item List of OSC-9832 R0.
44	Appendix X, 4.2	4.2 References 2.5 and 2.6 cover the design inputs calculations that are not complete. Preliminary data within the calculations support that 400W as a load size for U1/2/3 Vent Valves A/B/C is conservatively large. 400W is used in ETAP.



2XJ MCC.tcc Ref. Voltage: 600V Current in Amps x 10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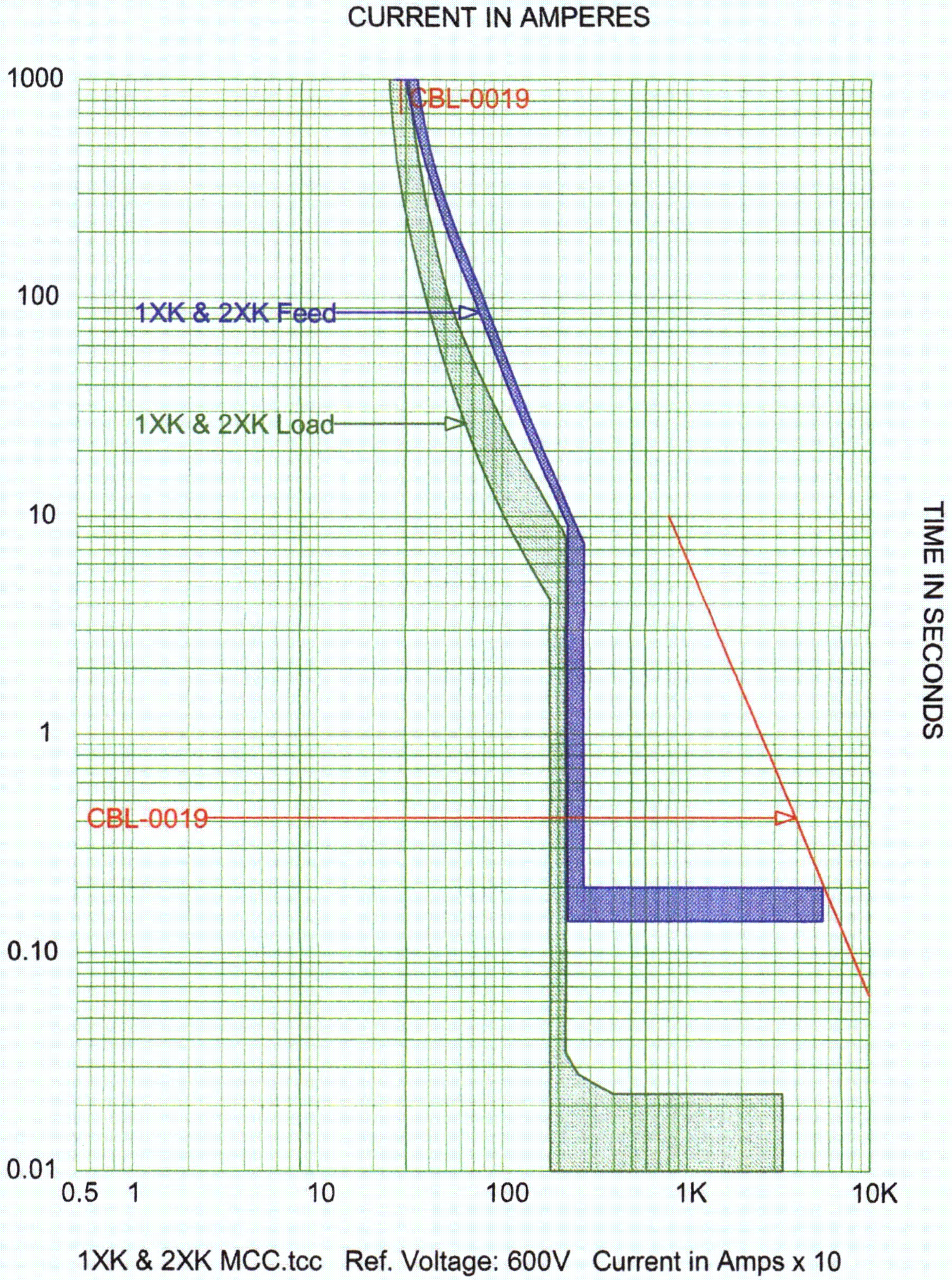
10
1
0.10
0.01
0.5
1
10
100
1K
10K
TIME IN SECONDS
CBL-0014
1XJ Feed
1XJ Fu
1XJ Load
1XJ Main
CBL-0014
1XJ MCC.tcc Ref. Voltage: 600V Current in Amps x 10


CURRENT IN AMPERES
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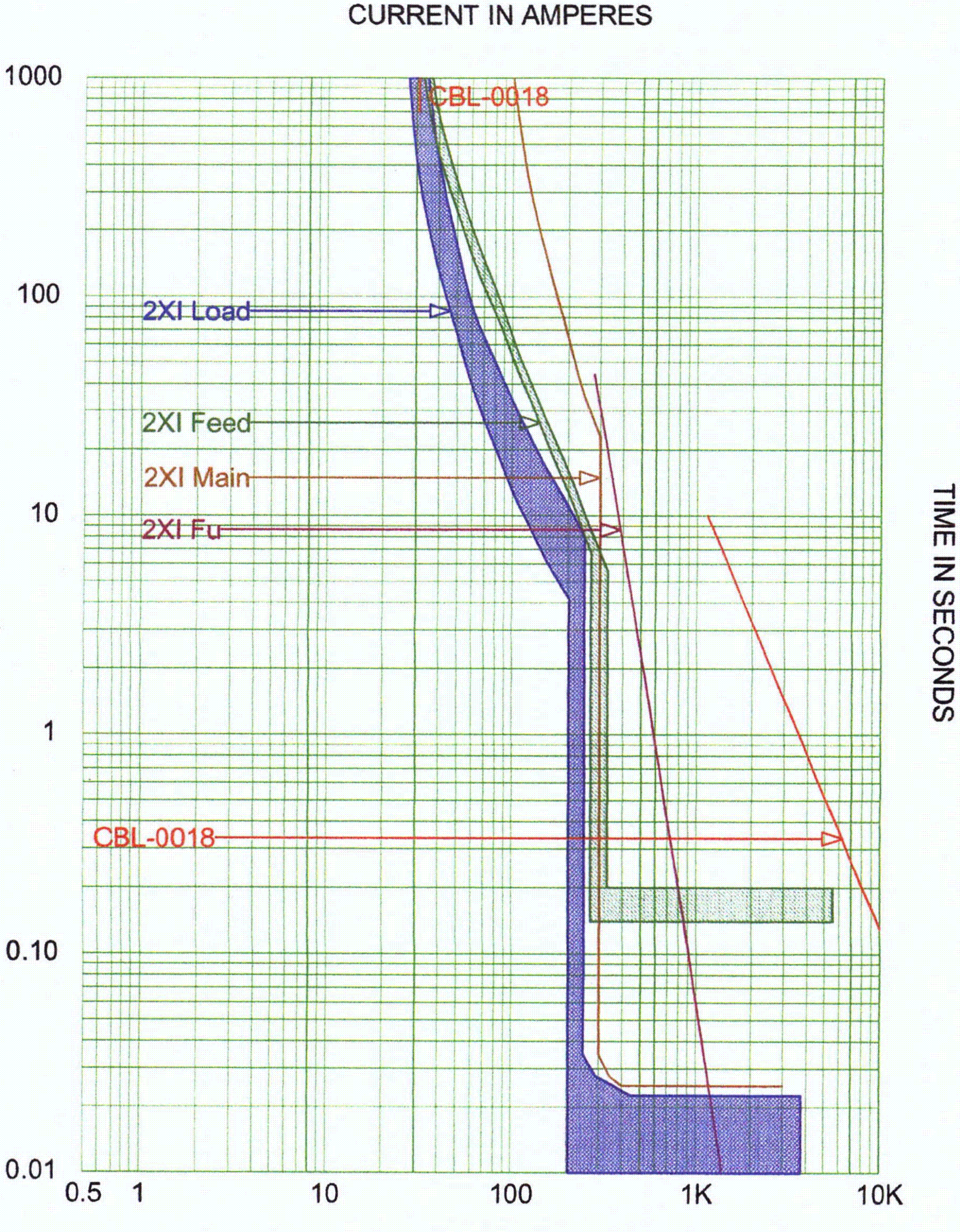
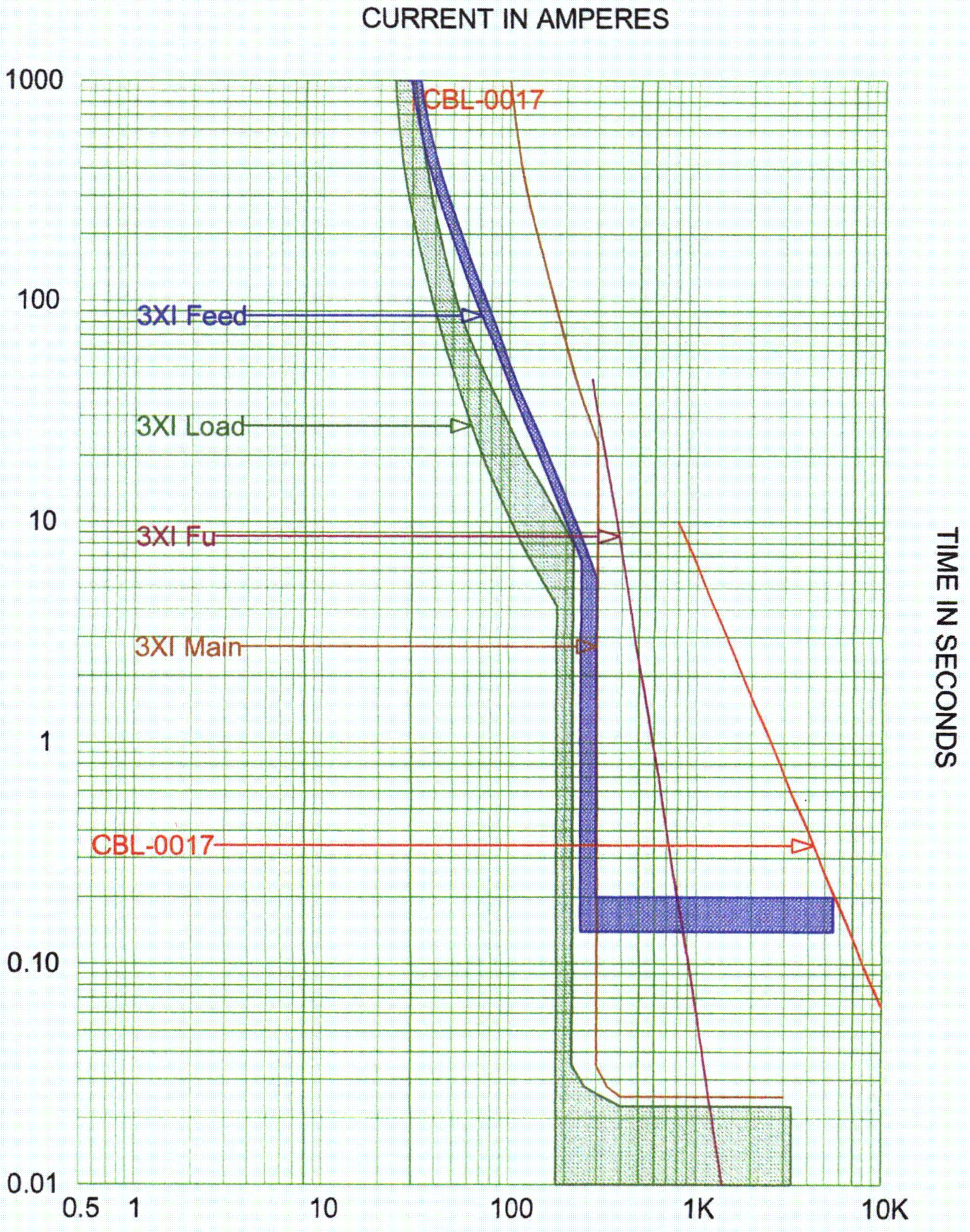
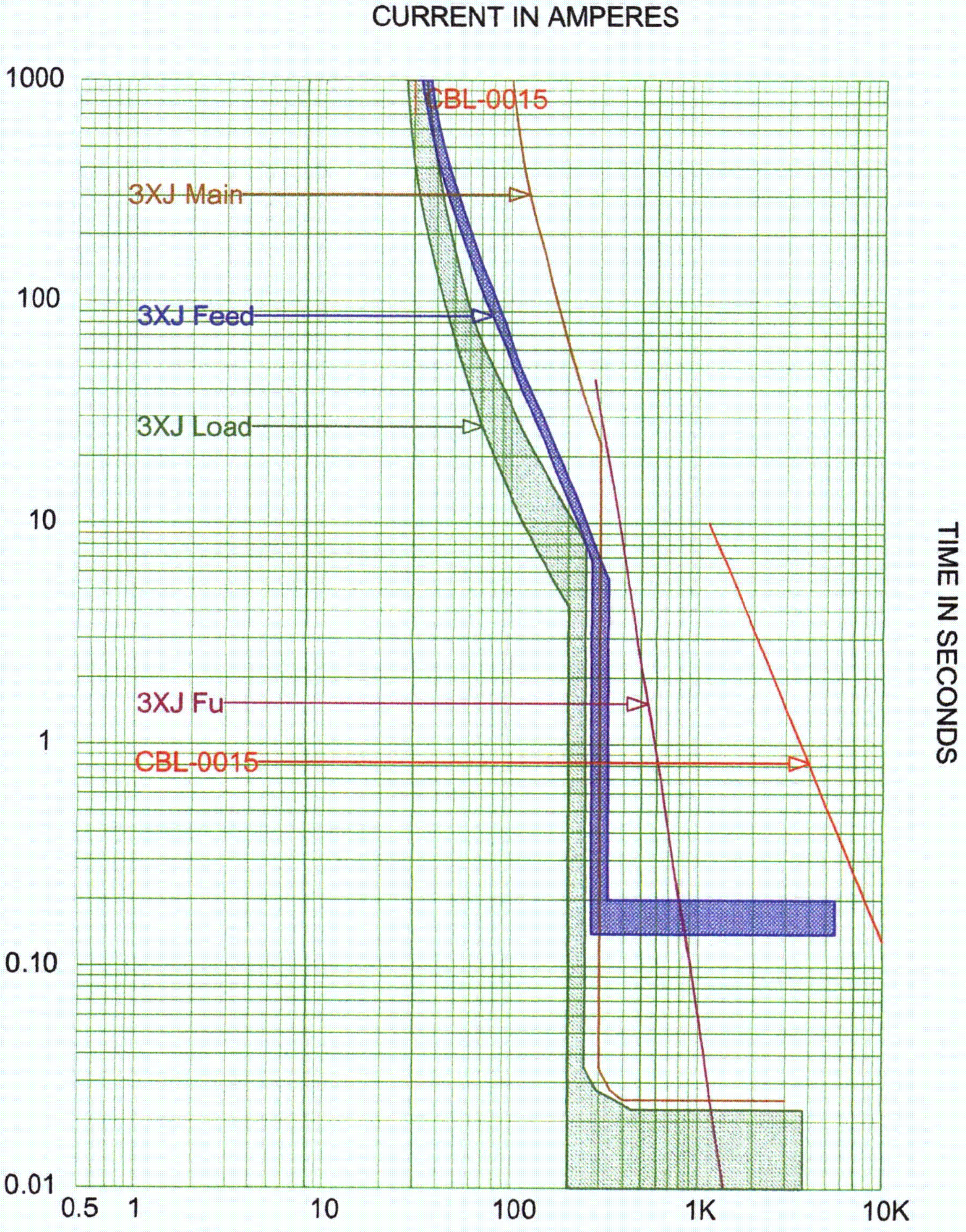
100
10
1
0.10
0.01
CBL-0019
1XK & 2XK Feed
1XK & 2XK Load
CBL-0019
TIME IN SECONDS
0.5
1
10
100
1K
10K
1XK & 2XK MCC.tcc Ref. Voltage: 600V Current in Amps x 10



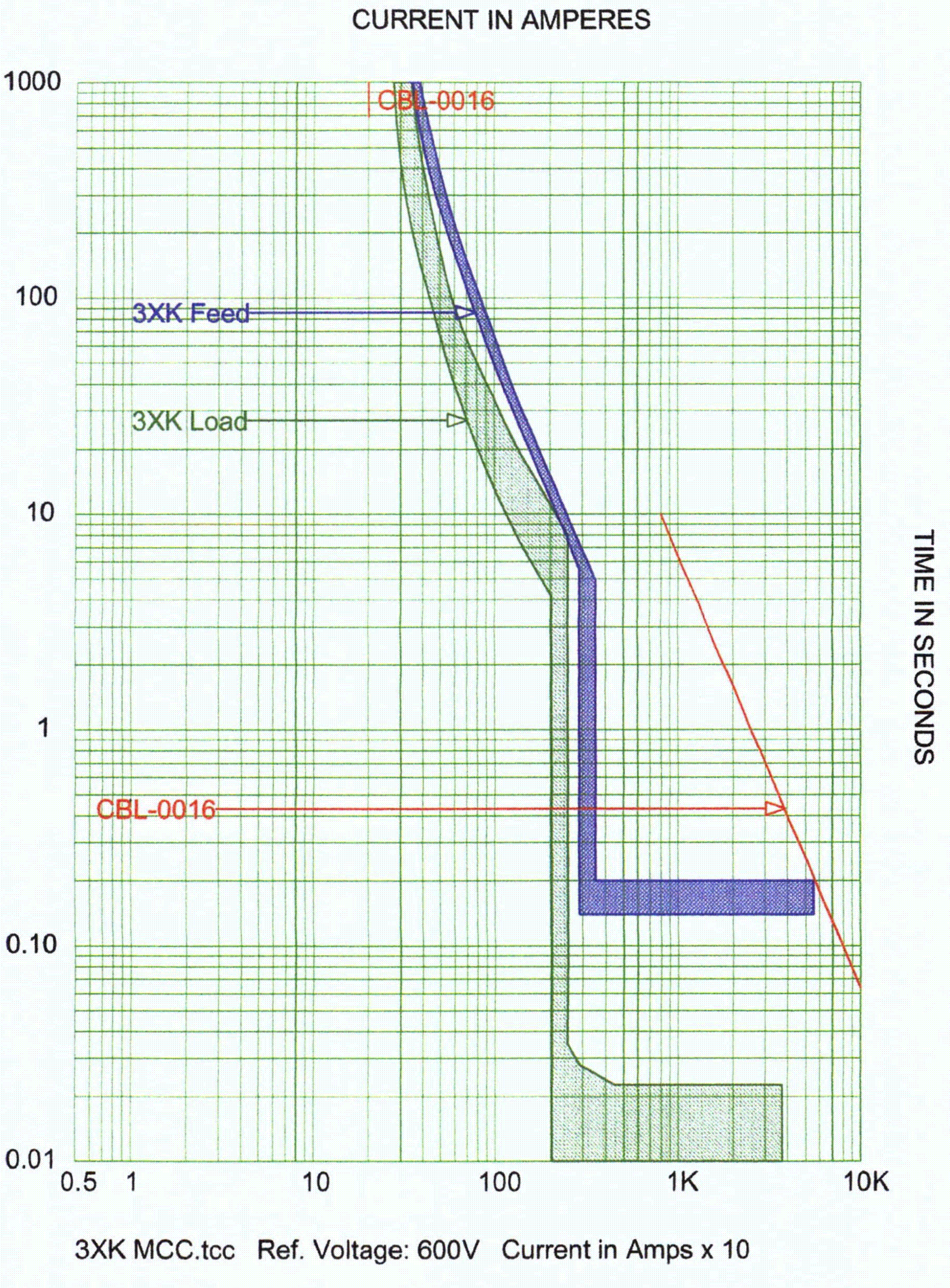
2XI MCC.tcc Ref. Voltage: 600V Current in Amps x 10



3XI MCC.tcc Ref. Voltage: 600V Current in Amps x 10



3XJ MCC.tcc Ref. Voltage: 600V Current in Amps x 10


CURRENT IN AMPERES
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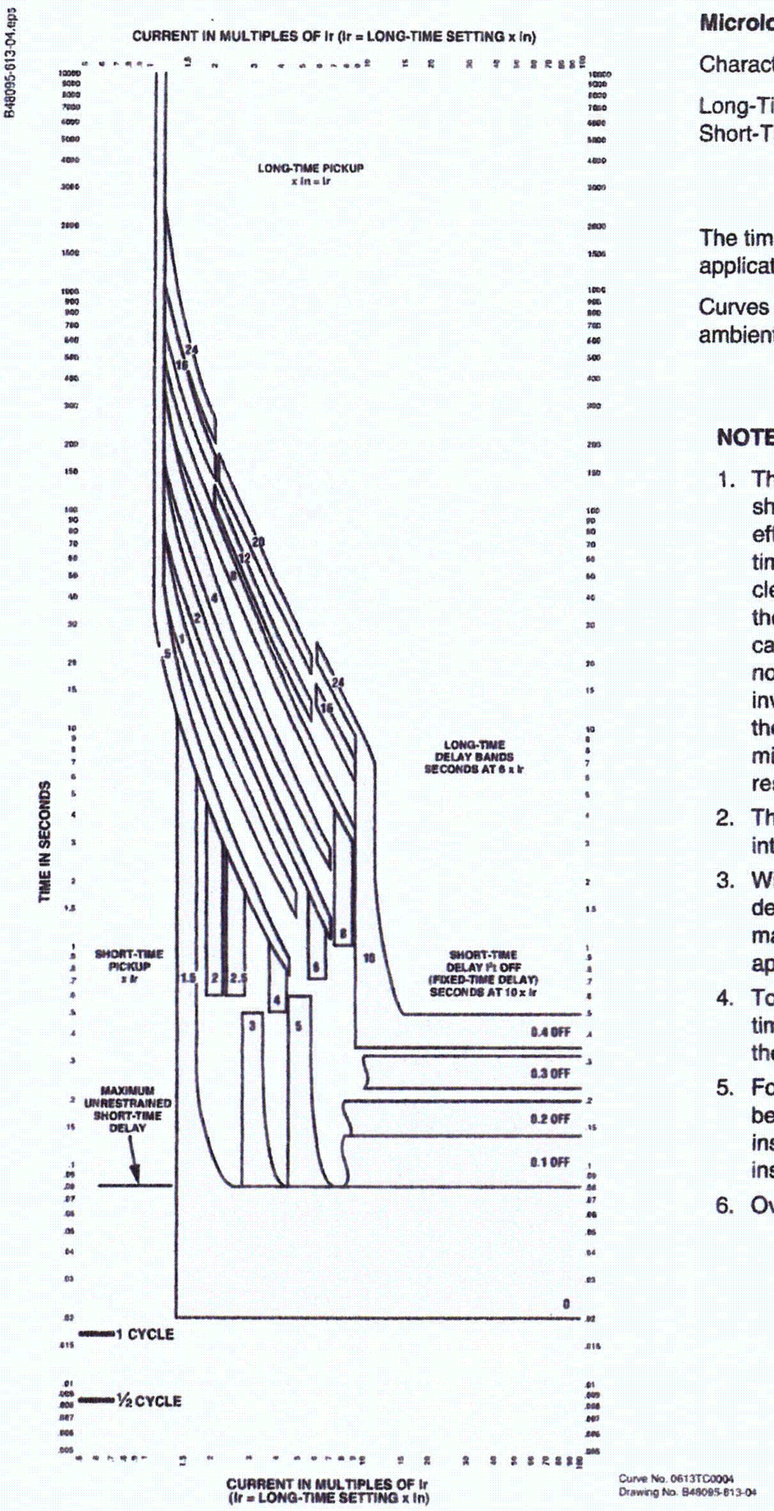
100
10
1
0.10
0.01
0.5
1
10
100
1K
10K
TIME IN SECONDS
CBL-0016
3XK Feed
3XK Load
CBL-0016
3XK MCC.tcc Ref. Voltage: 600V Current in Amps x 10

Micrologic 5.0/6.0 A/P/H Trip Unit

Figure 166: Micrologic 5.0/6.0 A/P/H Trip Units: Long-Time Pickup and Delay, Short-Time Pickup, and I^2t OFF Delay



Micrologic 5.0/6.0 A/P/H Trip Units

Characteristic Trip Curve No. 613-4

Long-Time Pickup and Delay
Short-Time Pickup and I^2t OFF Delay

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C (-22°F to +140°F) ambient temperature.

NOTE:

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately twenty minutes is required between overloads to completely reset thermal-imaging.
2. The end of the curve is determined by the interrupting rating of the circuit breaker.
3. With zone-selective interlocking ON, short-time delay utilized, and no restraining signal, the maximum unrestrained short-time delay time band applies regardless of the setting.
4. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current.
5. For a withstand circuit breaker, instantaneous can be turned OFF. See trip curve 613-7 for instantaneous trip curve. See trip curve 613-10 for instantaneous override values.
6. Overload indicator illuminates at 100%.

RAI #133

Prepared By: [signature] Date: 6/28/12
Reviewed By: [signature] Date: 6/28/12
Engineering Concurrence: [signature] Date: 6/29/12

Response Table for RAI #133:
The following includes Undervoltage, Overvoltage, Short Circuit, Cable Ampacity (as applicable) and the corresponding ratings of PSW equipment. The basis is OSC-9370 and OSC-9832, Revision 0.

Equipment	Rating/Required	Reference	Worst-Case Analyzed Value	Reference
MOTORS [Undervoltage, Overvoltage]				
0PSWMR0001 (Booster)	4kV	OSC-9370, Appendix A, Table A1		
Starting	80%		101.470%	OSC-9370, Appendix C, Table C1
Undervoltage	90%		102.919%	
Overvoltage	115%		109.621%	OSC-9370, Appendix D, Table D1
0PSWMR0002 (Primary)	4kV	OSC-9370, Appendix A, Table A1		
Starting	80%		88.100%	OSC-9370, Appendix C, Table C1
Undervoltage	90%		102.741%	
Overvoltage	115%		Note 1	OSC-9370, Appendix D, Table D1
SSF ASW	4kV	OSC-9370, Appendix A, Table A1		
Starting	80%		87.136%	OSC-9370, Appendix C, Table C1
Undervoltage	90%		102.888%	
Overvoltage	110%		109.037%	OSC-9370, Appendix D, Table D1
HPI 1A/1B, 2A/B, 3A/B	4kV	OSC-9370, Appendix A, Table A1		
Starting	80%		92.953%	OSC-9370, Appendix C, Table C1
Undervoltage	90%		102.586%	
Overvoltage	110%		Note 2	OSC-9370, Appendix D, Table D1
Submersible Pump Motor	575V	OSC-9370, Appendix A, Table A1		
Starting	80%		Note 3	OSC-9370, Appendix C, Table C1
Undervoltage	90%		101.034%	
Overvoltage	110%		Note 4	OSC-9370, Appendix D, Table D1
20 Ton Condensor	575V	OSC-9370, Appendix A, Table A1		
Starting	80%		85.137%	OSC-9370, Appendix C, Table C1
Undervoltage	90%		93.790%	
Overvoltage	110%		Note 4	OSC-9370, Appendix D, Table D1

RAI #133

Equipment	Rating/Required	Reference	Worst-Case Analyzed Value	Reference
3 Ton Condensor	575V	OSC-9370, Appendix A, Table A1		
Starting	80%		Note 3	OSC-9370, Appendix C, Table C1
Undervoltage	90%		93.816%	
Overvoltage	110%		Note 4	OSC-9370, Appendix D, Table D1
PSW Exhaust Fan Motor	575V	OSC-9832, Appendix J, 5.2.		
Starting	Note 5		-	
Undervoltage	Note 5		99.794%	OSC-9370, Appendix C, Pg. C30
Overvoltage	Note 5		Note 4	

Note 1 - *Primary and Booster motors have same power source. There is a larger load on the Primary motor and the cable lengths are of negligible difference, providing a greater voltage drop on the Primary motor. Overvoltage at the Booster bounds the Primary.*

Note 2 - Not analyzed for overvoltage. Defined configurations for PSW to feed HPI are not lightly loaded scenarios and therefore are not conservative for an overvoltage analysis.

Note 3 - Starting voltage is bound by the voltage available at the 20 Ton Condensor. Loads are powered from XPSW (have same starting voltage) and the 20 Ton Condensor has a larger load (larger voltage drop).

Note 4 - Values for overvoltage can be considered less than the overvoltage results produced on XSPW since these are loads on XPSW. XPSW also has an acceptance criteria of 110%.

Note 5 - PSW Exhaust *Fan Motor type/specifics not known at time of revision 0. Assumed ratings, see* OSC-9832, *App. J, 5.2. Preliminary documentation of* OSC-9832 and OSC-9370, Revision 1 shows *Starting* (75%) and Running (90% to 110%) voltages to be acceptable.

Equipment	Rating/Required	Reference	Worst-Case Analyzed Value	Reference
BUSES (Undervoltage, Overvoltage, Short Circuit)				
Keowee Switchgear (KPF Bkrs)	13.8kV			
SCCR	63kA (interrupt)	OSC-9370, Appendix F, Table F1	54.295kA (sym RMS)	OSC-9370, Appendix F, Table F1
B6T / B7T	13.8kV			
Undervoltage	Note 1		Note 1	
Overvoltage	108.7% (15kV)	OSC-9370, Appendix A, Table A4	105.553%	OSC-9370, Appendix D, Table D1
SCCR	77kA	OSC-9370, Appendix F, Table F1	29.22kA	OSC-9370, Appendix F, Table F1
B6T / B7T	4.16kV			
Undervoltage	Note 1		Note 1	
Overvoltage	114.4% (4.76kV)	OSC-9370, Appendix A, Table A4	105.442%	OSC-9370, Appendix D, Table D1
SCCR	78kA	OSC-9370, Appendix F, Table F1	34.133kA	OSC-9370, Appendix F, Table F1
OTS1	4.16kV			
Undervoltage	99%	OSC-9370, Appendix A, Table A4	99% (Note 2)	OSC-9370, Appendix C, Table C1
Overvoltage	105%	OSC-9370, Appendix A, Table A4	104.986%	OSC-9370, Appendix D, Table D1
SCCR	80kA	OSC-9370, Appendix F, Table F1	26.986kA	OSC-9370, Appendix F, Table F1

Equipment	Rating/Required	Reference	Worst-Case Analyzed Value	Reference
PSW Load Center PX13	600V			
Undervoltage	Note 1		Note 1	
Overvoltage	105.83% (635V)	OSC-9370, Appendix A, Table A4	105.159%	OSC-9370, Appendix D, Table D1
SCCR	100kA	OSC-9370, Appendix F, Table F1	80.170kA	OSC-9370, Appendix F, Table F1
XPSW	600V			
Undervoltage	90% (Note 3)	OSC-9370, Appendix A, Table A4	97.001%	OSC-9370, Appendix C, Table C1
Overvoltage	105%	OSC-9370, Appendix A, Table A4	104.976%	OSC-9370, Appendix D, Table D1
SCCR	65kA	OSC-9370, Appendix F, Table F1	53.50kA	OSC-9370, Appendix F, Table F1
1/2/3XPSW	600V			
Undervoltage	90% (Note 3)	OSC-9370, Appendix A, Table A4	95.058%	OSC-9370, Appendix C, Table C1
Overvoltage	105%	OSC-9370, Appendix A, Table A4	104.993%	OSC-9370, Appendix D, Table D1
SCCR	65kA	OSC-9370, Appendix F, Table F1	13.163kA	OSC-9370, Appendix F, Table F1
MCC 1XI	600V	OSC-9370, Appendix A, Table A2		
Undervoltage	86.7% (Note 3)		95.737%	OSC-9370, Appendix C, Table C1
MCC 1XK	600V	OSC-9370, Appendix A, Table A2		
Undervoltage	86.7% (Note 3)		95.718%	OSC-9370, Appendix C, Table C1
MCC 2XH	600V	OSC-9370, Appendix A, Table A2		
Undervoltage	79% (Note 3)		96.320%	OSC-9370, Appendix C, Table C1
MCC 2XI	600V	OSC-9370, Appendix A, Table A2		
Undervoltage	79% (Note 3)		96.382%	OSC-9370, Appendix C, Table C1
MCC 2XK	600V	OSC-9370, Appendix A, Table A2		
Undervoltage	79% (Note 3)		95.937%	OSC-9370, Appendix C, Table C1
MCC 3XH	600V	OSC-9370, Appendix A, Table A2		
Undervoltage	83.2% (Note 3)		96.268%	OSC-9370, Appendix C, Table C1
MCC 3XI	600V	OSC-9370, Appendix A, Table A2		
Undervoltage	83.2% (Note 3)		96.191%	OSC-9370, Appendix C, Table C1
MCC 3XK	600V	OSC-9370, Appendix A, Table A2		
Undervoltage	83.2% (Note 3)		96.143%	OSC-9370, Appendix C, Table C1

RAI #133

Equipment	Rating/Required	Reference	Worst-Case Analyzed Value	Reference
PSW Power Panel	208/120V			
Undervoltage	90%	OSC-9370, Appendix A, Table A4	94.526%	OSC-9370, Appendix C, Table C1
Overvoltage	105%	OSC-9370, Appendix A, Table A4	103.504%	OSC-9370, Appendix D, Table D1
SCCR	10kA	OSC-9370, Appendix F, Table F1	3.009kA	OSC-9370, Appendix F, Table F1
1/2/3KPSW	208/120V			
Undervoltage	90%	OSC-9370, Appendix A, Table A4	92.995%	OSC-9370, Appendix C, Table C1
Overvoltage	105%	OSC-9370, Appendix A, Table A4	104.543%	OSC-9370, Appendix D, Table D1
SCCR	10kA	OSC-9370, Appendix F, Table F1	1.513kA	OSC-9370, Appendix F, Table F1

Note 1 - Switchgear / Load Center is not analyzed for low voltage because bounding low voltages are determined on the load level.

Note 2 - Voltage is regulated upstream to provide 99% on OTS1. See OSC-9370, Attachment 1

Note 3 - XPSW and 1/2/3XPSW need 90% voltage per Attachment 4 of OSC-9370, Rev.0. Plant MCCs (XH, XI and XK) must maintain the voltage as shown per the references provided.

Equipment	Rating/Required	Reference	Worst-Case Analyzed Value	Reference
SYSTEM COMPONENTS [Undervoltage, Overvoltage, Short Circuit]				
Charger 1CA/1CB, 2CA/2CB, 3CA/3CB	575V	OSC-9370, Appendix A, Table A3		
Undervoltage	85%		91.723%	OSC-9370, Appendix C, Table C1
Overvoltage	115%		Note 1	OSC-9370, Appendix D, Table D1
PSW Charger A/B	600V	OSC-9370, Appendix A, Table A3		
Undervoltage	85%		96.894%	OSC-9370, Appendix C, Table C1
Overvoltage	110%		104.421%	OSC-9370, Appendix D, Table D1
PSW SAFETY RELATED HVAC	575V			
Undervoltage	90%	OSC-9370, Appendix C, Table C1	96.670%	OSC-9370, Appendix C, Table C1
Overvoltage	110%	OSC-9370, Appendix C, Table D1	104.688%	OSC-9370, Appendix C, Table D1
HPI Manual Alignment Switches	4kV			
SCCR	40kA	OSC-9370, Appendix F, Table F1	32.349kA	OSC-9370, Appendix F, Table F1
HPI Motor Operated Switches	4kV			
SCCR	61kA	OSC-9370, Appendix F, Table F1	53.391kA	OSC-9370, Appendix F, Table F1

Equipment	Rating/Required	Reference	Worst-Case Analyzed Value	Reference
Manual Transfer Switches	600V			
SCCR	35kA	OSC-9370, Appendix F, Table F1	18.682kA	OSC-9370, Appendix F, Table F1
Manual Transfer Switch (XPSW)	600V			
SCCR	65kA (Note 2)	OSC-9370, Appendix F, Table F1	64.925kA	OSC-9370, Appendix F, Table F1
Auto Transfer Switches (Battery)	600V			
SCCR	35kA	OSC-9370, Appendix F, Table F1	13.906kA	OSC-9370, Appendix F, Table F1

Note 1 - Not analyzed. It is known that the overvoltage study provides 3XPSW with 104.993% voltage (629.96V). Since the chargers are loads on the 1/2/3XPSW MCCs and they are rated to 115% of 575V (or 661V), there will be less than 629.96V at the chargers, which is acceptable.

Note 2 - 65kA rating used for Revision 0 will be replaced by 200kA rating per OM 328.--0068.001

CABLES [Ampacity]

Cables are checked for ampacity only in duct banks since the PSW-related recovery scenarios generally produced bounding ampacity values in duct over cable in tray, as shown in See OSC-9370, Appendix E, Section 3.4. The lone exception is the feed to OTS1 (SSF during shutdown), which has a load greater than the ampacity allowed in tray (per DC-3.12). The cable does not fail in the duct bank analysis and therefore the load on that cable (1EPSW4A) given the SSF scenario is bound by installation in tray.

In OSC-9370 ampacity is reported based on expected worst-case loading scenarios. Since actual loading and system configuration provides acceptable ampacity values, OSC-9370 Appendix E works to justify those loading scenarios and conservatively adds margin to cables as it may seem appropriate for use in future. Cables must not exceed 90 deg C per OSC-7729, Section 3.3.

Cable	*Applied Load Factor	Size (AWG)	Current (Amp)	Temp (deg C)
1EDSW9	151.00%	250	151	81.28
1ELSW11A,B-2	152.50%	500	270	86.02
1ELSW11A,B-1	152.50%	500	270	85.41
1ELSW1A,B-2	130.00%	500	212.44	68.95
1ELSW1A,B-1	130.00%	500	212.44	75.1
1ELSW2	130.00%	500	206.02	78.46
1EPSW4A,B-2	SSF house load < 100% during PSW event	500	19.66	76.47
1EPSW4A,B-1	SSF house load < 100% during PSW event	500	19.66	74.27
1EPSW6	100.00%	4/0	70.8	71.51
2EDSW9	151.00%	250	151	80.34
2ELSW11A,B-2	151.90%	500	270	88.81
2ELSW11A,B-1	151.90%	500	270	89.17

2ELSW1A,B-2	130.00%	500	153.75	79.11
2ELSW1A,B-1	130.00%	500	153.75	80.06
2ELSW2	130.00%	500	207.11	77.41
2ELSW3A,B-2	130.00%	500	167.88	81.59
2ELSW3A,B-1	130.00%	500	167.88	82.79
2EPSW6	100.00%	4/0	70.77	75.89
3EDSW9	151.00%	250	151	81.2
3ELSW11A,B-2	143.50%	500	270	86.86
3ELSW11A,B-1	143.50%	500	270	81.42
3ELSW1A,B-2	130.00%	500	145.96	78.99
3ELSW1A,B-1	130.00%	500	145.96	76.8
3ELSW2	130.00%	500	207.68	78.45
3ELSW3A,B-2	130.00%	500	142.22	72.67
3ELSW3A,B-1	130.00%	500	142.22	74.6
3EPSW6	100.00%	4/0	70.73	76.27
4EPSW5A,B-2	100.00%	350	118.92	68.06
4EPSW5A,B-1	100.00%	350	118.92	67.73
4EPSW7	100.00%	4/0	25.27	75.35

*Applied Load Factor: See OSC-9370, Appendix E Methodology where the load factors are justified.

Feeders to PSW from Power Source -- Load at which 90 degree C is reached (Max Ampacity)		
Fant Line	Single Cable (Amps)	Parallel Feed (Amps)
750MCM	511.37	473.02
Keowee	Single Cable (Amps)	Parallel Feed (Amps)
750MCM	509.8	429.38

RAI #149 (page 1 of 1)

3.2 Classification of Structures, Components, and Systems

3.2.1 Seismic Classification

3.2.1.1 Structures

The design bases for normal operating conditions are governed by the applicable building design codes. The basic design criterion for the worst loss-of-coolant accident and seismic conditions is that there shall be no loss of function if that function is related to public safety.

AEC publication TID 7024, "Nuclear Reactors and Earthquake," as amplified in Chapter 3 is used as the basic design guide for seismic analysis.

The design basis earthquake ground acceleration at the site is 0.05g. The maximum hypothetical earthquake ground acceleration is 0.10g, and 0.15g for Class 1 structures founded on bedrock and overburden respectively.

The plant structures are classified as one of three classes according to their function and the degree of integrity required to protect the public.

Add new line item: "Protected Service Water (PSW) Building (Reference Section 9.7.1.2.5)."

3.2.1.1.1 Class 1

Class 1 structures are those which prevent uncontrolled release of radioactivity and are designed to withstand all loadings without loss of function. Class 1 structures include the following:

Portions of the Auxiliary Building that house engineered safeguards systems, control room, fuel storage facilities and radioactive materials.

Reactor Building and its penetrations.

CT4 Transformer and 4KV Switchgear Enclosures (Blockhouses) (Reference Section 8.3.1.4.1.)

Unit Vent.

Standby Shutdown Facility (SSF) (Reference Section 9.6.3.4.1.)

Note: From the license renewal review, it was determined that Class 1 civil structures are included in the scope for license renewal.

3.2.1.1.2 Class 2

Class 2 structures are those whose limited damage would not result in a release of radioactivity and would permit a controlled plant shutdown but could interrupt power generation. Class 2 structures include the following:

Oconee Intake Structure
Oconee Turbine and Auxiliary Buildings, except as included in Class 1
Oconee Intake Canal Dike
Oconee Intake Underwater Weir
Keowee Powerhouse
Keowee Spillway
Keowee Service Bay Substructure
Keowee Breaker Vault
Keowee Intake Structure
Keowee Power and Penstock Tunnels
Keowee Dam

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Table 1 – Significant Parameters and Initial Conditions for DSLB with Loss of the 4kV Essential Power System

Initial Conditions	**Target Value**	**Comment**
Core Power (% of 2568 MWt)	102.0	2% uncertainty
RCS pressure (psig)	2095.0	Low value, conservative for DNBR
RCS Tave (°F)	577.0	Low value, maximize overcooling
PZR level (in)	195.0	Low value, minimize pressure
RCS flow (gpm)	371,360	Low value, conservative for DNBR
Fuel Tave (°F)	950.0	Low value, maximize overcooling
SG Level (%OR)	93%	High value, maximize overcooling
Core Kinetics Parameters		
Moderator feedback	EOC most negative	Maximize positive reactivity insertion during cooldown
Trip reactivity	5.2%Δk/k	EOC value, with most reactive rod stuck out of the core
Differential boron worth	120 ppm /%Δk/k	High value, minimize boron reactivity
Decay heat	90% of EOC	Reduced EOC values to maximize overcooling
Boundary Conditions		
Break Opening Time	Immediate	Event initiator
Single Active Failure	EFW control valve	Fails open on SG-A for case w/ RCPs on
Reactor trip	Immediate	To maximize overcooling
RCP Operation	Varies	See above description
ECCS (HPI)	Unavailable	Loss of 4kV
ECCS (LPI)	Not modeled	
CFT Boron Concentration	1817 ppm	COLR value, minus 1% uncertainty
BWST Boron Concentration	2198 ppm	2400 ppm, minus 1% uncertainty
Main Feedwater	Trip at start of event	MFW pumps coastdown following trip on loss of suction pressure
Emergency Feedwater	Only TDEFW	
Results		
Minimum reactivity margin to criticality ($)	2.38	case w/ RCPs on
Minimum reactivity margin to criticality ($)	2.68	case w/ RCPs stopped on loss of SCM

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Figure 1

ONS Double Steam Line Break
With Loss of 4kV Essential Power System; case w/ RCPs on

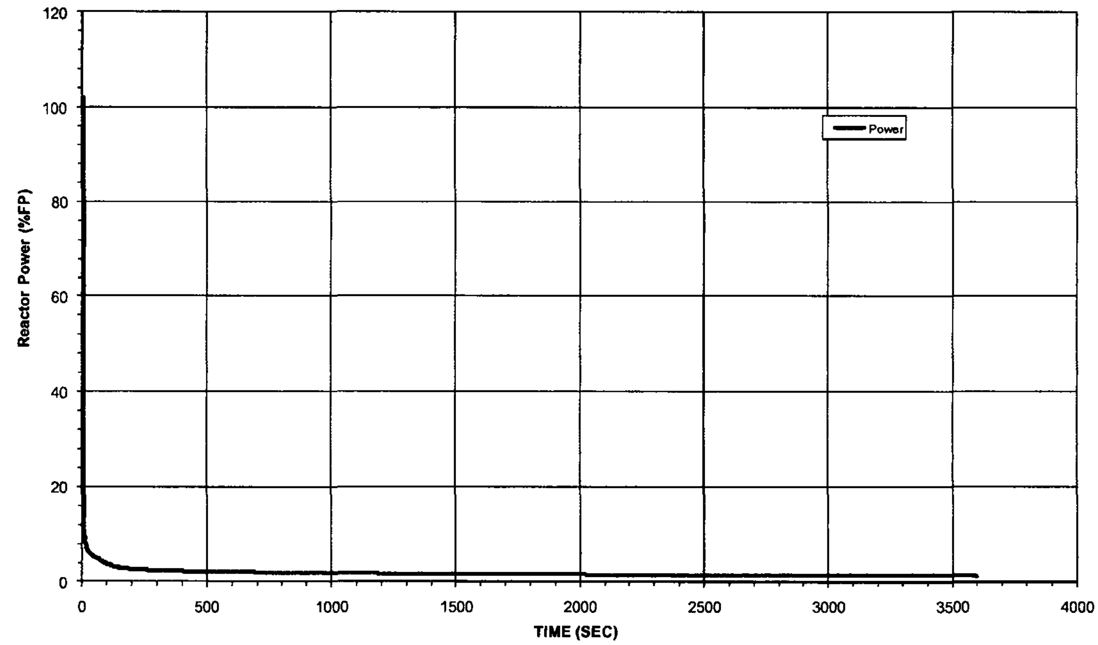

Figure 2

ONS Double Steam Line Break
With Loss of 4kV Essential Power System; case w/ RCPs on

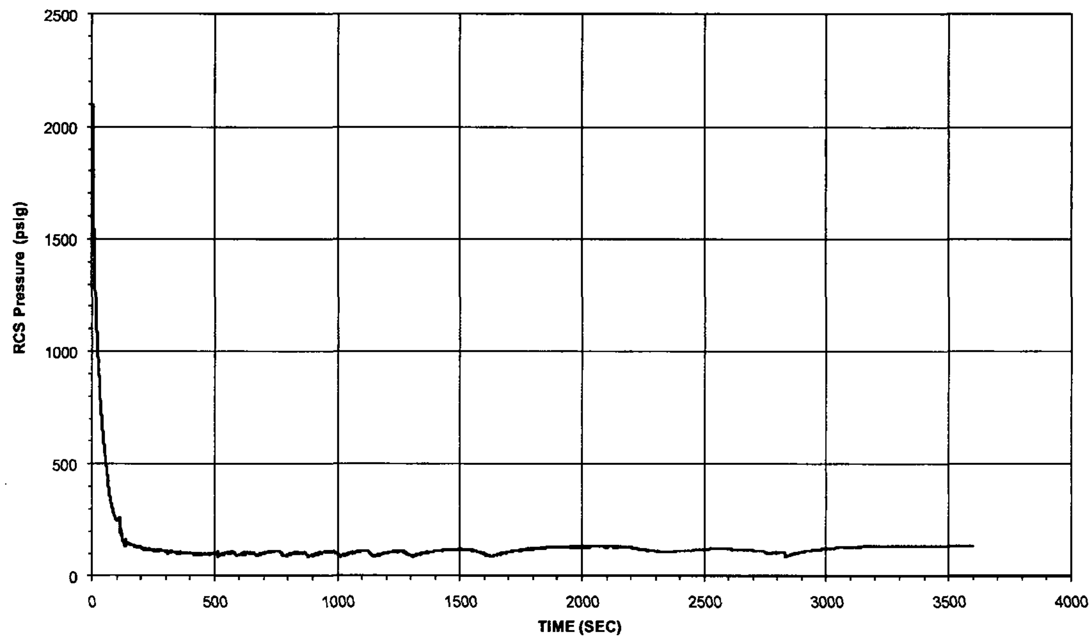

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Figure 3

ONS Double Steam Line Break
With Loss of 4kV Essential Power System; case w/ RCPs on

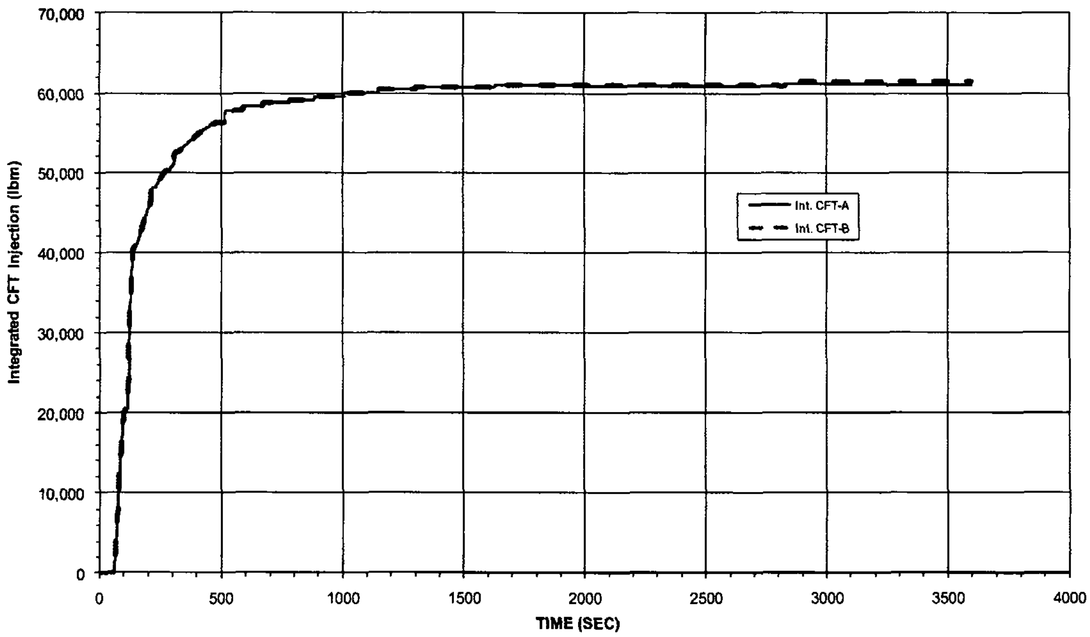

Figure 4

ONS Double Steam Line Break
With Loss of 4kV Essential Power System; case w/ RCPs on

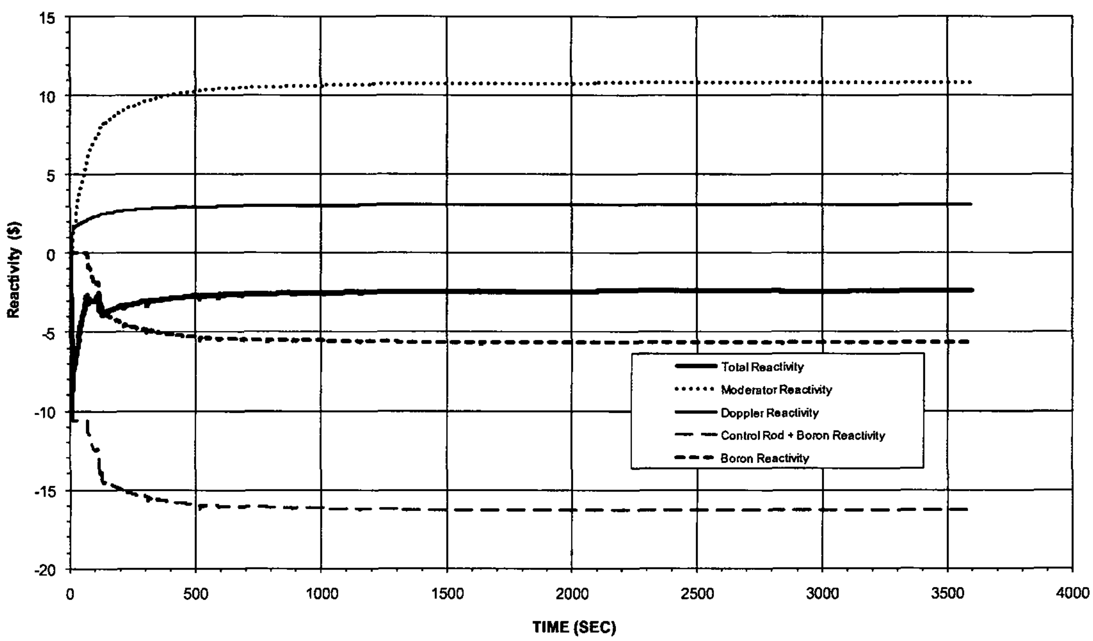

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Figure 5

ONS Double Steam Line Break
With Loss of 4kV Essential Power System; case w/ RCPs on

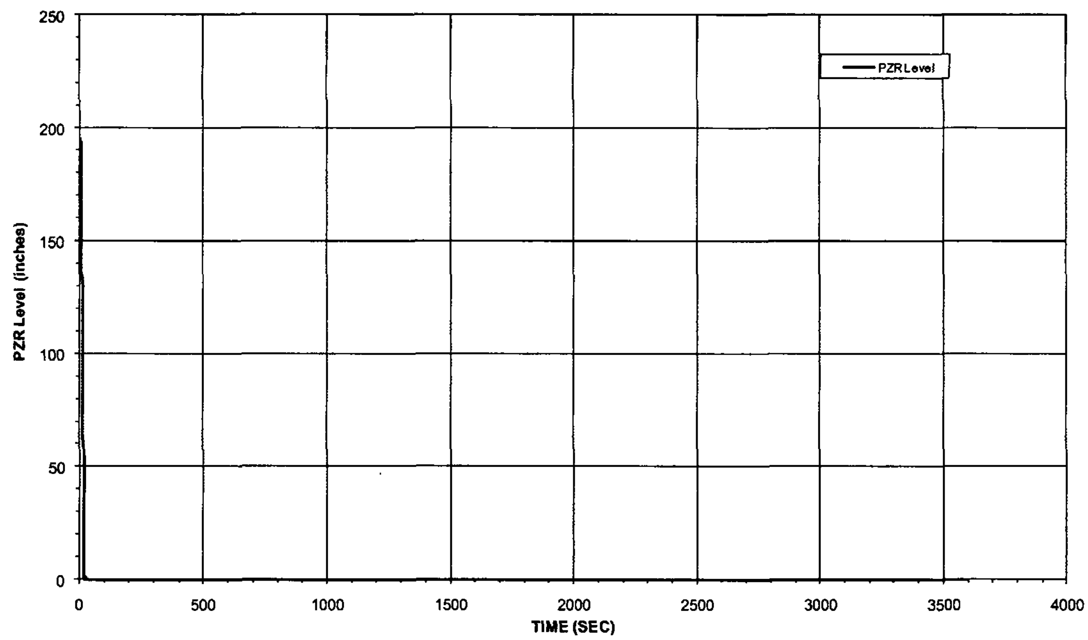

Figure 6

ONS Double Steam Line Break
With Loss of 4kV Essential Power System; case w/ RCPs on

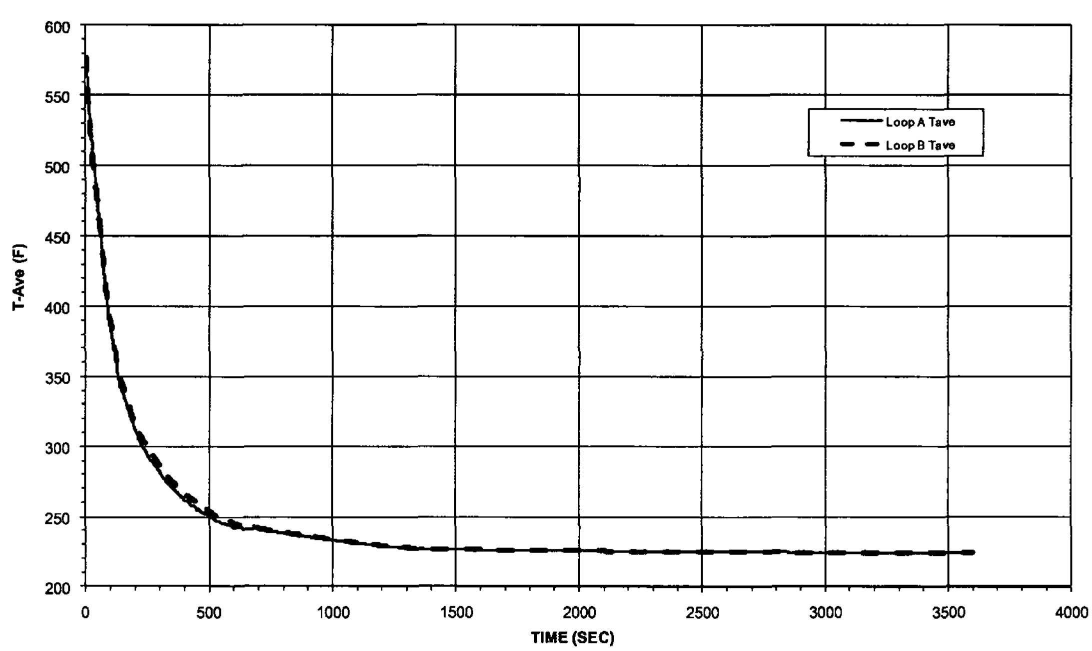

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Figure 7

ONS Double Steam Line Break
With Loss of 4kV Essential Power System; case w/ RCPs on

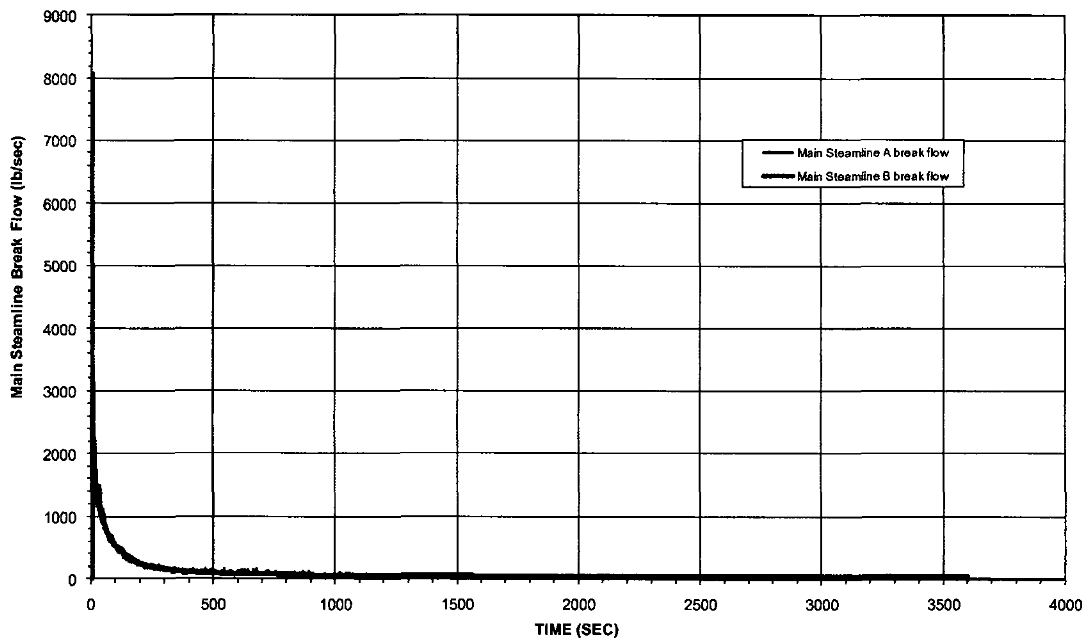

Figure 8

ONS Double Steam Line Break
With Loss of 4kV Essential Power System; case w/ RCPs on

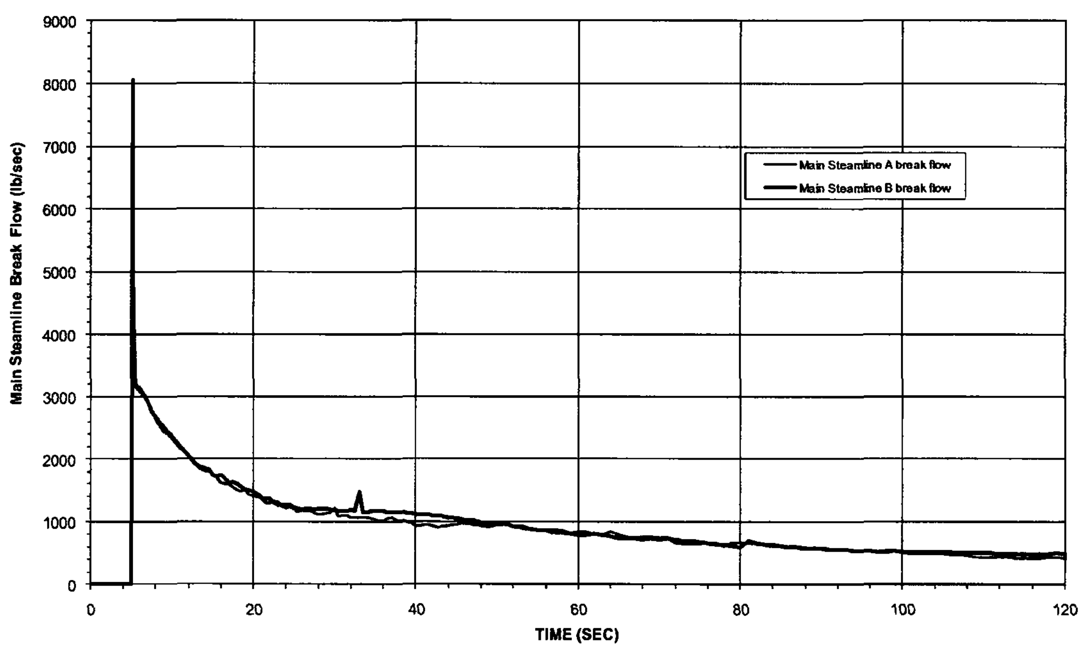

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Figure 9

ONS Double Steam Line Break
With Loss of 4kV Essential Power System; case w/ RCPs on

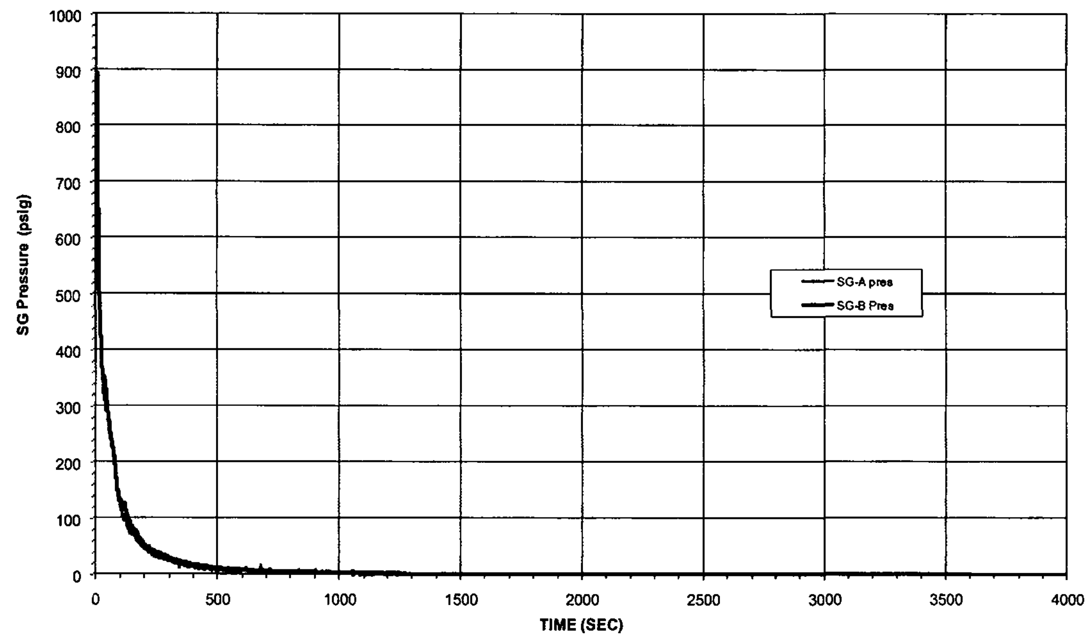

Figure 10

ONS Double Steam Line Break
With Loss of 4kV Essential Power System;
case w/ RCPs tripped on loss of SCM

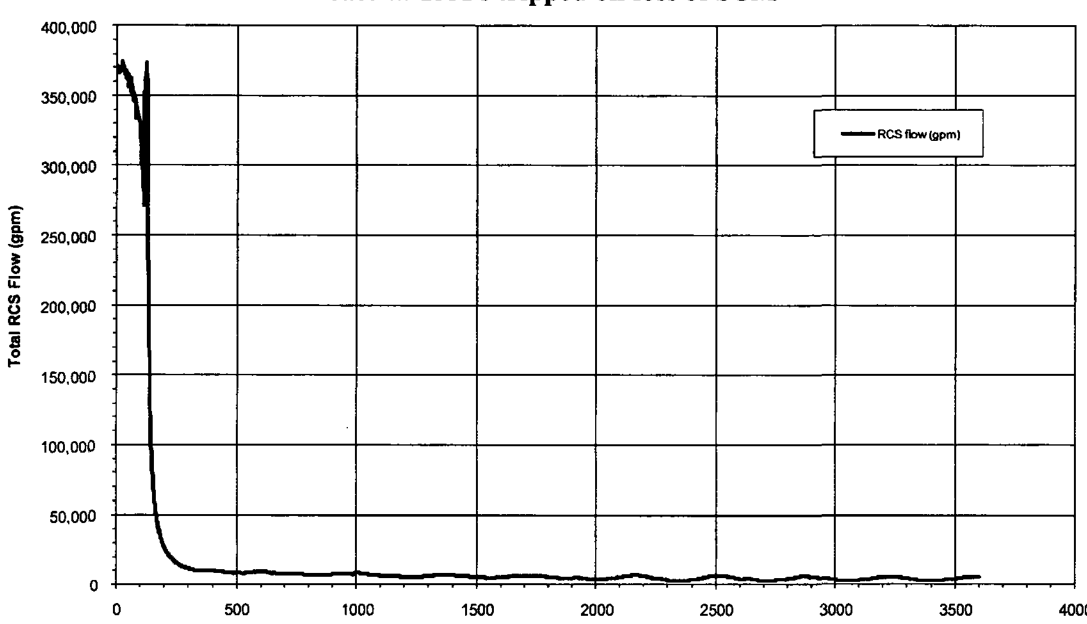

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Figure 11

**ONS Double Steam Line Break
With Loss of 4kV Essential Power System;
case w/ RCPs tripped on loss of SCM**

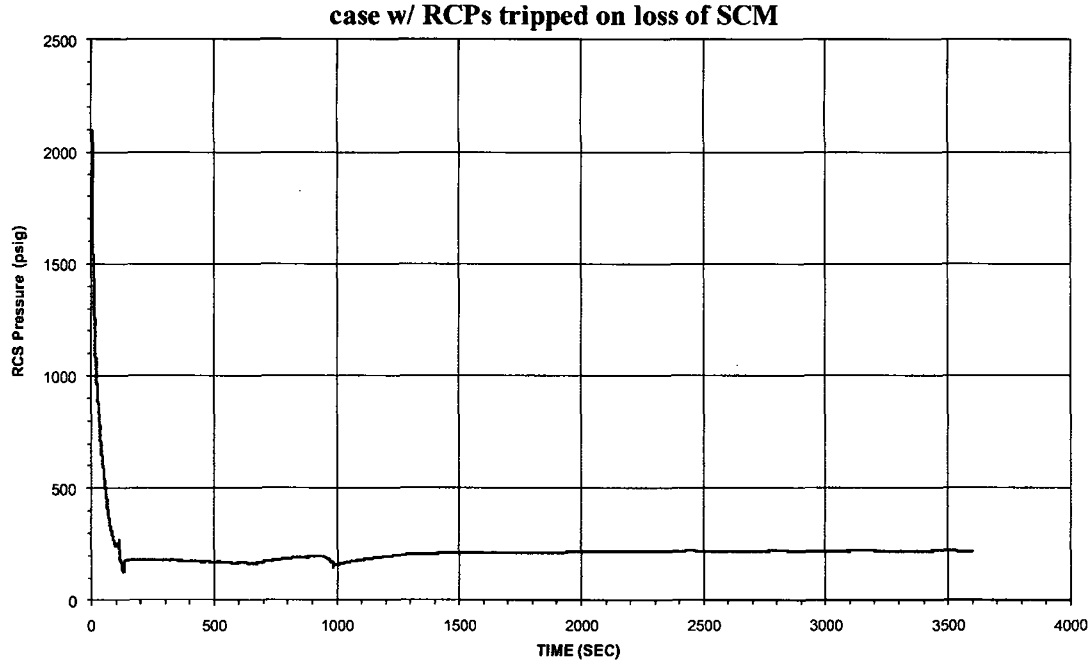

Figure 12

**ONS Double Steam Line Break
With Loss of 4kV Essential Power System;
case w/ RCPs tripped on loss of SCM**

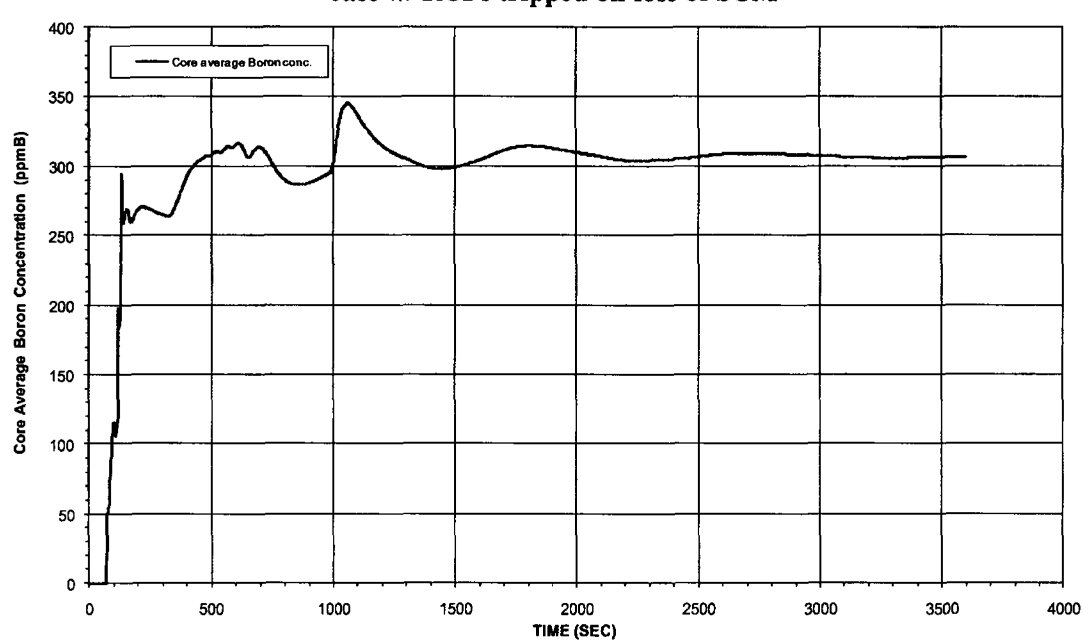

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Figure 13

**ONS Double Steam Line Break
With Loss of 4kV Essential Power System;
case w/ RCPs tripped on loss of SCM**

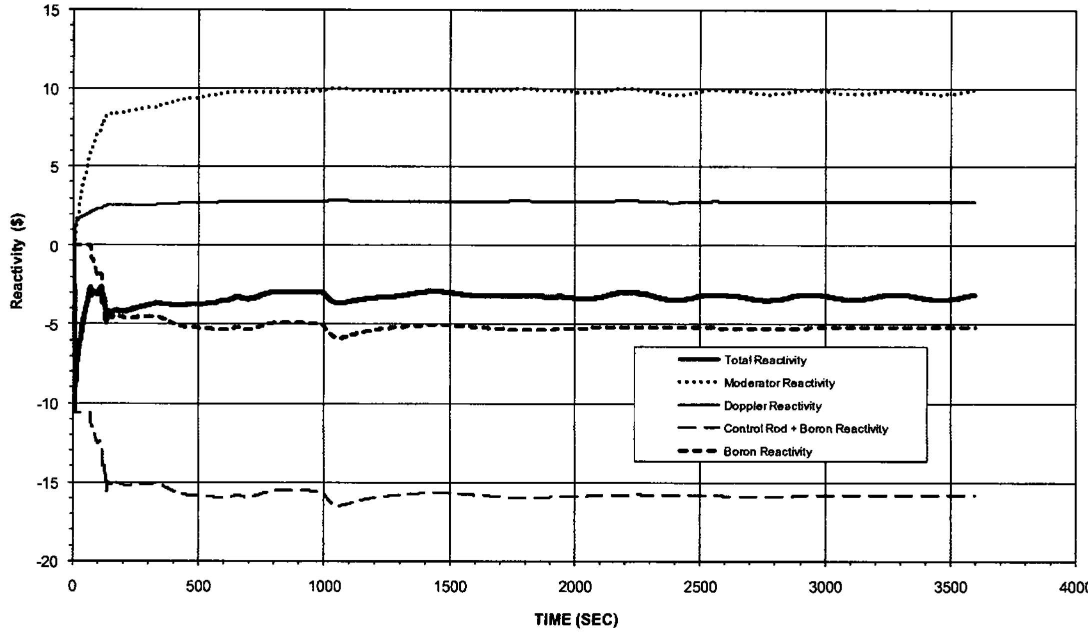

Figure 14

**ONS Double Steam Line Break
With Loss of 4kV Essential Power System;
case w/ RCPs tripped on loss of SCM**

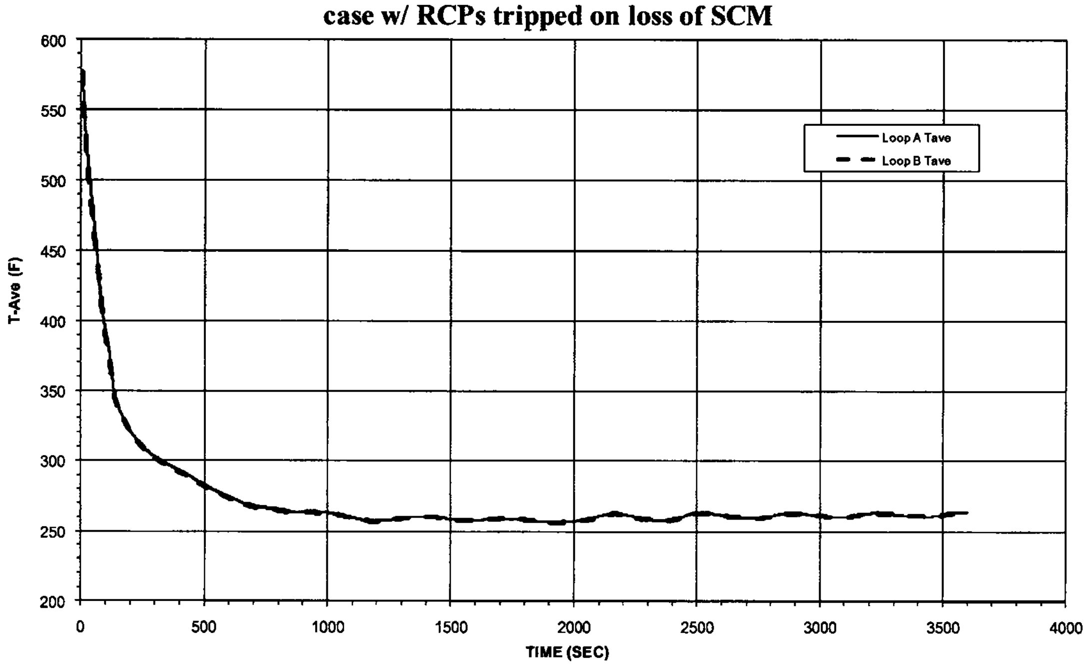

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Table 2 – Initial Conditions for Loss of MFW & EFW, with SSF Mitigation

Initial Conditions	Target Value	Comment
Core Power (% of 2568 MWt)	102.0	2% uncertainty
RCS pressure (psig)	2155	Nominal value
RCS Tave (°F)	579	Nominal value
PZR level (in)	220	Nominal value
RCS flow (gpm)	396,000	Nominal value
Fuel Tave (°F)	1050	Typical EOC value
SG Level (%OR)	55%	Nominal value
SG tube plugging	15%	Bounding value to minimize primary-to-secondary heat transfer
Core Kinetics Parameters		
Moderator feedback (MTC)	-3.0 pcm/°F	Nominal BOC value
Doppler feedback (MTC)	-1.3632 pcm/°F	Nominal BOC value
Trip reactivity	6.15 %Δk/k	Nominal BOC value
Differential boron worth	Not modeled	
Decay heat	EOC	Multipliers used to conservatively bound high EOC value
Boundary Conditions		
Loss of Feedwater	t=0.1 second	Event initiator
Single Active Failure (SAF)	None	SAF not required for SSF analyses
Reactor trip	1 second	Anticipatory Reactor Trip on Loss of Main Feedwater
RCP Operation	Tripped at 3 minutes after event	Current Time Critical Action
ECCS (HPI), (LPI)	Not modeled	
BWST, CFT Boron Concentration	Not modeled	
Main Feedwater	MFW coastdown time of 10 seconds	Best-estimate value
Emergency Feedwater	Not modeled	Assumed unavailable
SSF ASW Pump	Start at 15 minutes	
SSF ASW Pump Flow	175 gpm/SG at 1050 psig	Minimum flowrate vs. SG pressure
SSF RC Makeup Pump	Start at 20 minutes	Current Time Critical Action for SSF event
SSF RC Net Makeup Flow	5 gpm	Lower bounding value
SSF Pressurizer Heaters	Energized at 20 minutes	Current Time Critical Action
Pressurizer PORV	Modeled	Nominal open setpoint of 2450 psig; Nominal close setpoint of 2400 psig
Pressurizer PORV Block Valve	Closed at 20 minutes	Per SSF procedure

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Figure 15

ONS SSF Evaluation
Base Case

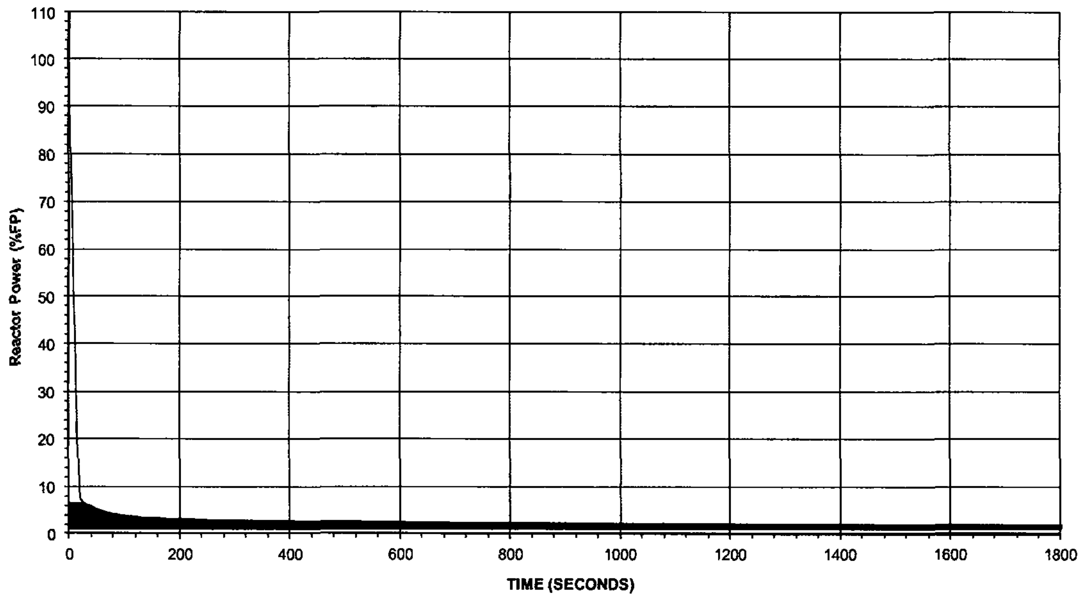

Figure 16

ONS SSF Evaluation
Base Case

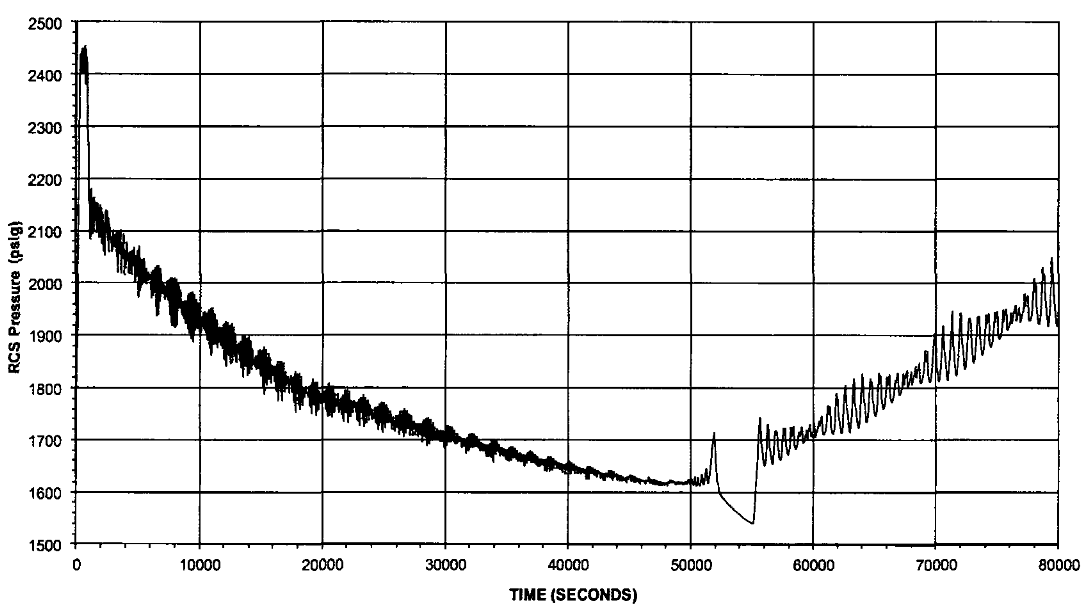

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Figure 17

ONS SSF Evaluation
Base Case

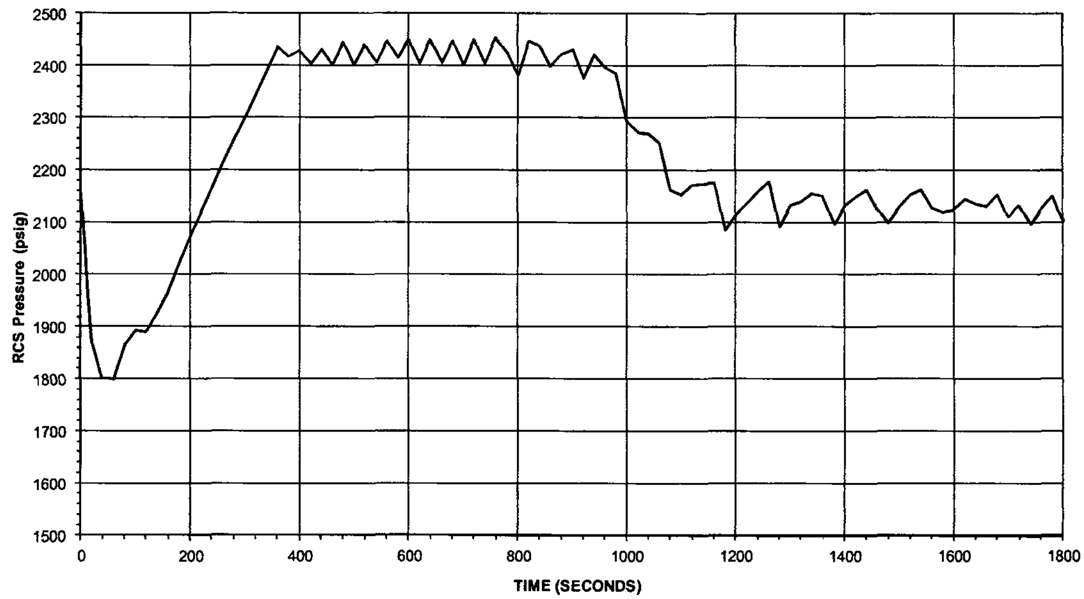

Figure 18

ONS SSF Evaluation
Base Case

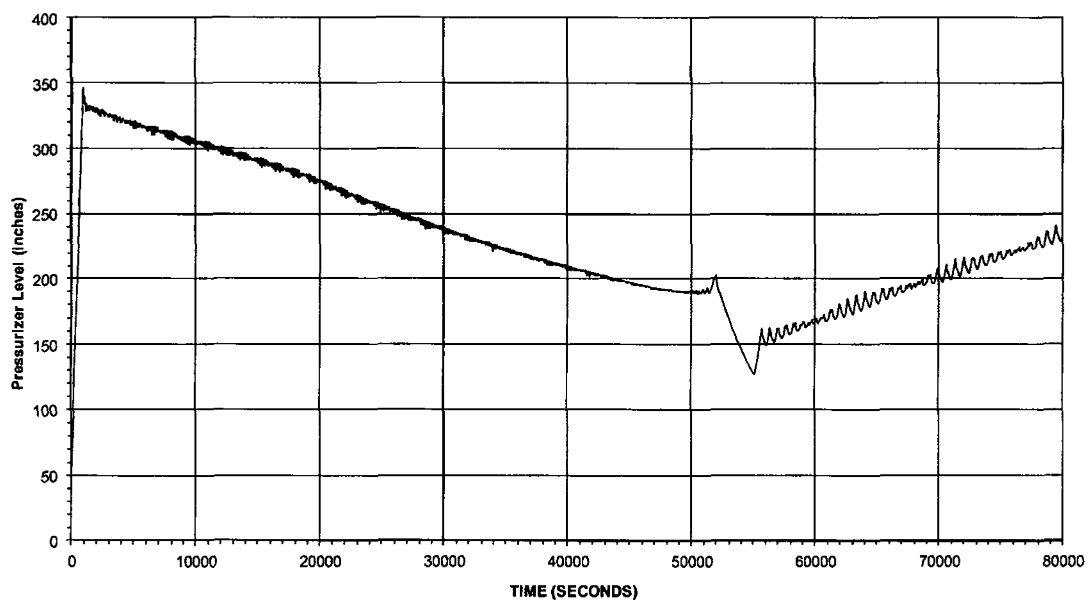

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Figure 19

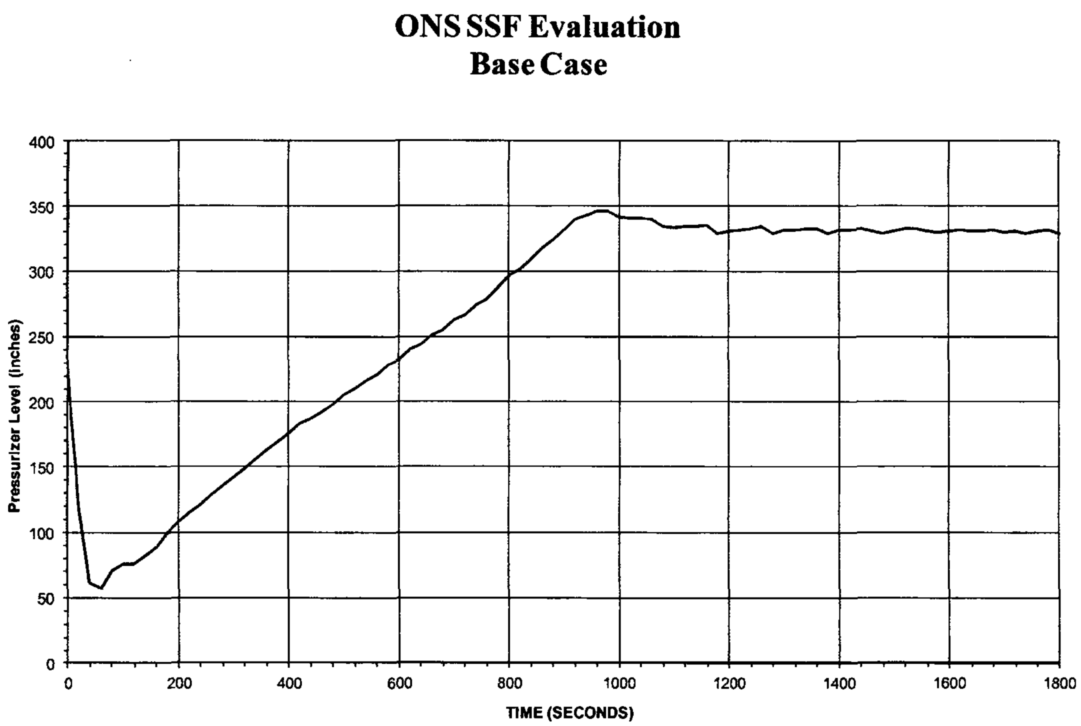

Figure 20

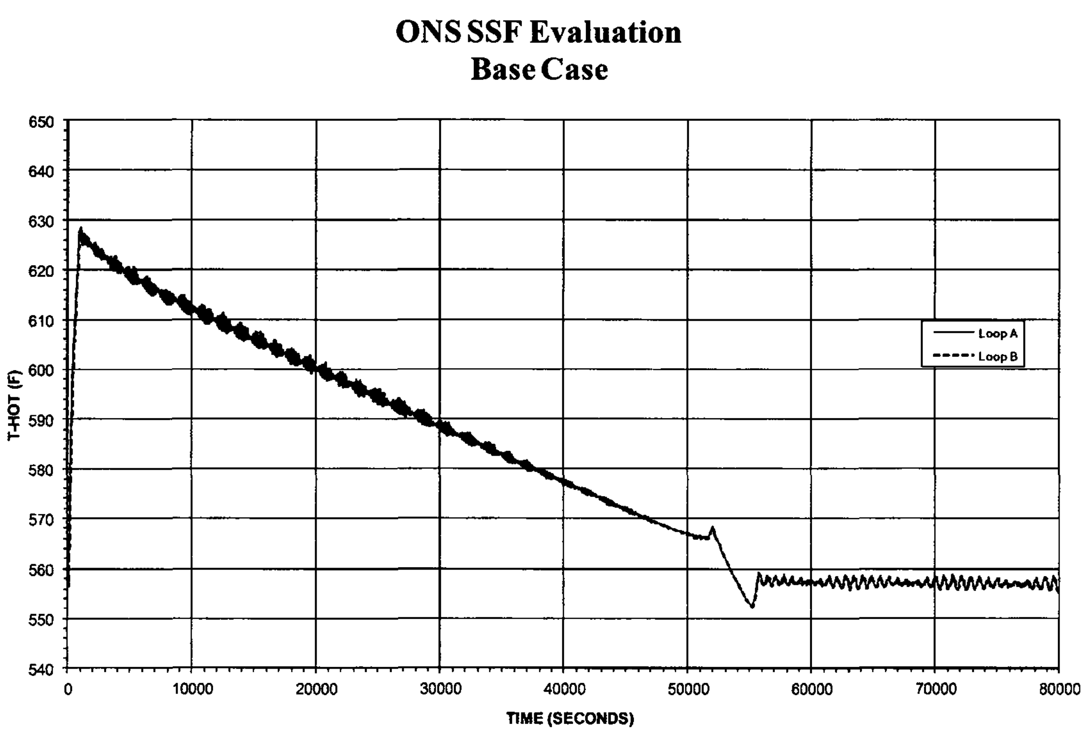

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Figure 21

ONS SSF Evaluation
Base Case

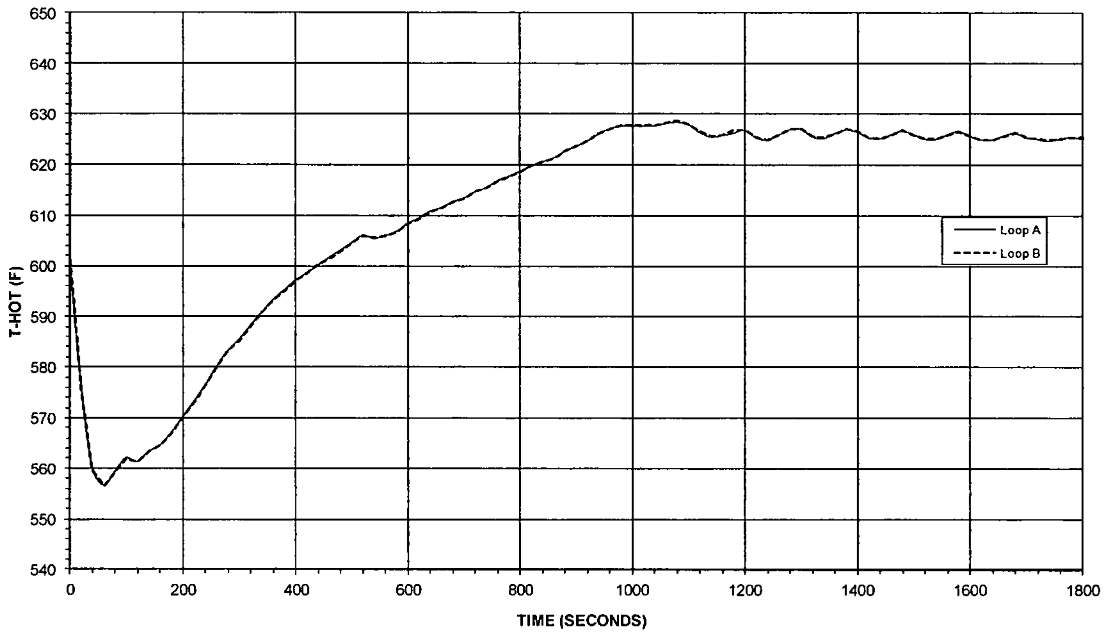

Figure 22

ONS SSF Evaluation
Base Case

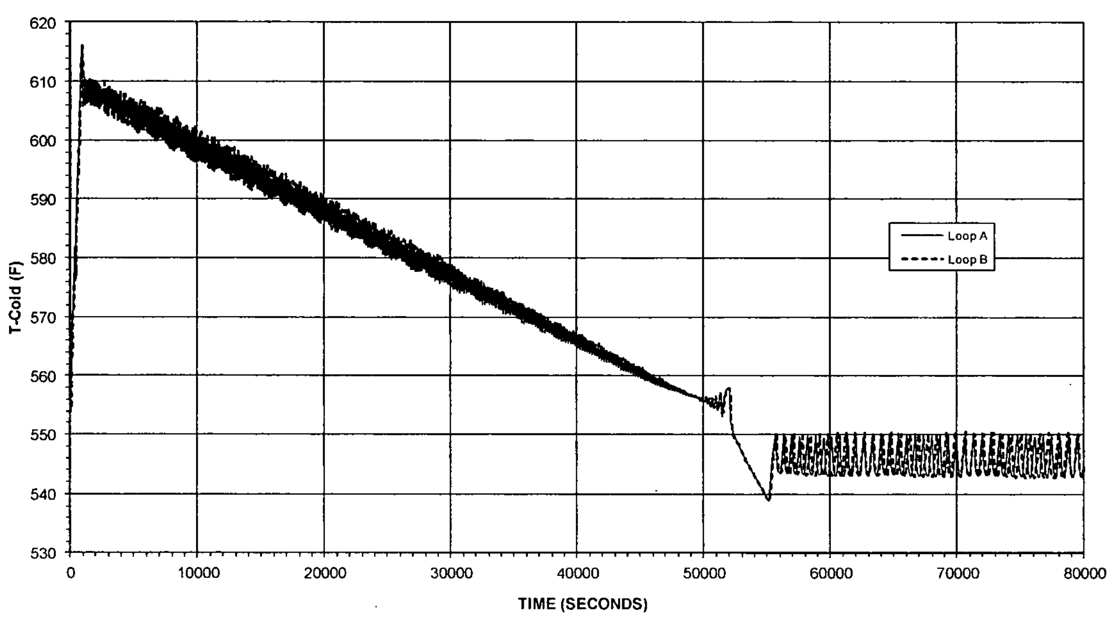

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Figure 23

**ONS SSF Evaluation
Base Case**

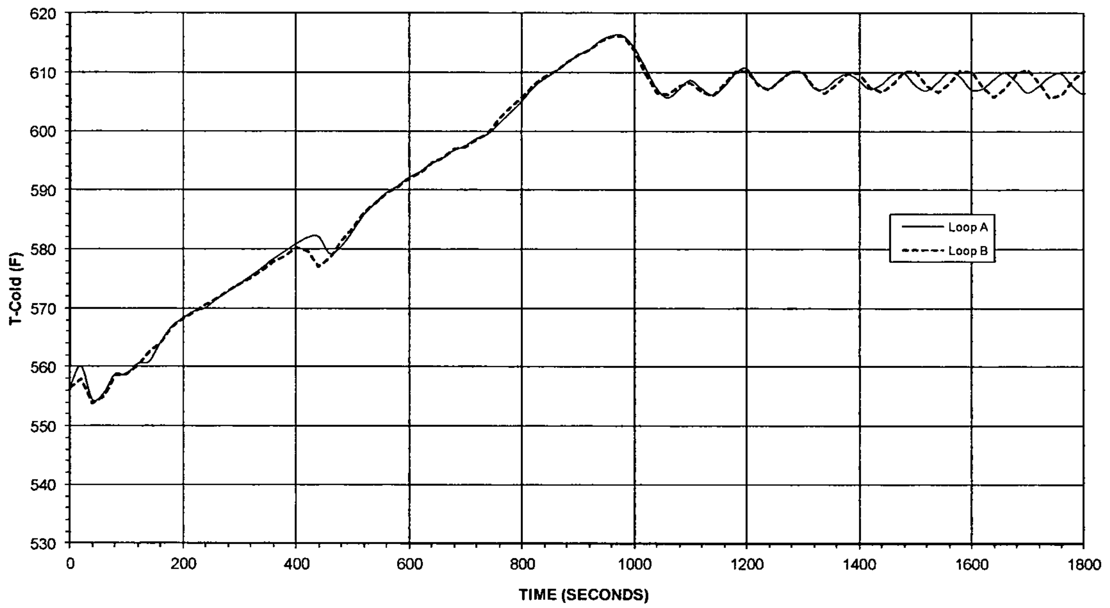

Figure 24

**ONS SSF Evaluation
Base Case**

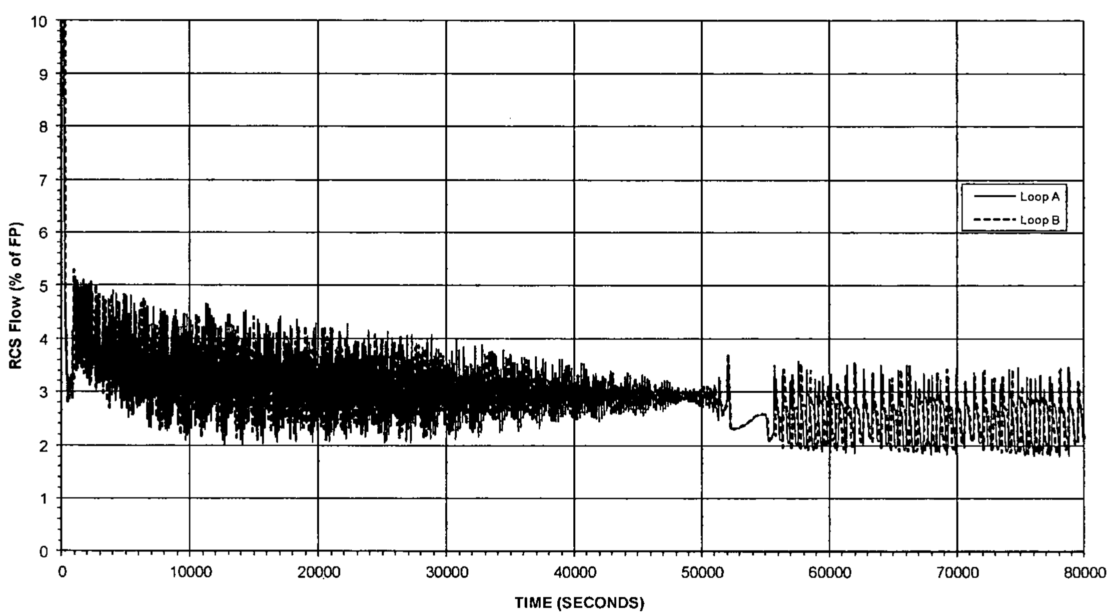

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Figure 25

ONS SSF Evaluation
Base Case

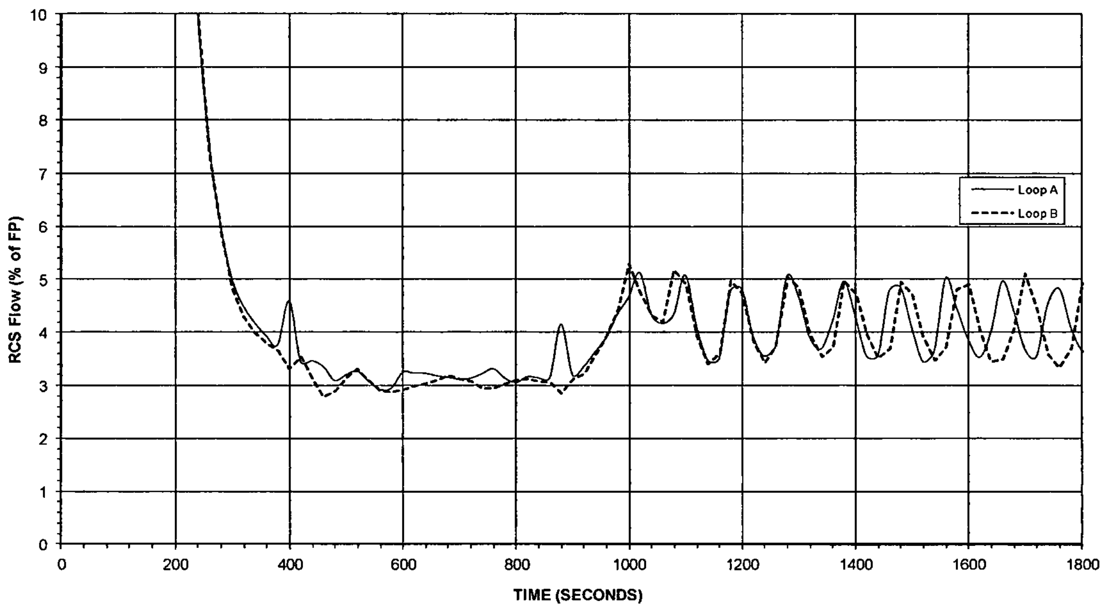

Figure 26

ONS SSF Evaluation
Base Case

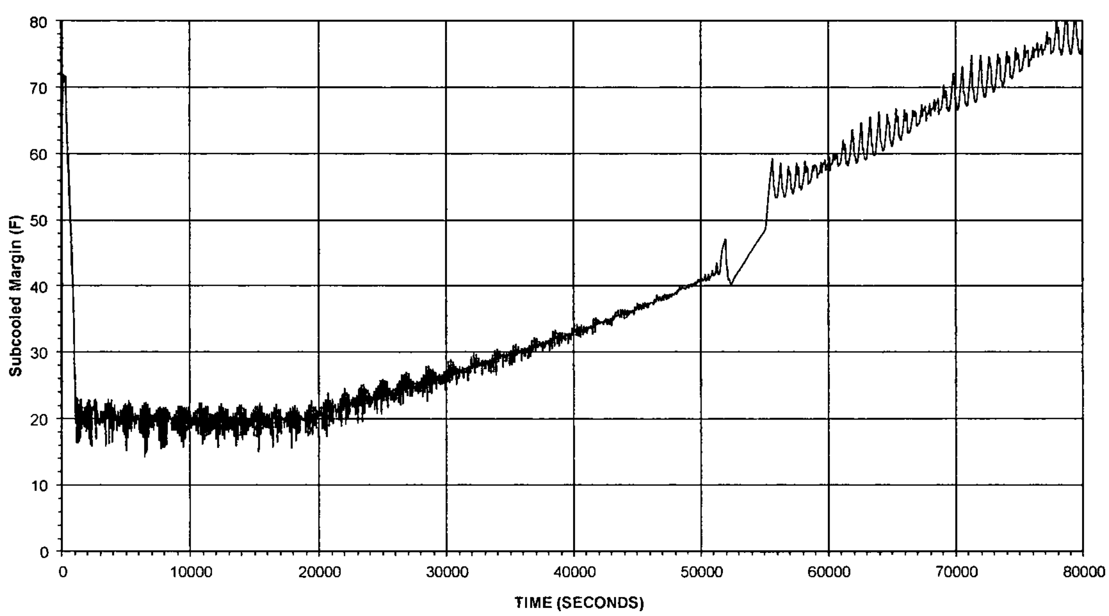

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Figure 27

ONS SSF Evaluation
Base Case

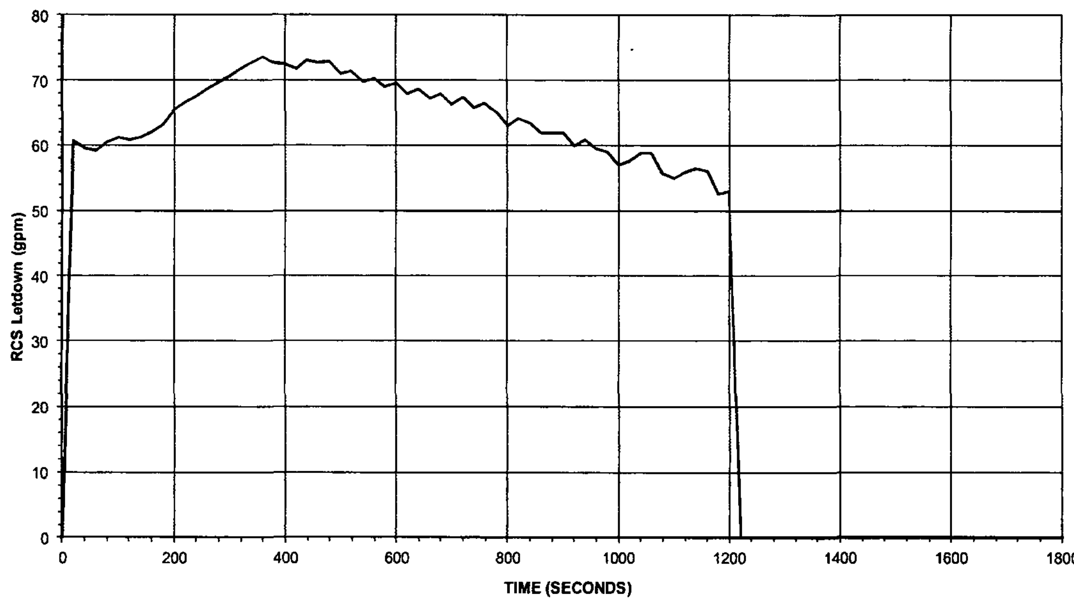

Figure 28

ONS SSF Evaluation
Base Case

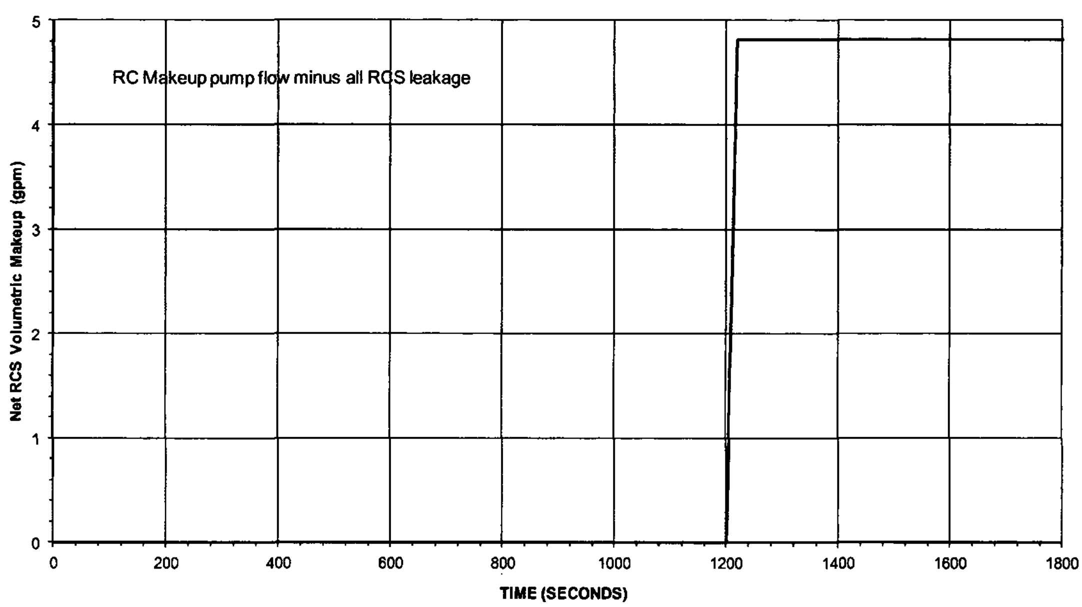

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Figure 29

**ONS SSF Evaluation
Base Case**

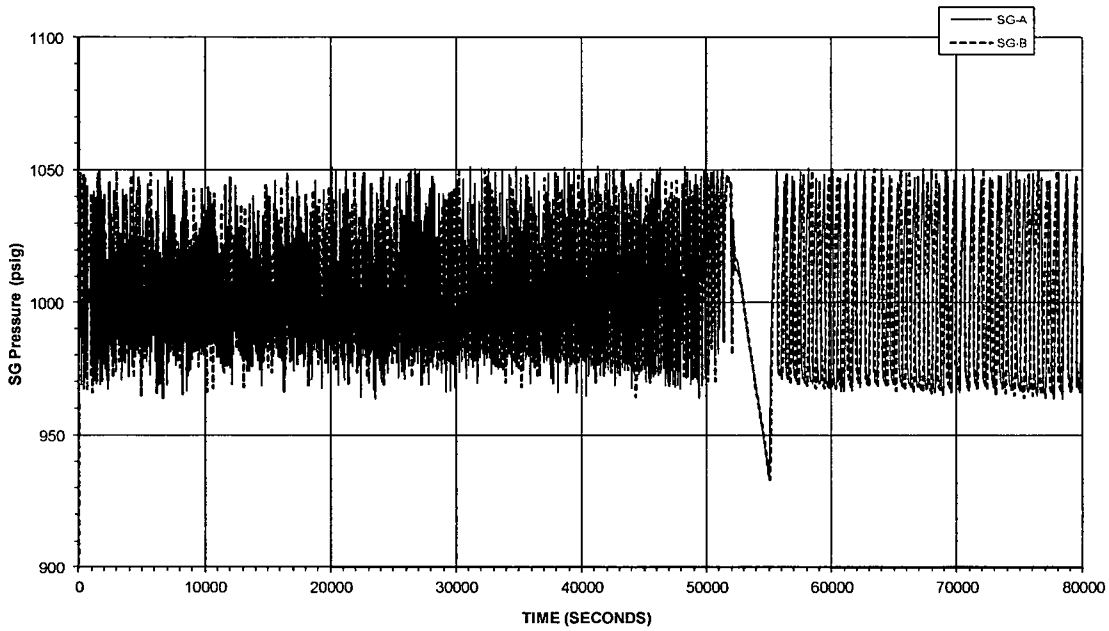

Figure 30

**ONS SSF Evaluation
Base Case**

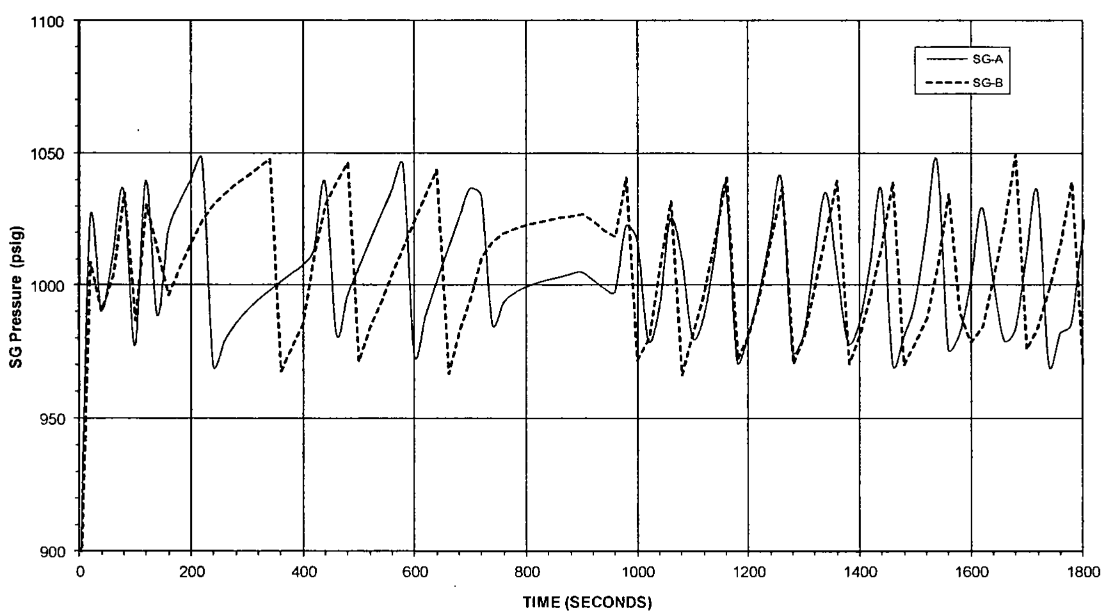

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Figure 31

**ONS SSF Evaluation
Base Case**

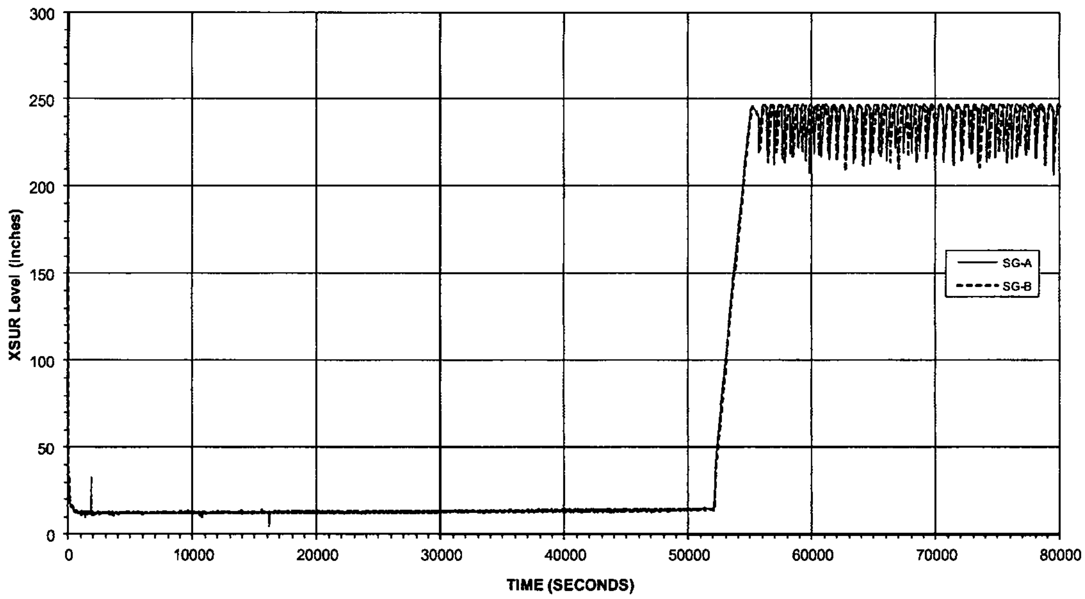

Figure 32

**ONS SSF Evaluation
Base Case**

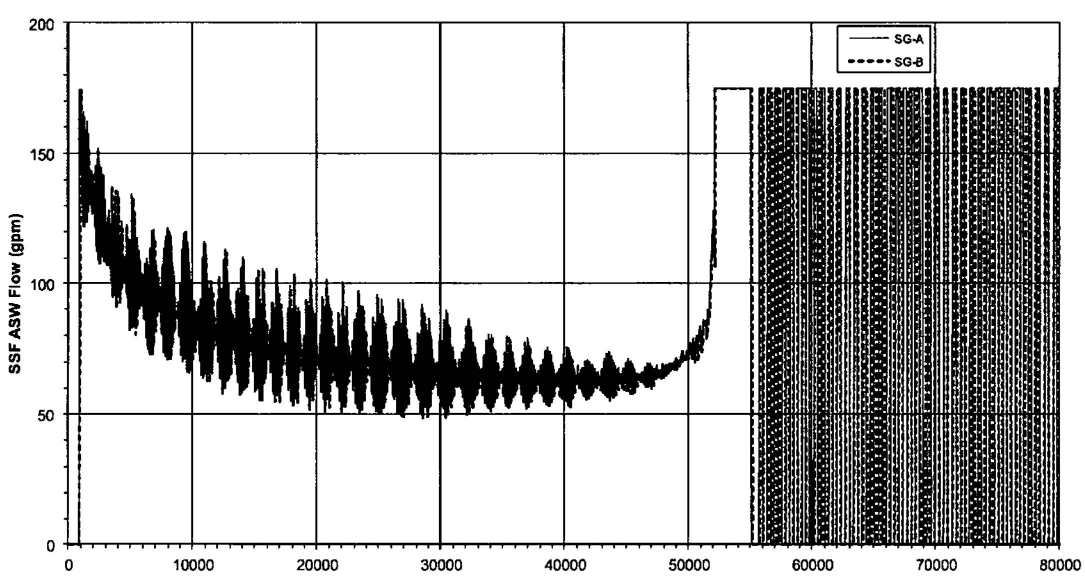

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Figure 33

ONS SSF Evaluation
Base Case

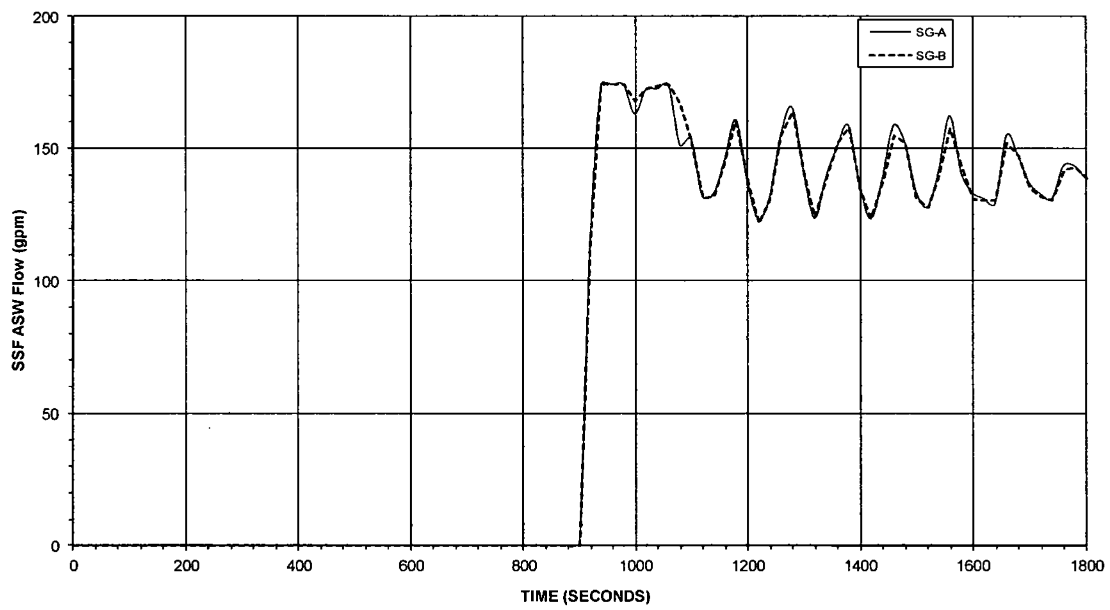

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Table 3 – Significant Parameters for DSLB with Loss of Offsite Power

Initial Conditions (RETRAN-3D)	**Target Value**	**Comment**
Core Power (% of 2568 MWt)	100.0 (Note 1)	SCD methodology
RCS pressure (psig)	2125.0	Low value, conservative for DNBR
RCS Tave (°F)	579.0	Nominal value, SCD methodology
PZR level (in)	285.0	High level alarm + uncertainty
RCS flow (gpm)	378,400	Nominal value, SCD methodology
Fuel Tave (°F)	1315.0	High value, conservative for DNBR
SG Level (%OR)	93%	High value, maximize overcooling
Boundary Conditions		
Break Opening Time	Immediate	Coincident with LOOP
Single Active Failure	None	None identified which affect result
Reactor trip	Immediate	Control rod drives de-energize on LOOP
RCP Operation	Immediate coastdown	RCPs trip coincident with LOOP
ECCS (HPI)	N/A	MDNBR occurs before injection begins
ECCS (LPI)	N/A	MDNBR occurs before injection begins
CFT Boron Concentration	N/A	MDNBR occurs before injection begins
BWST Boron Concentration	N/A	MDNBR occurs before injection begins
Main Feedwater	Coastdown on LOOP	Condensate Booster Pumps and D Heater Drain Pump trip on LOOP, MFW pumps conservatively modeled to remain at full power RPM
Emergency Feedwater	N/A	MDNBR occurs before TDEFW begins
VIPRE Results		
Minimum DNBR for mixed core Mk-B11 / Mk-B-HTP	1.658 @ 1.5 sec	Initial power level of 100% 2568 MWt
Minimum DNBR for mixed core Mk-B11 / Mk-B-HTP	1.594 @ 1.5 sec	Initial power level of 102% 2568 MWt
Minimum DNBR for full core of Mk-B-HTP	1.684 @ 1.5 sec	Initial power level of 102% 2568 MWt

1. The analysis submitted in ONDS-351 has since been revised to allow for an MUR uprate, but the conclusion that DNB does not occur remains valid.

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Figure 34

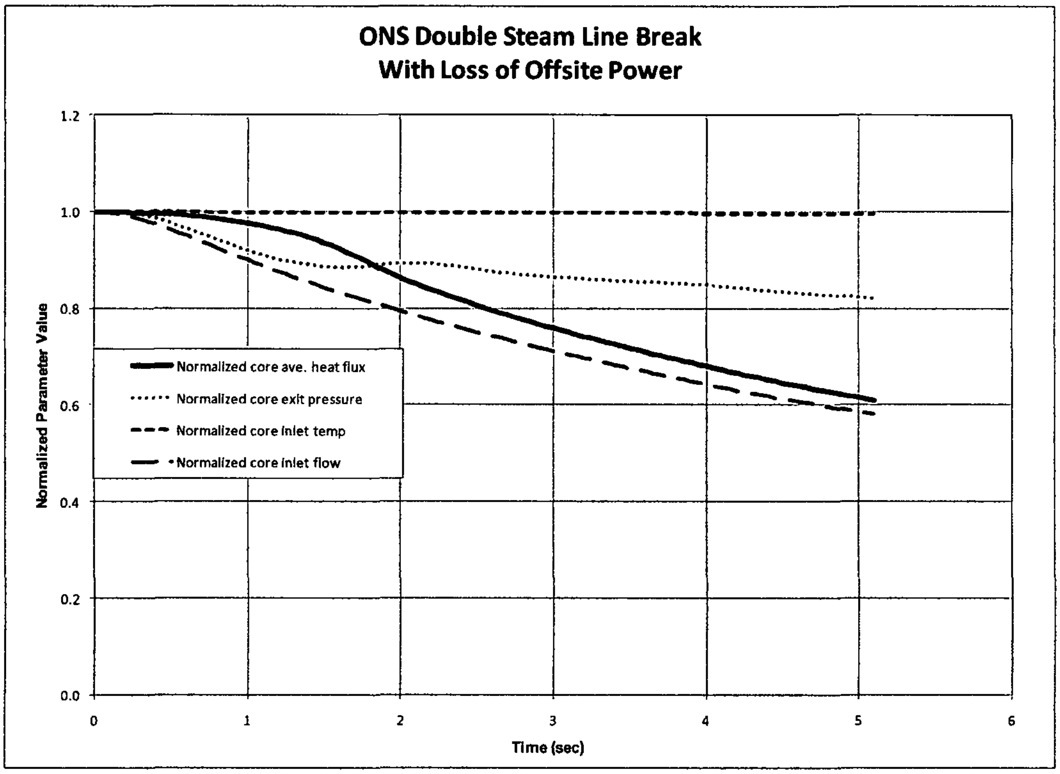

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Figure 161.1

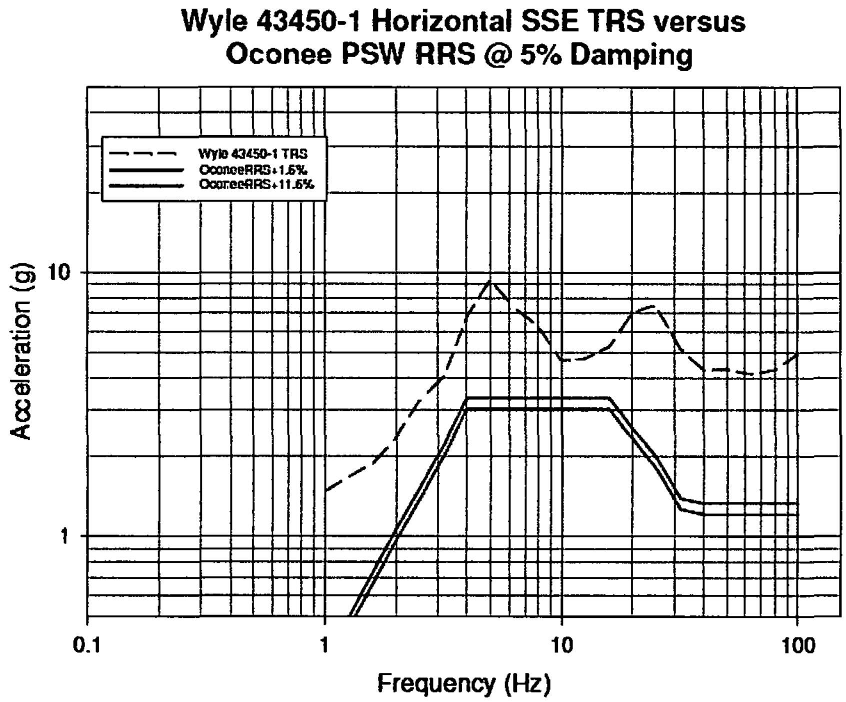

FIGURE 5.6(a): OCONEE HORIZONTAL SSE RRS COMPARED TO
THE WYLE NO. 43450-1 LOWER BOUND TRS

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Figure 161.2

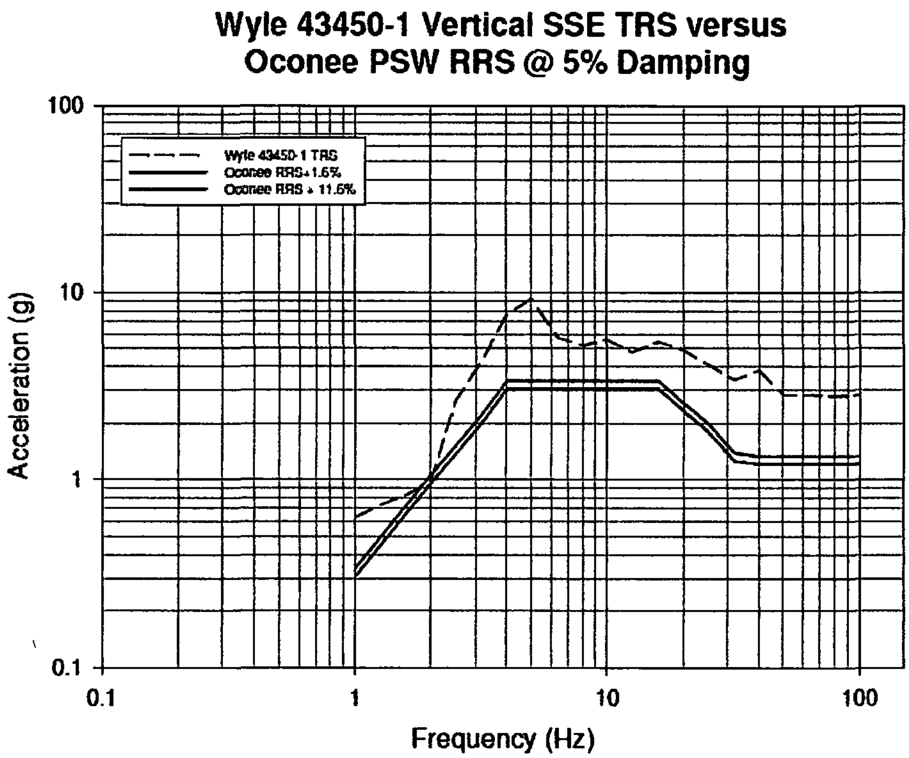

FIGURE 5.6(b): OCONEE VERTICAL SSE RRS COMPARED TO THE WYLE NO. 43450-1 LOWER BOUND TRS

Attachment 2

Regulatory Commitment Table

The following table identifies the regulatory commitments in this document. Any other statements in this submittal represent intended or planned actions. They are provided for information purposes and are not considered to be regulatory commitments.

Commitment	Due Date
1. Establish program to implement periodic condition inspections of the cable trenches, duct banks, manholes and drainage systems associated with the Keowee to PSW building underground path.	June 26, 2013
2. Include the Keowee to PSW underground path cables in the Oconee Cable Aging Management program.	December 15, 2013
3. Resolve the two (2) FMEA-related deficiencies associated with the designs of the 4 KV SSF and 13.8 KV Keowee distribution feeder circuits.	Prior to placing PSW into service