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May 19, 2016

Serial: BSEP 16-0024

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

Subject: Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2
Renewed Facility Operating License Nos. DPR-71 and DPR-62
Docket Nos. 50-325 and 50-324
Notification of Full Compliance with Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond Design Basis External Events" and Order EA-12-051, "Order to Modify Licenses With Regard To Reliable Spent Fuel Pool Instrumentation" for BSEP, Units 1 and 2

References:

1. Nuclear Regulatory Commission (NRC) Order Number EA-12-049, *Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events*, dated March 12, 2012, Agencywide Documents Access and Management System (ADAMS) Accession Number ML12054A735.
2. Duke Energy Letter, *Overall Integrated Plan in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)*, dated February 28, 2013, ADAMS Accession Number ML13071A559.
3. NRC Order Number EA-12-051, *Issuance of Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation*, dated March 12, 2012, ADAMS Accession Number ML12054A679.
4. Duke Energy Letter, *Carolina Power and Light Company's Overall Integrated Plan in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)*, dated February 28, 2013, ADAMS Accession Number ML13086A096.
5. NRC Letter, *Brunswick Steam Electric Plant, Units 1 and 2 - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC Nos. MF0975 and MF0976)*, dated November 22, 2013, ADAMS Accession Number ML13220A090.
6. NRC Letter, *Brunswick Steam Electric Plant, Units 1 and 2 - Interim Staff Evaluation and Request for Additional Information Regarding the Overall Integrated Plan for Implementation of Order EA-12-051, Reliable Spent Fuel Pool Instrumentation (TAC Nos. MF0973 and MF0974)*, dated November 18, 2013, ADAMS Accession Number ML13269A345.
7. NRC Letter, *Brunswick Steam Electric Plant, Units 1 and 2 - Report for the Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Pool Instrumentation*

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Related to Orders EA-12-049 and EA-12-051 (TAC Nos. MF0975, MF0976, MF0973 and MF0974), dated March 31, 2015, ADAMS Accession Number ML15082A155.

8. Duke Energy Letter, *First Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)*, dated August 20, 2013, ADAMS Accession Number ML13248A447.
9. Duke Energy Letter, *Second Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)*, dated February 28, 2014, ADAMS Accession Number ML14073A451.
10. Duke Energy Letter, *Third Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)*, dated August 28, 2014, ADAMS Accession Number ML14254A176.
11. Duke Energy Letter, *Fourth Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)*, dated February 27, 2015, ADAMS Accession Number ML15084A156.
12. Duke Energy Letter, *Fifth Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)*, dated August 26, 2015, ADAMS Accession Number ML15246A034.
13. Duke Energy Letter, *Sixth Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)*, dated February 24, 2016, ADAMS Accession Number ML16074A394.
14. Duke Energy Letter, *First Six-Month Status Reports in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)*, dated August 26, 2013, ADAMS Accession Number ML13242A010.
15. Duke Energy Letter, *Second Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)*, dated February 27, 2014, ADAMS Accession Number ML14073A063.
16. Duke Energy Letter, *Third Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)*, dated August 28, 2014, ADAMS Accession Number ML14254A404.
17. Duke Energy Letter, *Fourth Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)*, dated February 27, 2015, ADAMS Accession Number ML15075A024.
18. Duke Energy Letter, *Fifth Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool*

Instrumentation (Order Number EA-12-051), dated August 26, 2015, ADAMS Accession Number ML15246A033.

19. Duke Energy Letter, *Sixth Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)*, dated February 24, 2016, ADAMS Accession Number ML16074A398.
20. Duke Energy Letter, *Notification of Full Compliance with Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond Design Basis External Events" and Order EA-12-051, "Order to Modify Licenses With Regard To Reliable Spent Fuel Pool Instrumentation" for BSEP, Unit 2*, dated June 3, 2015, ADAMS Accession Number ML15173A013.

Ladies and Gentlemen:

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Order EA-12-049, *Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,* and Order EA-12-051, *Issuance of Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation,* (Reference 1 and Reference 3, respectively).

The Orders require holders of operating reactor licenses and construction permits issued under Title 10 of the *Code of Federal Regulations* Part 50 to submit, for review, Overall Integrated Plans (OIPs) including descriptions of how compliance with the requirements of each Order will be achieved. By letter dated February 28, 2013 (Reference 2), the OIP for Brunswick Steam Electric Plant (BSEP), Units 1 and 2, in response to Order EA-12-049 was submitted. In a separate correspondence, the OIP for BSEP, Units 1 and 2, in response to Order EA-12-051 was submitted by letter dated February 28, 2013 (Reference 4).

Order EA-12-049, Section IV.A.2 and Order EA-12-051, Section IV.A.2 requires completion of full implementation to be no later than two (2) refueling cycles after submittal of the overall integrated plan, as required by Condition C.1.a, or December 31, 2016, whichever comes first. In addition, Section IV.C.3 of Orders EA-12-049 and EA-12-051 requires that Licensees and Construction Permit holders report to the NRC when full compliance is achieved. For BSEP Unit 2, the requirement for full implementation of NRC Orders EA-12-049 and EA-12-051 was prior to restart from the BSEP, Unit 2, Spring 2015 refueling outage (i.e., B222R1). For BSEP Unit 1, the requirement for full implementation of NRC Orders EA-12-049 and EA-12-051 was prior to restart from the BSEP, Unit 1, Spring 2016 refueling outage (i.e., B121R1).

On April 4, 2015, BSEP, Unit 2, entered Mode 2 (Startup) following the B222R1 refueling outage. As such, April 4, 2015, is the compliance date for BSEP, Unit 2, and BSEP, Unit 2 is in full compliance with Orders EA-12-049 and EA-12-051 as demonstrated by letter dated June 3, 2015 (Reference 20).

On March 23, 2016, BSEP, Unit 1, entered Mode 2 (Startup) following the B121R1 refueling outage. As such, March 23, 2016, is the compliance date for BSEP, Unit 1, and BSEP, Unit 1 is in full compliance with Orders EA-12-049 and EA-12-051, as demonstrated by this submittal and any other docketed correspondence concerning these Orders. This determination is based on the best available information and analyses that have been completed as of the date of this letter.

Enclosure 1 provides a brief summary of the key elements associated with compliance to Orders EA-12-049 and EA-12-051 for BSEP, Unit 1. BSEP has permanently pre-staged two FLEX Diesel Generators. This strategy is considered an alternative approach to the provisions of NEI 12-06, Revision 0. The justification for this alternative approach is provided in a separate correspondence dated June 3, 2015 (Reference 20). Refer to Enclosure 3 of Reference 20.

Enclosure 2 provides the response to the NRC Interim Staff Evaluation (ISE) (References 5 and 6) open and confirmatory items, and the NRC Audit Report (Reference 7) open items for BSEP, Units 1 and 2. For each Open and Confirmatory Item identified in Enclosure 2, a summary response in support of closure is provided. As such, Duke Energy considers these items complete pending NRC closure.

Enclosure 3 provides the BSEP, Units 1 and 2, FLEX Final Integrated Plan (FIP).

Enclosure 4 provides the BSEP, Units 1 and 2, Response to NRC Request for Additional Information for Reliable Spent Fuel Pool Level Instrumentation.

Enclosure 5 provides the BSEP, Units 1 and 2, Bridging Document Between Vendor Technical Information and BSEP Specific Considerations for Spent Fuel Pool Level Instrumentation.

This letter contains no new regulatory commitments.

If you have any questions regarding this submittal, please contact Mr. Lee Grzeck, Manager - Regulatory Affairs, at (910) 457-2487.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on May 19, 2016.

Sincerely,

William R. Gideon

Enclosures:

1. BSEP, Unit 1, Summary of Compliance Elements for Orders EA-12-049 and EA-12-051.
2. BSEP, Units 1 and 2, Interim Staff Evaluation Open and Confirmatory Items, and Audit Open Items.
3. BSEP, Units 1 and 2, FLEX Final Integrated Plan.
4. BSEP, Units 1 and 2, Response to NRC Request for Additional Information for Reliable Spent Fuel Pool Level Instrumentation.
5. BSEP, Units 1 and 2, Bridging Document Between Vendor Technical Information and BSEP Specific Considerations for Spent Fuel Pool Level Instrumentation.

cc (with enclosures):

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ENCLOSURE 1

BSEP, Unit 1, Summary of Compliance Elements for Orders EA-12-049 and EA-12-051

ENCLOSURE 1
BSEP, Unit 1, Summary of Compliance Elements for Orders EA-12-049 and EA-12-051

Note: References noted in this enclosure refer to the references on pages 3, 4, and 5 of this enclosure.

The elements identified below for BSEP, Unit 1, as well as the Overall Integrated Plans (OIP) for Orders EA-12-049 and EA-12-051 (References 2 and 4, respectively), the 6-Month Status Reports for Orders EA-12-049 and EA-12-051 (References 8 through 13 and 14 through 19, respectively), and any additional docketed correspondence, demonstrate compliance with Orders EA-12-049 and EA-12-051.

Strategies – Complete

BSEP, Unit 1, strategies are in compliance with Order EA-12-049. All strategy related Open Items, Confirmatory Items, or Audit Questions/Audit Report Open Items have been addressed and are considered complete pending NRC closure.

Identification of Levels of Required Monitoring - Complete

BSEP, Unit 1, has identified the three required levels for monitoring Spent Fuel Pool (SFP) level in compliance with Order EA-12-051. These levels have been integrated into the site processes for monitoring level during beyond-design-basis external events, including responding to loss of SFP inventory.

Modifications - Complete

The modifications required to support the FLEX strategies for BSEP, Unit 1, have been fully implemented in accordance with the station design control process. The design of the Spent Fuel Pool Level Instrumentation installed at BSEP, Unit 1, complies with the requirements specified in the Order and described in NEI 12-02, Revision 1, *Industry Guidance for Compliance with NRC Order EA-12-051*. The instruments have been installed in accordance with the station design control process.

Equipment – Procured and Maintenance & Testing - Complete

The equipment required to implement the Mitigation Strategies and Reliable Spent Fuel Pool Level Instrumentation is ready for use at BSEP, Unit 1. Testing and Maintenance processes have been established through the use of Industry endorsed Electric Power Research Institute (EPRI) Guideline and the BSEP Preventative Maintenance program such that FLEX equipment reliability is achieved. Operating and maintenance procedures for the Spent Fuel Pool Instruments for BSEP, Unit 1, have been developed, and integrated with existing procedures. These procedures have been verified and are available for use in accordance with the site procedure control program. Site processes have been established to ensure the Spent Fuel Pool Instruments are maintained at their design accuracy.

Protected Storage - Complete

The storage facilities required to implement the FLEX strategies for BSEP, Unit 1, have been completed and provide protection from the applicable site hazards. The equipment required to implement the FLEX strategies for BSEP, Unit 1, is stored in its protected configuration and is ready for use.

Procedures - Complete

FLEX Support Guidelines (FSG) and procedures for the maintenance and use of the Spent Fuel Pool Level Instrumentation for BSEP, Unit 1, have been developed in accordance with NEI 12-06, Revision 0, Section 3.2.2 and NEI 12-02, Revision 1, Section 4.2. The FSGs and affected existing procedures have been verified and are available for use in accordance with the site procedure control program.

Training - Complete

Training for BSEP, Unit 1, has been completed using the BSEP Systematic Approach to Training (SAT) as recommended in NEI 12-06, Revision 0, Section 11.6 and in NEI 12-02, Revision 1, Section 4.1.

Staffing - Complete

The staffing study for BSEP has been completed in accordance with NEI 12-01, Revision 0 and 10 CFR 50.54(f), *Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident*, Recommendation 9.3, dated March 12, 2012 (Reference 21), as documented in letter dated October 13, 2014 (Reference 22), and April 16, 2015 (Reference 23). The staffing study confirmed that BSEP has adequate staffing to perform the actions to mitigate beyond-design-basis external events.

National Safer Response Centers - Complete

Duke Energy has established a contract with the Pooled Equipment Inventory Company (PEICo) and has joined the Strategic Alliance for FLEX Emergency Response (SAFER) Team Equipment Committee for off-site facility coordination. PEICo is ready to support BSEP with Phase 3 equipment stored in the National SAFER Response Centers in accordance with the site specific SAFER Response Plan.

Validation - Complete

Duke Energy has completed performance of validation in accordance with industry developed guidance to assure required tasks, manual actions, and decisions for FLEX strategies are feasible and may be executed within the constraints identified in the Overall Integrated Plans (OIP) for Order EA-12-049.

FLEX Program Document - Complete

The FLEX Program Document for BSEP has been developed in accordance with the requirements of NEI 12-06, Revision 0, and has been revised to include BSEP, Unit 1.

References

1. Nuclear Regulatory Commission (NRC) Order Number EA-12-049, *Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events*, dated March 12, 2012, Agencywide Documents Access and Management System (ADAMS) Accession Number ML12054A735.
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6. NRC Letter, *Brunswick Steam Electric Plant, Units 1 and 2 - Interim Staff Evaluation and Request for Additional Information Regarding the Overall Integrated Plan for Implementation of Order EA-12-051, Reliable Spent Fuel Pool Instrumentation (TAC Nos. MF0973 and MF0974)*, dated November 18, 2013, ADAMS Accession Number ML13269A345.
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10. Duke Energy Letter, *Third Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)*, dated August 28, 2014, ADAMS Accession Number ML14254A176.
11. Duke Energy Letter, *Fourth Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)*, dated February 27, 2015, ADAMS Accession Number ML15084A156.

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13. Duke Energy Letter, *Sixth Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)*, dated February 24, 2016, ADAMS Accession Number ML16074A394.
14. Duke Energy Letter, *First Six-Month Status Reports in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)*, dated August 26, 2013, ADAMS Accession Number ML13242A010.
15. Duke Energy Letter, *Second Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)*, dated February 27, 2014, ADAMS Accession Number ML14073A063.
16. Duke Energy Letter, *Third Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)*, dated August 28, 2014, ADAMS Accession Number ML14254A404.
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20. Duke Energy Letter, *Notification of Full Compliance with Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond Design Basis External Events" and Order EA-12-051, "Order to Modify Licenses With Regard To Reliable Spent Fuel Pool Instrumentation" for BSEP, Unit 2*, dated June 3, 2015, ADAMS Accession Number ML15173A013.
21. NRC Letter, *Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident*, Recommendation 9.3, dated March 12, 2012, ADAMS Accession No. ML12053A340.
22. Duke Energy Letter, *Response to March 12, 2012, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.45(f) Regarding Recommendations of the Near Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, Enclosure 5, Recommendation 9.3, Emergency Preparedness- Staffing, Requested*

Information Items 1, 2, and 6 - Phase 2 Staffing Assessment, dated October 13, 2014, ADAMS Accession Number ML14296A474.

23. NRC Letter, *Brunswick Steam Electric Plant Units 1 and 2 – Response Regarding Phase 2 Staffing Submittals Associated With Near-Term Task Force Recommendation 9.3 Related to the Fukushima Dai-ichi Nuclear Power Plant Accident (TAC Nos. MF5141 and MF5142),* dated April 16, 2015, ADAMS Accession Number ML15082A441.
24. NEI 12-06, Revision 0, *Diverse and Flexible Coping Strategies (FLEX) Implementation Guide.*
25. NEI 12-02, Revision 1, *Industry Guidance for Compliance with NRC Order EA-12-051, to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation.*
26. NEI 12-01, Revision 0, *Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities.*

ENCLOSURE 2

BSEP, UNITS 1 AND 2, INTERIM STAFF EVALUATION OPEN AND CONFIRMATORY ITEMS, AND AUDIT OPEN ITEMS

ENCLOSURE 2
BSEP, UNITS 1 AND 2, INTERIM STAFF EVALUATION OPEN AND CONFIRMATORY ITEMS, AND AUDIT OPEN ITEMS

FLEX ISE - OPEN ITEMS		
Item Number	Description	Response
3.1.1.C	The licensee has indicated that BSEP procedures and programs are being developed to address storage structure requirements, but insufficient information was provided to ascertain that these procedures and programs will provide for securing large portable equipment to protect them during a seismic event or to ensure unsecured and/or non-seismic components do not damage the equipment as is specified in NEI 12-06, Section 5.3.1, considerations 2 and 3. Item 2 specifies that large portable equipment should be secured as appropriate to protect it during a seismic event. Item 3 specifies that stored equipment and structures should be evaluated and protected from seismic interactions to ensure that unsecured and/or non-seismic components do not damage the equipment.	The BSEP FLEX Storage Building is robust (with respect to seismic events, floods, and high winds, and associated missiles). The building has seismically designed anchor points within the building. See EC 290400. BSEP conducted an evaluation for the FLEX equipment storage configuration to be maintained in the Flex Storage Building. Equipment is maintained in the Flex Storage Building in accordance with this evaluation which uses spacing as the means for protecting large portable equipment during a seismic event, rather than securing large portable equipmentd. See EC 299559 Attachment Z17R2. All stored equipment is placed in the building such that ample spacing between nearby adjacent portable equipment is maintained as a defense-in-depth measure such that if some equipment were to move during a seismic event it will not impact any other equipment. The actual locations of the portable equipment is marked on the dome floor so that its location can be controlled. This equipment location is captured in the FLEX program manual for control.
3.1.1.2.B	The licensee identified on page 13 of their Integrated Plan, that they plan to construct a clean water tank to supply Reactor Core Isolation Cooling (RCIC) and High Pressure Coolant Injection (HPCI) with water of acceptable quality for RCIC/HPCI injection into the reactor pressure vessel (RPV). However, the licensee did not identify the design specifications for the clean water tank or state that the clean water tank will be designed to withstand all hazards. Therefore, there is not sufficient information	The OIP identified a modification to build a new Clean Water Storage Tank (CWST). This storage tank is not used in BSEP's FLEX strategy as reported in the BSEP third six month status update report (ML14254A176). BSEP evaluation shows the Condensate Storage Tanks (CST) are robust to all applicable external hazards with the exception of tornado missiles impacting the connection points on the CSTs (nozzles and associated piping). Missile barrier protection is designed and installed for the CSTs such that the CST(s) will be available for use following a Beyond-Design-Basis External Event (BDBEE). • EVAL EC 295856 contains documentation showing the CST are robust with respect to all applicable external hazards with the

FLEX ISE - OPEN ITEMS		
Item Number	Description	Response
	to confirm that the clean water tank will survive all hazards.	exception of tornado missiles impacting the connection points on the CSTs (nozzles and associated piping). • To address tornado missile impact to CST connections a barrier has been designed and is installed per the specifications in EC 295811. • The CST is designed as a clean water supply to both RCIC and HPCI for phase 1 response. • Modifications have been implemented to the CST drain lines to allow the phase 2 Flex pump to take suction from the CST and supply water to the Reactor Pressure Vessel and Spent Fuel Pool. FLEX strategies have been modified to reflect use of the CST (U1 EC 295520, U2 EC 295521).
3.1.1.3.B	The licensee did not provide a discussion in their Integrated Plan regarding implementation of the mitigating strategies with respect to the procedural interface considerations for seismic hazards associated with large internal flooding sources that are not seismically robust and do not require ac power and the use of ac power to mitigate ground water in critical locations. Therefore, there is not sufficient information to address NEI 12-06 Section 5.3.3 considerations 2 and 3.	BSEP Unit 1 and Unit 2 do not have any sources of large internal flooding from sources that are not seismically robust and do not require AC power. The large external sources of water for BSEP are from the ultimate heat sink, which is below the elevation of the site and requires a motive force to transport the water into the buildings. The internal areas for Flex response include the Emergency Diesel Generator (EDG) Fuel Oil vault, the EDG building, the Unit 1 and Unit 2 Reactor Buildings, and the Control Building 23 ft. elevation and above. None of these structures are subject to large internal flooding from external sources without AC power present. None of these areas rely upon AC power to mitigate ground water in critical locations.
3.2.1.1.F	The MAAP analysis report addressing coping time under ELAP conditions acknowledges that the initial wetwell liquid volume assumed in the MAAP analysis is approximately 25% greater than the actual liquid volume specified in the Brunswick final safety analysis report (reference Table 4-1 in calculation note CN-AE0-13-0001). The MAAP analysis report attempted to justify	BSEP has updated the MAAP analysis. The revised analysis, BSEP calculation BNP-MECH-FLEX-0002, contains code in the input file that corrects the wetwell liquid volume.

FLEX ISE - OPEN ITEMS		
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	this discrepancy by stating that the basis for the reduced water volume in the final safety analysis report was a modification to the suction strainers for the emergency core cooling system that are located in the wetwell. The MAAP analysis report further presumed that the consequent reduction to the wetwell initial water volume resulted solely from the displaced volume of the new strainers, ultimately reasoning that the MAAP analysis with the overestimated wetwell liquid volume remains valid because the product of the density and specific heat capacity of the metal strainers would be similar (e.g., estimates to within roughly 15%) to that of the displaced water volume. However, the reasoning presented in the MAAP analysis report appears questionable firstly because the suction strainers are not solid structures (i.e., it is not clear that a substantial part of what the MAAP analysis report presumes to be "displaced volume" is not in fact wetwell liquid that has passed through perforations and filled the interior volume of the strainers). Secondly, displacing a water volume of approximately 20,000 ft^3 solely with stainless steel would require a mass of steel (i.e., roughly 5000 tons) that is significantly larger than expected for wetwell suction strainers. In addition to the above concerns, since the	

FLEX ISE - OPEN ITEMS		
Item Number	Description	Response
	wetwell water volume is actually 20,000 ft^3 less than indicated in the MAAP analysis report, there is a concern over how accurately the initial water level value of 11.84 ft and the rate of water level decrease are represented within the analyses; a lower initial water level or a more rapid decrease in water level could result in inadequate RCIC NPSH when compared to the current analyses. In light of these issues, either provide adequate documentation to substantiate the assumptions and calculations in the MAAP analysis report, or else provide a revised analysis of the coping time available under ELAP conditions that incorporates an initial wetwell water volume and level that is representative of Brunswick.	
3.2.1.2.A	A review was conducted of the licensee's integrated plan and it was determined that there is insufficient information provided to determine the adequacy of the determination of recirculation pump seal or other sources of leakage used in the ELAP analysis.	BSEP has updated the MAAP analysis. a. BSEP calculation BNP-MECH-FLEX-0002 includes 61 gpm initial (at normal system operating pressure) leakage consisting of 36 gpm from the Recirculation pump seals and 25 gpm to account for maximum primary system Technical Specification leakage. b. BSEP calculation BNP-MECH-FLEX-0002 models the 61 gpm leakage as an equivalent opening size (small LOCA) that gives 61 gpm leakage at normal system pressure. This leakage decreases as primary system pressure is decreased in the analysis.
3.2.1.3.A	In subsequent discussions with the licensee during the audit process, information was requested regarding HPCI CST to suppression pool switchover instrumentation	Evaluation of existing conditions and modifications will result in the CST being robust and available following a BDBEE (see response to open item 3.1.1.2.B).

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	such that HPCI would remain operational with injection to the RPV uninterrupted, if during the ELAP event, the CST is damaged and no longer available. The discussion was to include whether the switchover function is automatic, fail- safe, and whether function logic and hardware, related piping, valves, systems, structures, and components (SSCs) to support the switchover function are of safety grade and are qualified for all criteria including tornado/high winds. If not, then justify how switchover from CST to Suppression Pool will be assured in ELAP conditions if the CSTs are unavailable. The licensee described the above information for RCIC but not HPCI as requested.	In normal operation HPCI and RCIC in standby have the suction aligned to the CST. Upon receipt of a low CST level, the suction will automatically transfer from the CST to the suppression pool. The CST level instruments are seismically robust and the instrumentation is missile protected, although there is a portion of the instrument vent pipe that is subject to missile impact that could result in a failure that could prevent the automatic suction swap over at the desired level. The instrumentation power supply is 125VDC. During an extended loss of AC power (ELAP) event, the RCIC/HPCI valves position will not be affected. Although some of the valves in the flow path are Primary Containment Isolation Valves, they do not fail safe upon a loss of AC power. With a lowering CST level, or if the CST level instrumentation experiences some failure, the operator would be alerted by control room alarm (RCIC SUCT XFR CST LO LVL [A-02 3-8], HPCI COND STORAGE TNK WTR LVL LO [A-01 6-4]), possible reduction in RCIC (or HPCI) flow, or a RCIC (or HPCI) pump trip on low suction pressure. Procedures and training will ensure operators will manually transfer the RCIC/HPCI suction from the CST to the suppression pool. All valve motor operators required to perform the suction transfer are DC powered. RCIC and HPCI piping, valves, logic, and logic power required to perform the transfer will be robust (with respect to seismic events, floods, and high winds, and associated missiles) components. The quality classification is Quality Class B, Augmented Quality. HPCI is not credited in the BSEP Flex response.
3.2.1.3.B	On page 41 of the Integrated Plan, the SOE timeline Action Item 3 describes the depressurization of the RPV to 150 - 300 psig within 1 hour. The integrated plan is not consistent between the discussions in the Maintain Containment section and the SOE timeline regarding RPV pressure. Additional information relative to the	BNP-MECH-FLEX-002 MAAP analysis assumes that the RPV is depressurized to 450 psia at t=1.0 hour. At t=2.0 hour, the RPV is depressurized to 165-315 psia and is maintained in the pressure band of 165-315 psia for the duration of the event to allow continuous injection from RCIC. The Technical Specification cool down rate limit of 100°F/hr is not exceeded for this analysis. In BNP-MECH-FLEX-002, the suppression pool reaches 190°F in

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	appropriate RPV pressures during the BDBEE is needed that includes a description of the impact of not attaining these pressure in the required times.	approximately 3 hours, at which point the RCIC suction is re-aligned to the Condensate Storage Tank. Also in this MAAP calculation, containment pressure is tracked to determine the time that the Hardened Containment Vent will be opened to prevent exceeding the Primary Containment Pressure Limit (PCPL). This occurs at approximately 17.7 hours after the event initiation. The timing and rate of the RPV cool down is not critical in this strategy. If the cool down is delayed, the result is that the RPV is maintained at higher pressure for a period of time greater than that analyzed. However, the RPV pressure is maintained in the same manner – by SRV discharge to the suppression pool coupled with RCIC steam extraction from the RPV, discharging to the suppression pool. The higher steam pressure maintains RCIC in service and a delay in depressurizing will not add any more heat to the suppression pool since these steam extractions will effectively match the decay heat rate. Likewise, if the depressurization is started earlier than analyzed, more SRV steam will be used to depressurize the RPV than that used at a later time when decay heat is reduced. However, the net effect on the suppression pool and containment parameters is minimal. The RCIC suction will still be re-aligned to the CST at 190°F and the containment vent will be opened at PCPL.
3.2.1.3.C	Information was not provided to determine if; RCIC will be started automatically or at a time required by analysis following the initiation of the event, if any elapsed time constraint exists for this action or if pressure and temperature conditions in the containment predicted in NEDC-33711P Rev 1, have been considered. In addition, the required net positive suction head	BSEP calculation BNP-MECH-FLEX-0002 modeled RCIC as operating automatically so that: a. Auto start on low RPV level b. No specific time constraint identified c. BSEP-specific containment response was calculated in this MAAP run. For the purposes of the BSEP strategy displayed in MAAP, RCIC is initially aligned to the suppression pool and the suction is transferred to

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	required for RCIC to be operable during an ELAP has not been discussed.	the CST, then when the suppression pool reaches 190°F the suction is transferred back to the CST. This ensures the suction is on cooler water with more NPSH available than from the suppression pool. MAAP models RCIC as running in batch mode between the low level start and high level trip setpoints. However, if the operators take manual control and throttle RCIC flow to avoid repeated starts, the lower flow rate and turbine speed will require lower NPSH. The worst anticipated operating condition for RCIC NPSH occurs, assuming the pump is operated at full speed, just before the transfer back to the CST. BSEP calculation 9527-8-E41-06F, Rev. 1 shows that RCIC has sufficient NPSH available at 193°F in the suppression pool and with the suppression pool at atmospheric pressure. Therefore, the lowest margin to RCIC loss of NPSH is approximately 3°F which is equivalent at that point to 1 foot of head.
3.2.1.3.F	The SOE timeline on page 42 of 57 identifies that at 19.5 hours, the Action is to vent containment via HCVS. The Remarks/Applicability section states that primary containment pressure is assumed based on MAAP run. It also identifies that the venting must take place prior to exceeding the Primary Containment Pressure Limit (PCPL- A) of 70 psia. In a review of NEDC-33771P, Revision 1, starting to vent containment via the HCVS at 19.5 hours does not appear to be supported when compared to the analysis presented in Appendix B, "BWR/4 Mark I Containment Response Plots (No Venting, Suction from Suppression Pool)" or Appendix C, "BWR/4 Mark I Containment Response Plots (No Venting, Suction from CST)." Please	BSEP calculation BNP-MECH-FLEX-0002, the updated MAAP analysis with corrected suppression pool volume, identifies that the Primary Containment Pressure Limit is reached in 17.7 hours so the updated time to open the hardened wetwell vent is 17.7 hours. NEDC-33771P, R1 used a representative BWR 4 with a Mark I containment that did not have the same size or power as BSEP. For example, BSEP thermal power at 100% is 2923 MWt, whereas the representative BWR Mark I was modeled with a higher thermal power. The suppression pool volume used in NEDC-33771P, R1 was different than the nominal BSEP suppression pool volume. Furthermore, the SHEX analysis of NEDC-33771P used a generic wetwell vent flow resistance whereas BNP-MECH-FLEX-0002 used a BSEP plant specific flow model that accounted for flow resistance and possible choked flow and re-calculated the flow resistance coefficient at each calculation time-step. Given that the BSEP calculation is plant-specific to BSEP, it should be considered a better estimate of BSEP plant response than the generic Mark 1 calculation of NEDC-33771P.

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	provide justification that 19.5 hours is appropriate.	
3.2.1.4.A	On page 14 of the integrated plan regarding Portable Equipment to Maintain Core Cooling, the licensee describes the use of portable pumps to provide RPV injection. No technical basis or a supporting analysis was provided for the; the diesel-driven FLEX pump capabilities considering the pressure within the RPV and the loss of pressure along with details regarding the FLEX pump supply line routes, length of hoses runs, connecting fittings, elevation changes to show that the pump is capable of injecting water into the RPV with a sufficient rate to maintain and recover core inventory for both the primary and alternate flow paths.	The design of the FLEX strategies' modification as described in EC 290412 includes a final hydraulic analysis of the piping/hose configuration. The final hydraulic analysis, BSEP calculation 0FLEX-0003, Hydraulic Analysis for Fukushima FLEX Connection Modifications, ensures the FLEX pump flow/pressure capacity is adequate for both the primary and alternate flow paths on both Unit 1 and Unit 2.
3.2.1.8.A	On page 50 of the Integrated Plan, the licensee provided Sketch 4, "Flow Diagram for FLEX Strategies." Note 5 states that a booster pump between the CWST and the RCIC pump suction will be dependent on the final design. However, no evaluation to determine if a booster pump is needed and a description of any changes has been provided.	The OIP identified a modification to build a new Clean Water Storage Tank (CWST). This storage tank is not used in BSEP's FLEX strategy as reported in the BSEP third six month status update report (ML14254A176). BSEP evaluation shows the Condensate Storage Tanks (CST) are robust to all applicable external hazards with the exception of tornado missiles impacting the connection points on the CSTs (nozzles and associated piping). Missile barrier protection is designed and installed for the CSTs such that the CST(s) will be available for use following a BDBEE. (see response to Open item 3.1.1.2.B). EC 290412 contains BSEP calculation 0FLEX-0003, Hydraulic Analysis for Fukushima FLEX Connection Modifications, showing that with the new configuration a booster pump is not required to meet flow

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		requirements.
3.2.3.A	The licensee is requested to provide finalized plant specific ELAP analysis information commensurate with the level of detail contained in NEDC-33771P, including analysis assumptions and results in their tabulated and plotted formats. An in-depth understanding of the relationship between the NEDC-33771P document and its applicability to plant-specific analyses and decision points, if any, in the licensee's integrated plan is essential to determining that containment functions will be maintained in all Phases of an ELAP.	BSEP calculation MAAP analysis BNP-MECH-FLEX-0002 provides the analysis for the FLEX strategy including the assumptions and tabulated results. Refer to Open Item Responses 3.2.1.2.A, 3.2.1.3.B, 3.2.1.3.C, 3.2.1.3.F, and Confirmatory Item Responses 3.2.1.1.B, 3.2.1.1.D, 3.2.1.1.E . In addition, BSEP performed a detailed review of NEDC-33771P and compared it to the current BSEP plans and strategies. Refer to Open Item Response 3.2.1.3.C.
3.2.3.B	The NRC staff considers the adoption of Revision 3 to the BWROG Emergency Procedure Guidelines (EPG)/Severe Accident Guidelines (SAG) by licensees to be a Generic Concern (and thus an open item for the licensee) because the BWROG has not addressed the potential for the revised venting strategy to increase (relative to currently accepted venting strategies) the likelihood of detrimental effects on containment response for events in which the venting strategy is invoked.	BSEP has developed their FLEX response strategy to vent at PCPL and will not rely on anticipatory venting of containment (as described in the guidance of BWR Owners' Group Emergency Procedure and Severe Accident Guidelines (BWROG EPG/SAG) Revision 3). Regarding the generic aspect of the issue, NEI, in conjunction with the BWROG, drafted a white paper to discuss the benefits for anticipatory venting. The NRC endorsed the document (ML13352A057, ML13358A206).
3.2.4.2.A	The licensee's response did not address maintaining battery room ventilation. A discussion on the hydrogen gas exhaust path for each strategy is needed, and a discussion of the accumulation of hydrogen when the batteries are being recharged	In accordance with both 0EOP-01-FSG-004, FLEX DG Alignment, and 0EOP-01-SBO-07, 480V E-Bus Crosstie, when the FLEX DG(s) is supplying the battery chargers the 480V breakers required for supplying power to a set of battery room supply and exhaust fans, and a control room air compressor will be energized and the battery room fans will be started. This action takes place immediately after energizing the battery

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	during Phase 2 and 3.	chargers for the 125VDC/250VDC batteries. With the fans in service, hydrogen accumulation is not a concern. If for some reason the battery room ventilation cannot be placed in service, then both 0EOP-01-FSG-004 and 0EOP-01-SBO-07 direct securing the battery room doors open to allow a turnover of air volume in the room and notifying the emergency response organization (ERO) of the lack of forced ventilation in the battery rooms.
3.2.4.2.B	With regard to elevated temperatures as a result of loss of ventilation and/or cooling on electrical equipment being credit as part of ELAP strategies, the licensee is requested to specify whether the initial temperature condition assumed the worst-case outside temperature with the plant operating at full power, provide the list of electrical components that are located in the pump rooms that are necessary to ensure successful operation of required pumps, and to provide the qualification level for temperature and pressure for these electrical components for the duration that the pumps are assumed to perform its mitigating strategies function.	BSEP has finalized the GOTHIC analysis, BNP-MECH-FLEX-0001, for the Reactor Building(s) temperature response to the ELAP event. This document contains all initial assumptions and building temperature profiles. The report is tabulated for electrical heat loads at a component and area level. Analysis input has a design outside temperature of 93°F with building temperatures of 100°F. Case 1 gives the temperature response for the primary mitigation strategy selected by BSEP. Regarding electrical components that are located in pump rooms necessary to support pumps relied upon for FLEX strategy response, the only pump in the Reactor Building that is credited in the BSEP Flex response is RCIC. The electrical components supporting operation of RCIC are located in the south portion of the -17 ft. elevation of the Reactor Building (RHR SE Lower Room). The temperature profiles for this area for case 1 show all temperatures remain well below the Max Normal area temperature of 165°F specified in the Emergency Operating Procedures (EOP) Secondary Containment Control Procedure (SCCP) for the RCIC area. Case 1 shows a room temperature of 110°F at 6 hours and 131°F at seven days. While executing the EOPs, specifically 0EOP-03-SCCP (rev. 10) steps SC/T-3 and SCCP-11, the EQ envelopes for equipment in this area is only of concern if the Max Normal temperature is exceeded.
3.2.4.2.C	A discussion is needed on the extreme low temperatures effects of the batteries capability to perform its function for the duration of the ELAP event.	The battery room temperatures are checked by non-licensed operators on a shift basis (twice per day) per Reactor Operator Daily Check Sheet. The procedure requires the battery room temperatures to be maintained between 65°-100°F. If temperatures are outside of this range, specific

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		actions are delineated to return the temperatures to within range. Given this procedural control, it is reasonable to conclude that at the initiation of a BDBEE ELAP the battery room temperatures are not at an extreme low temperature. There are no plausible scenarios post ELAP where the battery room temperatures would lower to extreme low temperatures as the event unfolds. The GOTHIC analysis performed on the Control Building shows temperatures well above those of concern. Additionally, per NEI 12-06, BSEP is below the 35th parallel; therefore, the FLEX strategies are not required to consider the impedances caused by extreme snowfall with snow removal equipment. Because the same basic trend applies to extreme low temperatures, per NEI 12-06, BSEP FLEX strategies are not required to address extreme low temperatures.
3.2.4.3.A	In the integrated plan the licensee did not discuss the effects of loss of power to heat tracing and therefore additional information is required to conclude that this consideration from NEI 12-06 has been adequately addressed.	No BSEP Flex response components require heat trace to implement the FLEX strategies. The only components of concern include the CST HPCI/RCIC level instrumentation. Heat tracing of this instrumentation is required to maintain TS operability of the level instruments and the heat trace is assumed to be in service preventing freezing of the associated piping/instrumentation at the time of the BDBEE. These instruments are not credited in the FLEX response. Additionally, per NEI 12-06, BSEP is below the 35th parallel; therefore, the FLEX strategies are not required to consider the impedances caused by extreme snowfall with snow removal equipment. Because the same basic trend applies to extreme low temperatures, per NEI 12-06, BSEP FLEX strategies are not required to address extreme low temperatures.
3.2.4.4.A	A review was made of the Integrated Plan for coping strategies discussing plant lighting and communications systems during an ELAP that support personnel access for coping strategies that maintaining core, containment and SFP cooling. The licensee	BSEP has purchased portable lighting that will be stored in the robust FLEX storage building. • 2 – Diesel Light towers for outdoor lighting / Terex RL4 / 4,000 watts • 22 – Larger LED Lights (e.g.. Smithlights / Model IN120LB) • 36 – Portable Lightweight LED Lights All of these lights will be housed in the FLEX Storage Building and all

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	has not discussed their coping strategies for portable and emergency lighting necessary to facilitate personnel access into plant locations to implement mitigating strategies. Therefore, there is insufficient information to conclude that coping strategies for portable and emergency lighting will conform to the guidance of NEI 12-06, Section 3.2.2, consideration (8).	Lights will be kept on trickle chargers to ensure standby readiness. Each FLEX Support Guideline contains a section for equipment requirements to perform the tasks. The equipment required includes any portable lighting requirements, such as flashlights. Operators will be cognizant of the additional available portable lights, and may choose their use over flashlights, which are the only credited FLEX lighting equipment, depending on the task and other influencing factors. The credited method of communications will be via satellite phones and line-of-sight radios. Non-credited communications that may be available depending on the external hazard causing the event include the plant radio system and the public address (PA) system.
3.2.4.5.A	The licensee provided no information regarding local access to the protected areas under ELAP.	The access to the protected areas that may be affected by loss of AC power are security doors. Security doors have key-locks that allow access/egress upon a loss of the Security function. Specified Operations' personnel have access to Security keys that can override the loss of door Security function. Personnel determined to require Security keys are given access to the Security keys.
3.2.4.8.A	The licensee plans on using the FLEX DGs to power various systems prior to battery depletion. The licensee did not provide any information or strategy regarding electrical isolation from installed plant equipment. It was determined that there was insufficient information available to conclude that there is reasonable assurance that the licensee will ensure that the FLEX DGs and the Class 1E diesel generators are isolated to prevent simultaneously supplying power to the same Class 1E bus.	If the Emergency Diesel Generators (EDG) are operational and functioning the FLEX DGs are not required. In this case, it is required that the FLEX DGs be electrically isolated from the plant electrical distribution system by design. Electrical isolation of each FLEX DG to the plant electrical distribution system is accomplished via two separate and distinct methods present in their standby alignment: • The output of each FLEX DG has a manually operated disconnect switch that must be closed to align the FLEX DG to its associated FLEX switchgear input breaker. This switch has no auto close capabilities. • The interface between the FLEX switchgear and the associated 480V E-bus is isolated by a racked out 480V breaker on the emergency bus switchgear. In cases where the EDGs are not available during a SBO (ELAP), prior

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		to placing a FLEX DG in service, the feeder breaker from the EDG to the 480 VAC E-bus is opened to ensure the 480 VAC E-bus is isolated prior to energizing from the FLEX DG (0EOP-01-FSG-04 and 0EOP-01-SBO-07). Additionally, the installed EDGs will be disabled and isolated such that they cannot supply the same electrical distribution by pulling dummy fuses at each EDG local control panel. This action is taken in accordance with 0EOP-01-SBO-02, step 2.3.10.
3.2.4.8.B	Additional description of the instrumentation that will be used to monitor portable/FLEX electrical power equipment including their associated measurement tolerances/accuracy to ensure that: 1) the electrical equipment remains protected (from an electrical power standpoint- e.g., power fluctuations) and 2) the operator is provided with accurate information to maintain core cooling, containment, and SFP cooling.	1. The 500 KW FLEX DGs that will supply AC power to FLEX credited equipment procurement specification includes, but is not limited to: a. AC voltmeter(s) for each phase or a phase selector switch. b. AC ammeter(s) for each phase or a phase selector switch. c. Frequency meter. d. Voltage-adjusting rheostat to allow ±5 percent voltage adjustment e. The voltage regulator shall be capable of responding to changes in loads to meet the following system stability requirements: 1) Stable voltage and frequency at all loads shall be provided up to the full-rated load. 2) Steady-State Voltage Operational Bandwidth: 0.5% percent of rated output voltage from no load to full load. 3) Transient Voltage Performance: Not more than 15 percent variation for any load step within the load list supplied. The voltage shall recover and remain within the steady-state operating band within 0.5 second. 4) Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load. 5) Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed. 6) Transient Frequency Performance: Less than 2-Hz variation

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		for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds. The transient frequency performance shall not exceed 5% maximum for any load step within the load list provided. 7) Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG-1, shall not exceed 50 percent. 8) Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components. 9) Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load 2. Instrumentation that the operators will use post BDBEE is installed instrumentation that is used during normal operation. This instrumentation may be DC powered, or AC powered, from the FLEX DG or DC through an inverter.
3.2.4.9.A	The Integrated Plan states that fuel oil storage tanks will supply portable pumps and DGs. The Integrated Plan does not, however, document the amount or the expected usage rates of fuel that would be necessary to support Phase 2 equipment. Additionally, the Integrated Plan omits any details about the robust structural designs to house, or store fuel for Phase 2 equipment and its protection from seismic events, floods, high winds and missiles/projectiles.	BSEP has four separate day tanks each with a Technical Specification lower limit of 22,650 gallons for a minimum total of 90,600 gallons as the source of fuel oil for the station's four Emergency Diesel Generators. The day tanks are located in an underground vault that is protected from flood, wind, tornado borne missiles, and is a seismic Class I structure (GDC-02 compliant).

Phase 2 Equipment	One hour total (Gallons)	72 hour total (Gallons)
3 - 6 KW DGs	2.3	165.6
2 - Hale Pumps	50	3,600
2 - Air Compressors	13.1	943.2

<table>
<tr><th colspan="3">FLEX ISE - OPEN ITEMS</th></tr>
<tr><td>Item Number</td><td>Description</td><td>Response</td></tr>
<tr><td></td><td>The licensee provided updated information as part of the audit process regarding fuel storage for Phase 2. The licensee stated that FLEX equipment will be replenished with on-site diesel fuel stored in a Class 1 structure. The licensee is requested to document the amount and the expected usage rates of fuel for all Phase 2 equipment.</td><td><table>
<tr><td>2 - FLEX DGs</td><td>68.8</td><td>4,953.6</td></tr>
<tr><td>1 - Fuel Oil Transfer Pump</td><td>1</td><td>72</td></tr>
<tr><td>1 - CAT 924K</td><td>2</td><td>144</td></tr>
<tr><td>1 - Dodge 5500 Truck</td><td>4</td><td>288</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Totals</td><td>141.2</td><td>10,166.4</td></tr>
</table></td></tr>
<tr><td>3.2.4.9.B</td><td>The licensee also stated that the fuel oil storage 4-day tank minimum volume is 22,650 gallons (90,600 gallons total) on- site and that technical surveillance requirements ensure fuel oil is maintained in accordance with the Diesel Fuel Oil Testing Program. The licensee did not discuss the diesel fuel oil supply pathway for the diesel driven FLEX pumps and the permanently pre-staged FLEX DGs and how continued operation to ensure core and SFP cooling is maintained indefinitely (i.e., Phase 2 and 3) particularly in flooded conditions.</td><td>BSEP established a fuel oil retrieval strategy via EC 290398. This EC contains the fuel oil retrieval method and evaluation of all applicable external hazards potential impact on the ability to perform fuel oil retrieval via this method. The strategy will be implemented in the field via 0EOP-01-FSG-06, Fuel Oil Transfer.

In addition, as a follow up to the Fukushima Flooding evaluation walk downs, EC 292956, a Post Fukushima Flood Protection "As Found" Assessment was conducted. This assessment identified an error in BSEP's UFSAR calculation used to determine the duration of flood water on site. A new calculation was developed and documented within the EC as Attachment I (it is included in the EC world folder as Z08R4). The new calculation identified that flood levels above 20' MSL would only be onsite for approximately 2.5 to 3 hours. Current plans are to use this calculation as a design input to a future revision of the UFSAR. Also, due to the site ground elevation being physically above both the intake and discharge canal, no significant amount of water can accumulate on site during some other rain event due to a drain path into both canals. FLEX DG's and FLEX Pumps have a fuel capacity of approximately 12 hours resulting in no impact to their run time associated with flooding conditions on plant site. Refueling capability can be established following a flood with a significant margin to the required refuel time of FLEX equipment.</td></tr>
</table>

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3.1.1.1.A	The licensee is planning on constructing a FLEX Equipment Storage Building (FESB) that meets the requirements of NEI 12-06 Section 11, but has not discussed the specific protection requirements described in NEI 12-06 for the applicable hazard. During the audit process, the licensee provided a description of the design considerations for the FESB however their considerations were not inclusive of all applicable hazards.	The BSEP FLEX storage building is robust (with respect to seismic events, floods, and high winds, and associated missiles). The building has seismically designed anchor points within the building. See EC 290400. BSEP conducted an evaluation for the FLEX equipment storage configuration to be maintained in the Flex Storage Building. Equipment is maintained in the Flex Storage Building in accordance with this evaluation which uses spacing as the means for protecting large portable equipment during a seismic event, rather than securing large portable equipment. See EC 299559 Attachment Z17R2. All stored equipment is placed in the building such that ample spacing between nearby adjacent portable equipment is maintained as a defense-in-depth measure such that if some equipment were to move during a seismic event it will not impact any other equipment. The actual locations of the portable equipment is marked on the dome floor so that its location can be controlled. This equipment location is captured in the FLEX program manual for control.
3.1.1.1.B	The licensee updated methodologies and processes associated with the HCVS that will be incorporated into the response to Order EA-13-109, and the BSEP Units 1 and 2 will be modified for these processes in accordance with the requirements of Order EA-13-109. Any applicable Phase 2 FLEX equipment required for the modification/process to facilitate the venting practices (HCVS) will need to be stored and/or protected for all hazards.	Strategies have been developed to reenergize panels to restore power to installed valves and logic in the Hardened Wetwell Vent (HWWV) flow path such that the system can be operated from the Control Room during an ELAP event. If it is determined it is not feasible to operate the HWWV system by reenergizing installed plant equipment, then the system will be operated manually using existing Extreme Damage Mitigation Guideline (EDMG) procedure 0EDMG-003, Containment Venting Under Conditions of Extreme Damage. Guidance has been developed in 0EOP-01-FSG-04, FLEX Diesel Generator Alignment, which allows energizing the normal AC power supply once the FLEX Diesel Generator has been placed in service.

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		Additionally, 0EOP-01-FSG-05, FLEX Pneumatic Alignment, has been developed which provides guidance to place a FLEX Air Compressor in service to provide a motive force for the HWWV air operated valves. All equipment associated with these two procedures satisfy the requirements of N+1 and are maintained in a robust location that protects the equipment from all applicable external hazards.
3.1.1.2.A	The licensee identified two vehicles as a means to deploy equipment, provide fuel replenishment, etc., and four flatbed trailers as a means to store and transport hoses, strainers, cables, and miscellaneous equipment, but omitted discussion of the protection to be afforded these vehicles/trailers from seismic hazards.	The BSEP FLEX storage building is robust (with respect to seismic events, floods, and high winds, and associated missiles). The building has seismically designed anchor points within the building. See EC 290400. BSEP conducted an evaluation for the FLEX equipment storage configuration to be maintained in the Flex Storage Building. Equipment is maintained in the Flex Storage Building in accordance with this evaluation which uses spacing as the means for protecting large portable equipment during a seismic event, rather than securing large portable equipment. See EC 299559 Attachment Z17R2. All stored equipment is placed in the building such that ample spacing between nearby adjacent portable equipment is maintained as a defense-in-depth measure such that if some equipment were to move during a seismic event it will not impact any other equipment. The actual locations of the portable equipment is marked on the dome floor so that its location can be controlled. This equipment location is captured in the FLEX program manual for control.
3.1.1.3.A	The licensee did not provide sufficient information concerning coping strategies for the failure of seismically qualified electrical equipment that can be affected by beyond-design-basis seismic events as discussed in NEI 12-06, Section 5.3.3 consideration 1. The licensee determined that a local process for local vital indications would be	BSEP has developed a strategy for retrieving critical parameter reading with a loss of portions of the DC system. All portable equipment required to implement this strategy will be stored in a robust location that protects the equipment from all applicable external hazards. 0EOP-01-FSG-08, FLEX Instrumentation, provides guidance on how to obtain alternate indication for RPV level, RPV pressure, Drywell pressure, Torus pressure, Torus level and Containment temperature if

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	developed to support BSEP's FLEX response.	all AC and DC power is lost to instrumentation. All equipment required to obtain these alternate indications are maintained in a robust structure and are protected from all applicable external hazards.
3.1.1.4.A	The licensee has not identified local staging areas and method(s) of transportation of SAFER equipment.	BSEP has memorandums of understanding (MOU) with the Wilmington International Airport (ILM) and Air Wilmington as a landing and staging area for National Safer Response Center (NSRC) equipment. Transport of the NSRC equipment will be the responsibility of the NSRC. They will deliver the equipment to a staging area at Brunswick in the West parking lot, and assist with movement from that staging area to the plant location of need.
3.1.2.A	While the licensee has identified the limiting source of flooding as the Probable Maximum Hurricane, the applicable flooding hazard was not characterized in terms of warning time and persistence.	0AOP-13.0, Operation During Hurricane, Flood Conditions, Tornado, or Earthquake, is entered when the site is notified of either a Hurricane Warning or a Hurricane Watch and provides additional guidance for actions to be taken if the hurricane is expected to produce site flooding. Specifically, both Unit 1 and 2 have to be in Mode 3 no later than 9 hours prior to the projected storm center crossing the shoreline and actions initiated to enter Mode 4. Additional requirements include requirements for both units to be in Mode 4 within 2 hours of reaching +20 feet MSL which is the nominal plant grade. Hurricane Warnings are a warning that sustained winds 74 mph or higher associated with a hurricane are expected in a specified coastal area in 36 hours or less. A hurricane Watch is an announcement for specific coastal areas from NOAA that hurricane conditions are possible within 48 hours. 0AI-68, Brunswick Nuclear Plant Response to Severe Weather Warnings, provides guidance for preparation of the Brunswick Plant in response to severe weather conditions prior to implementation of the Radiological Emergency Response Plan. Specific actions contained in 0AI-68 include the installation of "Cliff Edge" flood barriers at least 12 hours prior to the predicted storm surge of 20 ft or greater on site.

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		These barriers provide additional protection to the Control Building Cable Spread area, the Reactor Building Railroad Airlocks, and the Emergency Diesel Generator Building. Additional flood barriers are installed to protect the rattle space areas from flood conditions.
3.1.2.2.A	There was no discussion of the considerations for movement of equipment and restocking of supplies in the context of a flood with long persistence.	BSEP does not have a scenario for a long persistent flood on site. As a follow up to the Fukushima Flooding evaluation walk downs, EC 292956, a Post Fukushima Flood Protection "As Found" Assessment was conducted. A new calculation was developed and identified that flood levels above 20' MSL (i.e., site grade elevation) would only be onsite for approximately 2.5 to 3 hours. Also, due to the site ground elevation being physically above both the intake and discharge canal no significant amount of water can accumulate on site during some other rain event due to a drain path into both canals.
3.1.3.2.A	The licensee has not provided sufficient information with regard to the deployment of FLEX equipment. The licensee stated that strategies and movement of equipment during hurricanes will be incorporated into the Flex Support Guidelines to ensure successful deployment without endangering personnel. Due to hurricanes providing days of forewarning, strategies may include pre-staging or certain equipment in robust structures other than the permanent FLEX storage building. These strategies are still under development.	During development of FLEX strategies, it was determined that the design basis hurricane flood could prevent timely deployment of portable FLEX DGs to supply power to the 125 VDC battery chargers in time to meet the objectives of Order EA-12-049. As a result, BSEP has modified the plant to provide two permanently staged 500KW FLEX DGs in a location that is protected from all applicable external hazards. No other equipment was determined to require permanent staging, or employment of other methods, based on the ability to deploy equipment during a BDBEE.
3.1.4.2.A	The licensee stated that the deployment of debris removal equipment (including ice removal) has not been finalized.	With the declaration of an ELAP, the SRO will direct deployment of FLEX equipment in accordance with 0EOP-01-FSG-001, FLEX Initial Assessment and Equipment Staging. The FLEX equipment will be deployed from the FSB, west through the TAC parking lot, onto the site access road, into the west parking lot and around to the Sally Port entrance into the Protected Area (PA). The CAT 924K will remove

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		debris in the travel path and the Dodge 5500 will be the tow vehicle. On subsequent trips the CAT 924K may be used as a tow vehicle as well. For events caused by extreme ice, the CAT 924K may be used to remove ice in the travel path, but the Dodge 5500 and the salt spreader attachment will be the primary means of controlling ice buildup on the deployment path.
3.1.5.3.A	The licensee did not provide a discussion of the potential effects of high temperatures at the location where the portable equipment would actually operate during a high temperature hazard. The licensee stated that the equipment would be purchased with the requirements to operate during a high temperature hazard and that the FLEX DGs and structure will be purchased/designed to ensure proper operation at elevated temperatures.	Design input for the FLEX Diesel Generators included environmental conditions for the interior of the FLEX Diesel Building and also outside ambient conditions as Minimum 15°F and Maximum 110°F with relative humidity of 10% to 100%. In accordance with NEI 12-06, Section 11.1, equipment used in FLEX strategies will be procured as commercial equipment. BSEP relies on portable Fire Pumps, Air Compressors, Fuel Oil Transfer Pumps, Dodge Truck and a Caterpillar 924K, all of which were purchased as commercial grade equipment and will be staged outside of all building and/or structures.
3.2.1.1.A	From the June 2013 position paper, benchmarks must be identified and discussed which demonstrate that MAAP4 is an appropriate code for the simulation of an ELAP event at Brunswick.	BSEP calculation BNP-MECH-FLEX-0002 Rev. 0 includes an appendix that fully documents compliance with the recommendations of EPRI report "Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications," 3002001785, June 2013 as well as the letter of October 3, 2013, from Jack Davis (NRR) to Joe Pollock (NEI).
3.2.1.1.B	The collapsed level must remain above Top of Active Fuel (TAF) and the cool down rate must be within technical specification limits.	BSEP calculation BNP-MECH-FLEX-0002 Rev. 0 includes an appendix that fully documents compliance with the recommendations of EPRI report "Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications," 3002001785, June 2013, as well as the letter of October 3, 2013, from Jack Davis (NRR) to Joe Pollock (NEI). This appendix contains specific documentation regarding the collapsed level remaining above TAF as well as the cooldown rate not exceeding TS limits.

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3.2.1.1.C	MAAP4 must be used in accordance with Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013 position paper.	BSEP calculation BNP-MECH-FLEX-0002 Rev. 0 includes an appendix that fully documents compliance with the recommendations of EPRI report "Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications," 3002001785, June 2013, as well as the letter of October 3, 2013, from Jack Davis (NRR) to Joe Pollock (NEI).
3.2.1.1.D	In using MAAP4, the licensee must identify and justify the subset of key modeling parameters cited from Tables 4-1 through 4-6 of the "MAAP4 Application Guidance, Desktop Reference for Using MAAP4 Software, Revision 2" (Electric Power Research Institute Report 1 020236). This should include response at a plant-specific level regarding specific modeling options and parameter choices for key models that would be expected to substantially affect the ELAP analysis performed for that licensee's plant. Although some suggested key phenomena are identified below, other parameters considered important in the simulation of the ELAP event by the vendor/ licensee should also be included. Nodalization General two-phase flow modeling Modeling of heat transfer and losses Choked flow Vent line pressure losses Decay heat (fission products/actinides/etc.)	BSEP calculation BNP-MECH-FLEX-0002 Rev. 0 includes an appendix that fully documents compliance with the recommendations of EPRI report "Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications," 3002001785, June 2013, as well as the letter of October 3, 2013, from Jack Davis (NRR) to Joe Pollock (NEI). This appendix contains specific documentation regarding: a. Nodalization b. General two-phase flow modeling c. Modeling of heat transfer and losses d. Choked flow e. Vent line pressure losses f. Decay heat (fission products/actinides/etc.)
3.2.1.1.E	The specific MAAP4 analysis case that was used to validate the timing of mitigating strategies in the integrated plan must be	BSEP calculation BNP-MECH-FLEX-0002 Rev. 0 contains specific documentation regarding the collapsed level remaining above TAF as well as the cooldown rate not exceeding TS limits.

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	identified and should be available on the ePortal for NRC staff to view. Alternately, a comparable level of information may be included in the supplemental response. In either case, the analysis should include a plot of the collapsed vessel level to confirm that TAF is not reached (the elevation of the TAF should be provided) and a plot of the temperature cool down to confirm that the cool down is within tech spec limits.	
3.2.1.3.D	The SOE identifies that at 15 minutes, SBO is declared and battery load shedding begins. At approximately 1 hour and 15 minutes the deep load shedding is complete (if both SAMA diesel generators fail to start). During the audit process, the licensee stated that the deep load shedding decision point is at 1 hour 15 minutes into the event and would occur if both FLEX DGs failed to start. Clarification is needed relative to the completion timing of deep load shedding.	During the maturing of strategies and development of battery evaluations it became clear that the most limiting coping time of the Div II batteries without the assistance of a battery charger was going to be a challenge. As a result the decision was made to permanently stage the FLEX DGs so that battery chargers would have power restored prior to the Div II batteries reaching the minimum voltage of 105 VDC. With this strategy, deep load shed of batteries is no longer required or part of the BSEP FLEX response.
3.2.1.3.E	On page 10 of their Integrated Plan, the licensee stated that SRVs provide RPV pressure control during an ELAP. However, the licensee did not provide information regarding what was needed to support SRV actuation (DC power or pneumatics) or how long those support systems would be available. In addition, depending on primary containment environmental conditions during the event, SRV actuation may require a higher than nominal DC voltage to actuate	BSEP modification and analysis support the basis that SRV operation will not be challenged. Although not required to meet pneumatic needs in the first 24 hours, a plant modification EC 290410 installed two more nitrogen bottles per division to enhance SRV pneumatics availability to at least 24 hours into the event. A FLEX pneumatic source will be installed post 24 hrs. MAAP analysis indicates that drywell temperature remains below 300 degrees F. This is within the present EOP requirement and below the EQ qualified temperature of 340 degrees F.

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	the SRVs. The SRV pilot solenoid coil electrical resistance would increase due to a higher containment temperature with a longer duration event than an existing SBO coping time. In subsequent discussions with the licensee during the audit process, information was provided that included a plant modification for additional nitrogen bottles to ensure SRV pneumatics would be available for 24 hours into the event and an evaluation/qualification of the SRV solenoid voltage during thermal testing. Completion of the nitrogen supply modification and associated testing will be confirmed.	The battery load calculation (BNP-E-6.124) uses a lower limit of 105 VDC. Power requirements for the solenoid are 125 VDC and 960mA (FP-9316). SRV solenoid EQ thermal testing was performed to 342 degrees F. The valve assembly was actuated at 60 VDC at room temperature. During the thermal aging test, the valves were actuated 32, 32, and 36 times at 92.5, 125, and 154 VDC, respectively, while the ambient temperature varied from 220 to 265 degrees F.
3.2.3.C	The licensee has not demonstrated that the calculated drywell temperature will not exceed the limits of penetration seals or other equipment.	BSEP calculation BNP-MECH-FLEX-0002 Rev. 0 includes plots of drywell temperature and demonstrates that this temperature does not exceed the design temperature of 340°F.
3.2.4.4.B	The licensee described, and the staff accepted, upgrades to the site's communications systems (ADAMS Accession Nos. ML12311A299 and ML11309A341, respectively). The staff will confirm these upgrades have been completed.	BSEP purchased Iridium 9555 Satellite Phones (and at least two batteries per phone) for use in ERO facilities and as spares. The Satellite Phones/Batteries are stored in the FLEX Storage Building, Control Room, and Alternate ERO facility. 0PEP-04.2, Emergency Facilities and Equipment, has inventory checks for the Satellite Phone • EOF - 13 phones and 2 additional phones for JIC use (Attachment 11) • TSC - 12 phones (Attachment 11) • OSC – 8 phones (Attachment 11) • Control Room/Central Alarm Station – 4 phones (Attachment 7) • Alternate ERO Facility – 3 phones (Attachment 7)

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		• Satellite phones provided to Warning Points - 6 (Attachment 7) The BSEP Emergency Plan and Fleet procedures implementing the use of Iridium 9555 Satellite Phones include: • 0PEP-03.1.3, Use of Communication Equipment • 0PEP-04.2, Emergency Facilities and Equipment • AD-EP-ALL-0400, Emergency Communication Equipment (Fleet procedure)
3.2.4.6.A	The licensee indicated in the audit process that Control Room long term habitability will be assured by monitoring of Control Room conditions, heat stress countermeasures, and rotation of personnel to the extent feasible and that the FLEX Support Guidelines will provide guidance for control room staff to evaluate the control room temperature and take actions as necessary. Further, Brunswick is evaluating the use of passive cooling technologies to be used for response personnel and is performing GOTHIC analysis for the Reactor Building (including RCIC area and refuel floor). Completion of these evaluations and confirmation of implementation needs to be performed.	<u>Control Building</u> BSEP has a GOTHIC report for the Control Building detailing all elevations of the Control Building throughout the ELAP event. The report results show a need for compensatory measures to help with Control Room conditions and maintain habitability. Procedure 0EOP-01-SBO-02, section 2.3 addresses ELAP conditions and contains guidance to place Control Room A/C and supply fans in service once the FLEX DG has been placed in service feeding the Div I and Div II 480V emergency buses. If for some reason Control Room A/C and a supply fan cannot be placed in service, then attachment 1 to this same procedure provides guidance to establish forced ventilation to the Control Room 49 ft. elevation (man control room elevation) via temporary fans/duct work and securing doors open to allow air turnover. <u>Reactor Building</u> BSEP has a GOTHIC report, BNP-MECH-FLEX-0001, for the Reactor Building detailing all elevations of the Reactor Building throughout the ELAP event. The report results show a need for compensatory measures to help with Reactor Building conditions and maintain habitability. Case 1 of the report gives the temperature response for the primary mitigation strategy selected by BSEP and contains assumptions that the Reactor Building roof hatch at the 167 ft. elevation and personal access door on the 20 ft. elevation are opened by the six hour point. 0EOP-01-SBO-04, Blacked Out Unit Local Actions, contains procedural

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		guidance to open and secure the 20 ft. Reactor Building personal airlock doors (two doors in series at one location), and open and secure the 167 ft. door leading to the roof hatch and then open and secure the roof hatch. The BSEP strategy includes swapping RCIC suction from the suppression pool to the CST prior to the suppression pool water temperature increasing to a point where RCIC pump seals are challenged and leak; therefore, the RCIC room will not heat up to a point of challenging short term habitability.
3.2.4.7.A	The licensee created a new Open Item 21 in their system to track development of a new process for long-term makeup to the CWST.	BSEP strategy was revised as documented in the third six month update status report (ML14254A176) to remove the CWST as part of the strategy. BSEP will use the installed Condensate Storage Tank (CST) instead of the CWST. BSEP developed procedural guidance to fill the CST following a BDBEE. That guidance is contained in 0EOP-01-FSG-15, Condensate Storage Tank Fill.
3.2.4.8.C	The licensee provided updated information as part of the audit process regarding sizing of the Phase 2 and 3 generators. The licensee has not finalized their load sizing analysis for the Phase 2 and 3 DGs.	EC 290388 Attachment Z01 is the source document for FLEX DG sizing. Based on this, the 500KW Cummins DG sets were determined to be acceptable with margin. Also, the NSRC DG is of sufficient size to accommodate the loads listed below. <u>MCC 1CA</u> Battery Charger 1A-1 — 64 KW Battery Charger 1A-2 — 64KW Battery Charger 21-A-1 — 8KW Battery Charger 21-A-2 — 8KW Lighting and Comm UPS — 35KW Batt Rm 1A supply fan 1C — 3KW Batt Rm 1A exhaust fan 1C — 3KW NUMAC 1-B21-XY-5948A — 0.1KW NUMAC 1-B21-XY-5949A — 0.1KW Largest MOV 1-E11-F015A — 32KW

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		<u>MCC1CB</u> Battery Charger 1B-1 64 KW Battery Charger 1B-2 64KW Battery Charger 22-B-1 8KW Battery Charger 22-B-2 8KW Batt Rm 1B supply fan 1B 3KW Batt Rm 1B exhaust fan 1B 3KW NUMAC 1-B21-XY-5948B 0.1KW NUMAC 1-B21-XY-5949B 0.1KW **Total load 367.4KW** <u>MCC 2CA</u> Battery Charger 2A-1 64 KW Battery Charger 2A-2 64KW Battery Charger 23-A-1 8KW Battery Charger 23-A-2 8KW Lighting and Comm UPS 35KW Batt Rm 2A supply fan 1C 3KW Batt Rm 2A exhaust fan 1C 3KW NUMAC 2-B21-XY-5948A 0.1KW NUMAC 2-B21-XY-5949A 0.1KW Largest MOV 2-E11-F015A 32KW <u>MCC2CB</u> Battery Charger 2B-1 64 KW Battery Charger 2B-2 64KW Battery Charger 24-B-1 8KW Battery Charger 24-B-2 8KW Batt Rm 2B supply fan 1B 3KW Batt Rm 2B exhaust fan 1B 3KW

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		NUMAC 2-B21-XY-5948B 0.1KW NUMAC 2-B21-XY-5949B 0.1KW **Total load 367.4KW**
3.2.4.10.A	The Generic Concern related to extended battery duty cycles is applicable to this plant. The Generic Concern related to extended battery duty cycles has been resolved generically through the NRC endorsement of Nuclear Energy Institute (NEI) position paper entitled "Battery Life Issue" (ADAMS Accession no ML 13241A186 (NRC endorsement letter) and ML 13241A188 (NEI position paper)) The NRC staff will evaluate a licensee's application of the guidance (calculations and supporting data) in its development of the final Safety Evaluation documenting compliance with NRC Order EA-12-049.	BSEP document Nexus Report 13-4085.001, Unit 1 and 2 125/250 VDC Battery Capability Study for Extended Loss of AC Power (ELAP), verifies the BSEP 125/250V batteries are capable of supporting initial RCIC system operation, along with all necessary DC powered indicators, during an ELAP event. This ELAP event is concurrent with and an added complication to the Station Blackout (SBO) event. For ELAP, there are no operable installed emergency AC sources (i.e. permanently installed 4160V diesel generators capable of carrying the entire required load for normal station shutdown). HPCI operation is included for completeness, although it is not credited in the ELAP response. The battery capacity is verified by performing voltage/load flow calculations with the IEEE 485 methodology to ensure the battery terminal voltage during the discharge cycle remains above the minimum allowable voltage requirement (105V). The results of this calculation confirm the two-hour duration of the initial phase of the coping strategy to a Fukushima style event, which relies solely on installed plant equipment and execution of the SBO load shedding strategy per BSEP's response to IER 11-4. The calculation was produced in response to, and is in alignment with, the generic battery concern addressed in NEI white paper, Battery Life Issue, and the NRC endorsement letter.
3.2.4.10.B	The licensee has not finalized their battery depletion analysis.	Battery depletion is addressed in Nexus report 13-4085.001, Unit 1 and 2 125/250 VDC Battery Capability Study for Extended Loss of AC Power (ELAP), produced to verify that the Brunswick Plant 125/250 V batteries are capable of supporting initial RCIC system operation performed in response to the NEI white paper and NRC endorsement letter. The calculation shows all batteries have sufficient capacity to support the connected loads for greater than two hours in an ELAP event with the SBO coping strategy as defined in 0AOP-36.2, Station

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		Blackout. The calculation was stopped at the 1B-2 and 2B-2 Division II battery exhaustion time because RCIC is specifically credited for the ELAP response. Extended Division I battery operation beyond Division II coping capability is not analyzed in this calculation. Battery Capability Study BNP-E-6.127, Unit 1 and 2 125/250 VDC Battery Capability Study for Extended Loss of AC Power (ELAP) with No Load Shedding, was completed to determine battery coping time with no operator action. The results of this evaluation determined the 125/250 VDC bus would remain above 105 V for 1 hour and 50 minutes.
3.3.2.A	There is insufficient information to conclude that configuration control of equipment and connections will be controlled in conformance with the guidance of NEI 12-06, Section 11.8, Items 1 and 3 regarding a program documentation and change control process.	BSEP developed a program manual following the NEI template. The template requires configuration control as discussed in NEI 12-06, section 11.8, items 1 and 3 to be part of the BSEP Fukushima program manual. The BSEP program manual, section 4.6.1 states: NEI 12-06 (Reference 6.2.4) provides requirements for an overall program document that (1) maintains the FLEX strategies and associated basis, (2) contains a historical record of previous strategies and the basis for changes, and (3) contains the basis for the ongoing maintenance and testing programs chosen for the FLEX equipment. This program document CSD-EG-BNP-8888 satisfies these requirements. In addition, the BSEP program manual, section 4.6.2 states: NEI 12-06 also states that FLEX strategies may be changed without prior NRC approval provided that (1) the revised FLEX strategy meets the intent of NEI 12-06, and (2) an engineering basis is documented that ensures that the change in FLEX strategy continues to ensure the key safety functions are met.

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3.4.A	The licensee's plans for off-site resources conform to the minimum capabilities specified in NEI 12-06 Section 12.2 Consideration 1; however, the licensee did not address Considerations 2 through 10 regarding the functionality of the equipment.	BSEP is addressing NEI 12-06, section 12-02 per the guidance in National SAFER Response Centers white paper (ML14259A223) as transmitted to the NRC by NEI (ML14259A222).

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CI 3.4.A	NSRC interface	The Strategic Alliance for FLEX Emergency Response (SAFER) Plan for BSEP, Units 1 and 2, is provided as an attachment to the FLEX program manual (CSD-EG-BNP-8888). The document was provided on the eportal for audit. A description of the document content is provided below. The purpose of the SAFER Response Plan is to set forth the overall plan to effectively execute FLEX Phase 3 NSRC implementation only. This document is intended to define the SAFER team and Brunswick Steam Electric Plant (BSEP) actions to ensure successful activation, delivery, and operational status of the equipment required by BSEP to ensure indefinite coping capability in the event of a BDBEE as described in NEI 12-06 and EA-12-049. To ensure a comprehensive approach to the Phase 3 response, requirements for six Functional Areas are established: • SAFER Control Center (SCC) • National SAFER Response Center (NSRC) • Logistics and Transportation (L&T) • Staging Area (SA) • Site Interface Procedure (SIP) • Equipment Requirements (EQP) The introduction section includes SAFER and Site Responsibilities Flowchart, SAFER and Site Decision Tree, Generic SAFER and Site FLEX Phase 3 Timeline, and Safer and Participant Responsibilities. SAFER Control Center (SCC) This section provides the process and procedures for activation, operation, and deactivation of the SAFER Control Center (SCC). This chapter details the facility, personnel, communications, and interface

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		attributes for the SCC. National SAFER Response Center (NSRC) This section provides the process and procedures for activation, operation, and deactivation of the National SAFER Response Center (NSRC). This chapter details the facility, personnel, communications, and interface attributes for the NSRC. Logistics and Transportation (L&T) This chapter provides the process and procedures for activation, operation, and deactivation of Logistics and Transportation (L&T). This chapter details the facility, personnel, communications, and interface attributes for L&T. Staging Area (SA) This chapter provides the process and procedures for activation, operation, and deactivation of the Staging Area (SA). This chapter details the facility, personnel, communications, and interface attributes for the SA. Site Interface Procedure (SIP) This chapter provides the input for site-specific procedure development to implement the SAFER Response Plan. Equipment Requirements (EQP) This chapter lists the site-specific equipment to be deployed for FLEX Phase 3.
OIP-3	Guidelines to manage and control unavailability of mitigating strategies equipment	The process for mitigating strategies equipment unavailability controls and the associated procedure/guideline was provided on the eportal for audit. A description of the document content is provided below. The plant procedure 0PLP-01.4, Fukushima FLEX System Availability, Action, and Surveillance Requirements, **purpose** is to establish

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		appropriate controls to provide reasonable assurance that FLEX equipment is maintained Available and Accessible to implement site specific FLEX strategies required to mitigate a BDBEE. The **scope** addresses the applicability, availability, and actions, as it relates to FLEX credited activities for equipment, surveillance, and compensatory actions, and also addresses periodic inspections and performance testing of FLEX response systems. In addition to purpose and scope, definitions, responsibilities, and instructions sections are provided. **Definitions** include Accessible, Action, and Availability/Unavailability. Accessible: Access/egress to the components requiring operation in FLEX procedures are not obstructed by temporary or permanent structures, components, or material. The primary deployment path from the FLEX Storage Building to the equipment staging areas is not obstructed. Action: Requirements specified to be performed based on unavailability of FLEX equipment and strategies. Availability/Unavailability: Equipment maintained by inventory lists (0EOP-01-UG) for use in FLEX procedures are in a state or condition of being ready and capable of deployment within the allotted time. **Responsibilities** are described for Manager – Operations, Operations Shift Manager whom administers the procedure, Configuration Management, and Manager – Engineering whom Identifies the appropriate compensatory measures which are necessary during FLEX equipment or component unavailability. **Instructions** are provided for FLEX Equipment, including General, Applicability, Availability, Action, and Basis for Implementation subsections. General instructions include N+1 capability, impairments, risk, CST capability, and SFP level capability. Applicability is AT ALL TIMES.

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		Availability includes Components, Connection Points, Single Support Components, Support Equipment (credited), and Support Equipment (non-credited) related to FLEX and Spent Fuel Pool level instrumentation. The minimum acceptable requirements are provided. A full list of required (i.e., credited and non-credited) equipment is contained in 0EOP-01-UG (i.e., EOP Users Guide). 1. Components: - FLEX DGs, FLEX pumps, Fuel Oil Transfer Pumps, FLEX Diesel Air Compressors, FLEX Storage Building Doors, Spent Fuel Pool Level Instrumentation, Instrumentation toolkit (i.e., containment parameters, RPV level), FLEX Hose Trailers, FLEX Fuel Trailer, FLEX Pneumatic Trailer, FLEX Control Room Ventilation Trailer. 2. Connection Points: - Condensate Storage Tank (CST) Supply, Exterior RPV Injection, Exterior SFP Injection, Interior RPV Injection, Interior SFP Injection, Pneumatic Supply, Fuel Oil Supply. 3. Single Support Components: - Debris Removal Vehicle (CAT 924K Loader), Deployment Vehicle (Dodge 5500 Truck), Fuel Storage Tank, FLEX Storage Building, CST, E-Bus 480V Breakers for FLEX DG, FLEX NSRC Generator Cable Trailer, Discharge Weir/Canal Suction Trailer, Salt Spreader. 4. Support Equipment (credited): - See 0EOP-01-UG. 5. Support Equipment (non-credited) - See 0EOP-01-UG. Actions are provided for Components, Connection Points, Single Support Components, Support Equipment (credited), and Support Equipment (non-credited) related to FLEX and Spent Fuel Pool level instrumentation. 1. Components:

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		- With less than N+1 but equal to N, restore N+1 within 90 days - If it is determined that the component or instrument cannot be restored to Available status within 90 days, upon determination, immediately begin implementation of compensatory measures to be completed within 72 hours. - With less than N, Initiate actions within 24 hours to restore N. Implement Compensatory Actions within 72 hours. 2. Connection Points: - With less than two Connection points per unit, restore two Connection points within 90 days - If it is determined a component or instrument cannot be restored to Available status within 90 days, upon determination, immediately begin implementation of compensatory measures to be completed within 72 hours. - With No Connection points, Initiate actions within 24 hours to restore one Connection point, and Implement Compensatory Actions within 72 hours. 3. Single Support Components: - Initiate actions within 24 hours to restore the single component. - Implement Compensatory Actions within 72 hours. 4. Support Equipment (credited) - Evaluate impact to associated strategy. - Initiate Compensatory Actions. 5. Support Equipment (non-credited) - Initiate a nuclear condition report (NCR) to replace the equipment within 180 days. **Instructions** are provided for Surveillance, including General, Applicability, Availability, and Action subsections. Actions include tests and test frequencies, and replacement frequencies where applicable, related to FLEX including FLEX DGs, FLEX pumps, FLEX Diesel Air Compressor, Debris Removal Vehicle (CAT-924K

<table>
<tr><th colspan="3">AUDIT – OPEN ITEMS</th></tr>
<tr><td></td><td></td><td>Loader), FLEX Deployment Vehicle (Dodge 5500 Truck), FLEX Water Hoses, Portable Generators, FLEX Air Hoses, FLEX Fuel Oil Hoses, Additional FLEX equipment such as tools, flashlights, radios, etc., and Spent Fuel Pool level instrumentation.

Instructions are provided for Compensatory Actions, including General, Applicability, Availability, and Action subsections. General instructions include if (N) equipment is unavailable, initiate actions within 24 hours to restore the site FLEX capability (N) and implement compensatory measures (e.g., use of alternate suitable equipment) within 72 hours. Equipment that is expected to be unavailable for more than 90 days should be supplemented with alternate suitable equipment.

<u>Actions</u> include examples of compensatory actions for:
- A single primary or back-up component, level channel or strategy out of service beyond 90 days.
- Both the primary and back-up components, level channels or strategies out of service.
- For On-Line Condensate Storage Tank (CST) level low.
- For Outage Condensate Storage Tank (CST) level low when cavity is NOT flooded.</td></tr>
<tr><td>OIP-14</td><td>SFPI modification</td><td>The modification package was provided on the eportal for audit. A description of the modification package is provided below.

The master engineering change for SFP Wide Range Level Indication are provided in EC 289577 and EC 289578 for Unit 1 and Unit 2, respectively.

Each Engineering Change supports the design and installation of the Spent Fuel Pool Level Instrumentation (SFPLI) equipment. The EC document that the instrumentation selected meets the requirements set forth in the NRC Order EA-12-051, along with subsequent documents NEI 12-02 and JLD-ISG-2012-03 as endorsed by the NRC.</td></tr>
</table>

AUDIT – OPEN ITEMS		
		Each EC includes installation of two separate independent channels to monitor the water level in the SFP, with output read-out local display and remote display in the Main Control Room. The two level instrument channels are battery-backed, with battery life specified to last the specified seven (7) days post-event or until off-site resources are available. The sensors, conduits and any supporting electronics are seismically rugged and judged to be capable of withstanding a Safe Shutdown Earthquake (SSE), using IEEE 344-2004, Clauses 7, 8, 9, and 10 (Ref. B.2.1.t). The waveguide and sensors, including its electronics, are qualified to perform their functions under high temperature, humidity and radiation conditions where they are installed, and under conditions including SFP water levels from normal level down to the top of the fuel racks, level 3. The local indicators for both channels A and B are located at an accessible location slightly above the Reactor Building 80' elevation. The channel A and Channel B Power Control Panels (PCP's) are located in the Control Room back panel area slightly above the 49' elevation. The remote indicators are mounted in the vicinity of the PCP's. The instrument equipment is being provided by AREVA. Equipment supply includes horn antenna, waveguide pipe, two seismic supports per Waveguide System (one at the horn end and the other at the sensor end), sensor electronics, level indicator, remote indicator, vendor manuals and analysis required for equipment operability under all beyond-design-basis external event environments required by NEI 12-02.
SFP.10	SFPI maintenance and testing	The related documents were provided on the eportal for audit. A description of operating, calibration, test, and maintenance procedures is provided below.

AUDIT – OPEN ITEMS		
		OPERATING Weekly channel checks are performed using plant procedures to ensure the Channel A and Channel B local and remote indications are aligned. Reactor Operator Daily Checks, performed once per 7 days, compare new control room SFP level indicator readings to each other (i.e., ± 2 inch). Reactor Building Auxiliary Operator Daily Checks, performed once per 7 days, compare new Reactor Building SFP level indicator readings to each other (i.e., ± 2 inch). The plant Fuel Pool Cooling and Cleanup System Operating Procedures provide the electrical and panel lineups for the new spent fuel pool level instrumentation. CALIBRATION Calibration procedure 0LP-LT008, VEGAPULS 62 LEVEL TRANSMITTER CALIBRATION, provides the instructions for testing and calibrating the SFPLI equipment. This procedure performs Removal from Service, Backup Battery Test, Calibration Check, Calibration, Return to Service, and Post Maintenance Activities. Within this procedure the SFPLI indication levels are verified against the SFP ruler gauge level and against each other to ensure level instrumentation accuracy. Level indication for channels A and B shall be within 1" (+/-) of the ruler gauge level and the Channel A & B indications shall be within 1" +/- of each other. A preventative maintenance (PM) request has been created to perform calibration of the SFPLI equipment on a 2-year basis, prior to scheduled refueling cycles. This PM will validate the level instrumentation values against the SFP Ruler Gauge and against each other to ensure functionality of the system, as described above. TEST The plant procedure 0PLP-01.4, Fukushima FLEX System Availability,

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		Action, and Surveillance Requirements, described in OIP-3 response above, addresses the Surveillance applicability, availability, and actions, as it relates to Spent Fuel Pool level instrumentation.
		
		Instructions are provided for Surveillance, including Applicability, Availability, and Action subsections. Applicability is AT ALL TIMES. Availability is AT ALL TIMES.
		
		Actions include tests and test frequencies, and replacement frequencies where applicable, related to Spent Fuel Pool level instrumentation.
		
		- Surveillances or testing to validate functionality of an installed instrument channel shall be performed within 60 days of a planned refueling outage considering normal testing scheduling allowances (e.g. 25%). This is not required to be performed more than once per 12 months.
		- SFPLI measurement system level sensors (1/2-G41-LT-5001,5002), and level indicators (1/2-G41-LI-5001, 5002, 5003, 5004):
		  - Biennial – Calibration
		  - Biennial – Replace Power Control Panel (PCP) batteries
		- Lambda power supplies (DSP10) located in 1/2-G41-P003, SFPLI power control panel CH A and 1/2-G41-P004, SFPLI power control panel CH B:
		  - Biennial – Measure AC and DC output voltages
		- SFPLI measurement system level sensor (1/2-G41-LT-5001):
		- Every 8 years – Replace level sensors
		
		MAINTENANCE
		Optimal preventive maintenance (PM) strategy uses a combination of monitoring, predictive, preventative and replacement actions to ensure reliable equipment operation. This graded approach balances the potential for failure, the risk of failure against the risk of replacement and/or maintenance induced failures. Plant processes use Critical

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		Component Classification to determine the risk and replacement strategy. There are no components that are considered critical (Critical Component Classification "C"). PMs are not required for Critical Component Classification run-to-maintenance ("R") and not applicable ("NA") categories, so the PM strategy addresses Critical Component Classification "I" Important Components. Important "I" components are classified based on the "Failure may lead to regulatory consequences". The SFPLI is required by NRC Order EA-12-051 so the level sensors, power control panels, and the remote control room indicators are classified as "I". The local indicators are designated as run-to-maintenance "R" and a failure will not impact the remainder of the system from functioning. The plant practices of validating indications and initiating work requests when appropriate supplements the prescribed PM program. Therefore, these failures will be evaluated for impact on SFPLI availability. An "R" Critical Component Classification is appropriate for those components with a minimal impact to plant operation. The intent on "R" classified equipment is only to do maintenance on these components when corrective action is required. Run-to-Maintenance "R" components and Not Applicable "NA" components are classified based on the "Failures have minimal impact to plant operation or failure can be acceptably managed". The component should be run until corrective maintenance is required. Critical Component Classification "R": SFP LEVEL INDICATORS CH A & CH B (Reactor Building 80' elevation) SFPLI POWER CONTROL PANEL CH A & CH B FUSE Critical Component Classification "I": SFP LEVEL TRANSMITTER CH A SFP LEVEL TRANSMITTER CH B

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		SFP DIGITAL LEVEL DISPLAY CH A & CH B (Control Room Back Panel) SFPLI POWER CONTROL PANEL CH A & CH B The PM strategy is derived as no PMs for those components classified "N" or "R" and selected PMs for those components classified as "I." New preventive maintenance requests (PMR) have been created for periodic calibration of the new instruments, sensor service life replacement, and replacement of the Power Control Panel batteries. 1) The recommended PM action for periodic calibration of SFPLI level sensors and indicators is every refueling cycle. A new plant procedure provides instructions for this calibration. 2) The recommended PM action for battery replacement is performance at every refueling cycle. 3) The recommended PM action for sensor replacement is every eight (8) years. This PM action only to one of the two sensors on each BSEP Unit due to higher radiation exposure levels at those sensors installed location. 4) The recommended PM action for measurement of AC voltage ripple and DC output voltage is every 3 years. A preventive maintenance (PM) request is created to address the following maintenance. 1) The periodic calibration of the SFPLI level sensors, and level indicators at the frequency of every refueling cycle. 2) The periodic replacement of level sensors at the frequency of eight (8) years. 3) The periodic replacement of Power Control Panel (PCP) batteries at the frequency of every refueling cycle. 4) The periodic measurement of AC voltage ripple and DC output voltage for power supplies at the frequency of every refueling outage. This frequency, which differs from the recommended PM action of every 3 years, aligns this PM frequency with those performed every refueling

<table>
<tr><th colspan="3">AUDIT – OPEN ITEMS</th></tr>
<tr><td></td><td></td><td>cycle.</td></tr>
<tr><td>SFP.13</td><td>SFPI out-of-service administrative controls</td><td>The response for compensatory actions for out-of-service SFPI was provided on the eportal for audit. A description of the procedure and compensatory actions is provided below.

<u>0PLP-01.4</u>

The plant procedure 0PLP-01.4, Fukushima FLEX System Availability, Action, and Surveillance Requirements, described in OIP-3 response above, addresses the equipment applicability, availability, actions, and compensatory measures as it relates to Spent Fuel Pool Level Instrumentation (SFPLI).

Instructions are provided for SFPLI, including Applicability, Availability, Action, and Basis for Implementation subsections.
<u>Applicability</u> is AT ALL TIMES.
<u>Availability</u> requires two channels of SFPLI for each unit.
<u>Actions</u> are provided for Components, which include SFPLI. As related to SFPLI:

<table><tr><td>Component</td><td>N</td><td>+1</td><td>N+1</td></tr><tr><td>Spent Fuel Pool Level Instrumentation (Channel A & B)</td><td>2</td><td>N/A</td><td>2</td></tr></table>
For Components:
- With less than N+1 but equal to N, restore N+1 within 90 days
- If it is determined that the component or instrument cannot be restored to Available status within 90 days, upon determination, immediately begin implementation of compensatory measures to be completed within 72 hours.
- With less than N, initiate actions within 24 hours to restore N. Implement Compensatory Actions within 72 hours.</td></tr>
</table>

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		Instructions are provided for Compensatory Actions, including General, Applicability, Availability, and Action subsections. General instructions include if (N) equipment is unavailable, initiate actions within 24 hours to restore the site FLEX capability (N) and implement compensatory measures (e.g., use of alternate suitable equipment) within 72 hours. Equipment that is expected to be unavailable for more than 90 days should be supplemented with alternate suitable equipment.
		
		Actions include examples of compensatory actions for SPLI, but are not limited to the following:
		- A single primary or back-up component, level channel or strategy out of service beyond 90 days.
		  - Increased surveillance (channel check) to verify functionality of the remaining component, level channel or strategy
		  - Implementation of equipment protection measures
		  - Increased operator visual surveillance of the available components, connection areas, SFP level and associated area
		  - Maintain elevated SFP level
		  - Reduce SFP temperature
		  - Supplemental operations staffing
		
		- Both the primary and back-up components, level channels or strategies out of service.
		  - Increased operator visual surveillance of the SFP level and area
		  - Maintain elevated SFP level
		  - Reduce SFP temperature
		  - Supplemental operations staffing
		  - Pre-stage FLEX support equipment (nozzles, hoses, etc.) which are relied upon for SFP make-up. Pre-staged equipment would be located within Seismic Category I

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		structures.
SE.4	Confirm that administrative controls will be implemented in accordance with Rev. 3 of the Boiling Water Reactor Owners Group Emergency Procedure Guidelines/Severe Accident Guidelines to prevent negative pressure transients in containment as identified in the NRG letter dated January 9, 2014 (ADAMS Accession No. ML 13358A206).	The procedures and/or strategy that shows site-specific steps to prevent negative pressure transients during anticipatory venting was provided on the eportal for audit. A description of the procedure steps and bases is provided below. Site-specific steps to prevent negative pressure transients during anticipatory venting are provided in the emergency operating procedure (EOP). Procedures 0EOP-02-PCCP, Primary Containment Control, and 0OI-37.8, Primary Containment Control Procedure Basis Document, provide the necessary steps and basis. 0EOP-02-PCCP flowchart, Step PC/P-4 Fourth override directs "IF Torus pressure drops to 2.5 psig, THEN Terminate torus sprays." Torus spray is terminated when torus pressure drops to 2.5 psig to ensure that Primary Containment pressure is not reduced below atmospheric. Maintaining a positive torus pressure precludes air from being drawn in through the vacuum relief system to de-inert the Primary Containment and also ensures that a positive margin to the negative (external) design pressure of the Primary Containment exists. 0EOP-02-PCCP flowchart, Step PC/P-4 Fifth Override directs "IF Drywell pressure drops to 2.5 psig, THEN Terminate drywell sprays." Drywell spray is terminated when drywell pressure drops to 2.5 psig to ensure that Primary Containment pressure is not reduced below atmospheric. Maintaining a positive pressure precludes air from being drawn in through the vacuum relief system to de-inert the Primary Containment and also ensures that a positive margin to the negative (external) design pressure of the Primary Containment exists.
SE.9	Plant stack vulnerability to seismic, tornado, and wind-driven missile hazards.	The plant stack evaluation was provided on the eportal for audit. A description of the plant stack evaluation and conclusion is provided below.

AUDIT – OPEN ITEMS		
		2MSS-0011, Evaluation of the Plant Stack for Tornado Wind Forces and 2XSSE Earthquake, evaluated the structural adequacy of the Off-gas Stack at the Brunswick Plant subjected to tornado wind pressure and 2 X SSE earthquake magnitude. The evaluation includes the stack proper and its foundation. Tornado and earthquake events do not occur simultaneously. The scope of the tornado evaluation is limited to the effects of wind pressures resulting from tornado events with a wind speed of 230 mph. The methodology for tornado wind load on the stack is computed based on a tornado wind speed of 230 mph using appropriate wind pressure and shape factors for smooth round stacks. For evaluation of the stack proper, the forces on the stack due to the tornado wind forces are compared to the design forces used by the chimney contractor. For the evaluation of the stack foundation, the forces on the stack foundation due to the tornado wind forces and 2 X SSE earthquake are used to calculate the maximum soil pressure due to these phenomena and compared with the soil bearing capacity under overturning conditions. Also Factor of Safety against overturning for these events is investigated. For the evaluation of the stack under 2 X SSE loading, it is demonstrated that maximum stress in concrete and maximum stress in reinforcing steel are below limit state conditions per ACI Code 318-63. Based on the calculations, it is concluded that the Off-Gas Stack is expected to maintain structural integrity and stability when subject to 230 mph tornado wind forces or a 2 X SSE earthquake event. The effects of tornado-borne missiles on the stack is a separate evaluation provided as Attachment 6 to 2MSS-0011. This calculation quantifies the effect of a tornado generated missile on the plant stack. The methodology for evaluation of the plant stack for tornado missile

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		impacts is primarily based on three different analyses for local effects, global overturning, and stack strength. The design missile spectrum is first assessed to confirm that no missiles will fully perforate the stack walls using the modified Petry formula. This also checks that no secondary missiles will be created in the event of significant damage to the stack. The second analysis for global overturning evaluates the possibility of the missile impact imparting enough momentum to cause the stack to topple as a rigid body, subjected to simultaneous tornado wind pressure. This analysis is based on concepts of conservation of momentum and rigid body dynamics. Finally, the capability of the reinforced concrete stack to withstand the bending and shear forces created by the missile impact combined with tornado wind forces is verified against the ultimate strength capacity. Based on the calculations, the plant off-gas stack is expected to withstand impact due to the tornado generated missile spectrum (i.e., the site missile spectrum considered is specified in Section 3.5.1.4 of the UFSAR) simultaneous with 230 mph tornado wind forces without significant damage. The stack is structurally adequate and will not topple subjected to the postulated impact. Secondary concrete missiles due to a direct impact of the design basis tornado-generated missiles are expected to be small or insignificant due to the small penetration calculated and the fact that two walls of concrete chimney would have to be compromised. Therefore, any potential secondary missiles will be bounded by the existing tornado missile spectrum for Class I structures.
SE.10	Robustness of connected RWCU piping credited in FLEX strategies	Information related to RWCU piping evaluation was provided on the eportal for audit. A description of the evaluation and conclusion is provided below. For SE.10, RWCU robustness – the response is derived from EC 290412, Attachment Z05, RWCU Piping Evaluation. EC 290412 and EC 292800 evaluated the RWCU piping associated with

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		the FLEX Primary RPV injection point and the RWCU system for seismic qualifications. The piping between the RPV injection point and isolation valves G31-F044 (normally closed), G31-F033 (AOV that fails closed), and G31-V85 (manual valve) qualifies as seismically robust in respect to FLEX implementation requirements. 0EOP-01-FSG-02, Portable Pump RPV Injection, contains guidance to close the G31-V85 if a confirmed seismic event has occurred. The closure of this valve in conjunction with the G31-F044 (normally closed) and the auto closure of the G31-F033 ensures that the required boundary is established for RPV injection utilizing RWCU system. This isolates the RWCU piping required for RPV injection, which has been evaluated as acceptable for use from the non-evaluated section of RWCU system piping that has not been qualified for a seismic event response.

ENCLOSURE 3

BSEP, UNITS 1 AND 2, FLEX FINAL INTEGRATED PLAN

NRC Order EA-12-049
FLEX FINAL INTEGRATED PLAN

Brunswick Steam Electric Plant, Units 1 & 2

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Contents

1. Background

In 2011, an earthquake-induced tsunami caused Beyond-Design-Basis (BDB) flooding at the Fukushima Dai-ichi Nuclear Power Station in Japan. The flooding caused the emergency power supplies and electrical distribution systems to be inoperable, resulting in an extended loss of alternating current (AC) power (ELAP) in five of the six units on the site. The ELAP led to (1) the loss of core cooling, (2) loss of spent fuel pool cooling capabilities, and (3) a significant challenge to maintaining containment integrity. All direct current (DC) power was lost early in the event on Units 1 & 2 and after some period of time at the other units. Core damage occurred in three of the units along with a loss of containment integrity resulting in a release of radioactive material to the surrounding environment.

The U.S. Nuclear Regulatory Commission (NRC) assembled a Near-Term Task Force (NTTF) to advise the Commission on actions the U.S. nuclear industry should take to preclude core damage and a release of radioactive material after a natural disaster such as that seen at Fukushima. The NTTF report (Reference 1) contained many recommendations to fulfill this charter, including assessing extreme external event hazards and strengthening station capabilities for responding to beyond design basis external events (BDBEEs).

Based on NTTF Recommendation 4.2, the NRC issued Order EA-12-049 (Reference 2) on March 12, 2012 to implement mitigation strategies for BDBEEs. The order provided the following requirements for diverse and flexible coping strategies (FLEX strategies) to mitigate BDBEEs:

- Licensees shall develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities following a BDBEE.
- These strategies must be capable of mitigating a simultaneous loss of all AC power and loss of normal access to the ultimate heat sink (UHS) and have adequate capacity to address challenges to core cooling, containment and SFP cooling capabilities at all units on a site subject to the Order.
- Licensees must provide reasonable protection for the associated equipment from external events. Such protection must demonstrate that there is adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities at all units on a site subject to the Order.
- Licensees must be capable of implementing the strategies in all modes.
- Full compliance shall include procedures, guidance, training, and acquisition, staging or installing of equipment needed for the strategies.

The order specifies a three-phase approach for strategies to mitigate BDBEEs:

- Phase 1 - Initially cope by relying on installed equipment and on-site resources.
- Phase 2 - Transition from installed plant equipment to on-site FLEX equipment.
- Phase 3 - Obtain additional capability and redundancy from off-site equipment and resources until power, water, and coolant injection systems are restored or commissioned.

NRC Order EA-12-049 (Reference 2) required licensees of operating reactors to submit an overall integrated plan (OIP), including a description of how compliance with these requirements would be achieved.

The Nuclear Energy Institute (NEI) developed NEI 12-06 (Reference 3), which provides guidelines for nuclear stations to assess extreme external event hazards and implement the mitigation strategies specified in NRC Order EA-12-049. The NRC issued Interim Staff Guidance

JLD-ISG-2012-01 (Reference 4), which endorsed NEI 12-06 with clarifications on determining baseline coping capability and equipment quality.

Duke Energy (Duke) declared that Brunswick Steam Electric Plant (BSEP) Unit 2 was in compliance with Order EA-12-049 on April 4, 2015 following the B222R1 refueling outage (Reference 5). Duke declared that BSEP Unit 1 was in compliance with Order EA-12-049 on March 23, 2016 following the B121R1 refueling outage (Reference 6).

NRC Order EA-12-051 (Reference 7) required licensees to install reliable SFP level instrumentation (SFPLI) with specific design features for monitoring SFP water level. This order was prompted by NTTF Recommendation 7.1 (Reference 1).

NEI 12-02 (Reference 8) provided guidance for compliance with Order EA-12-051. The NRC determined that, with the exceptions and clarifications provided in JLD-ISG-2012-03 (Reference 9), conformance with the guidance in NEI 12-02 is an acceptable method for satisfying the requirements in Order EA-12-051.

Duke declared that BSEP Unit 2 was in compliance with Order EA-12-051 on April 4, 2015 following the B222R1 refueling outage (Reference 5). Duke declared that BSEP Unit 1 was in compliance with Order EA-12-051 on March 23, 2016 following the B121R1 refueling outage (Reference 6).

2. Order Implementation

2.1 General Elements

Initial conditions and boundary conditions consistent with NEI 12-06 were established to support development of FLEX strategies, as follows:

- The reactor is initially operating at power, unless there are procedural requirements to shut down due to the impending event. The reactor was operating at 100% power for the past 100 days.
- The reactor is successfully shut down when required and all rods are inserted. Steam release to maintain decay heat removal upon shutdown functions normally.
- On-site staff is at site administrative minimum shift staffing levels. All personnel on-site are available to support site response.
- The reactor and supporting plant equipment are either operating within normal ranges for pressure, temperature and water level, or available to operate, at the time of the event consistent with the design and licensing basis.
- No specific initiating event is used. The initial condition is assumed to be a loss of off-site power (LOOP) with installed sources of emergency on-site 4160 VAC power and station blackout (SBO) alternate 4160 VAC power sources unavailable with no prospect for recovery.
- Cooling and makeup water inventories contained in systems or structures with designs that are robust with respect to seismic events, floods, and high winds and associated missiles are available. Permanent plant equipment that is contained in structures with designs that are robust with respect to seismic events, floods, and high winds and associated missiles, are available.
- Normal access to the UHS is lost, but the water inventory in the UHS remains available and robust piping connecting the UHS to plant systems remains intact. The motive force for UHS flow, i.e., pumps, is assumed to be lost with no prospect for recovery.

- Fuel for FLEX equipment stored in structures with designs that are robust with respect to seismic events, floods and high winds and associated missiles, remains available.
- Installed electrical distribution systems, including inverters and battery chargers, remain available provided they are protected consistent with the current station design.
- No additional accidents, events, or failures are assumed to occur immediately prior to or during the event, including security events.
- Reactor coolant inventory loss occurs by applicable mechanisms described in NEI 12-06, including normal system leakage, recirculation pump seal leakage, and losses due to operation of steam-driven systems, safety relief valve cycling, and reactor pressure vessel depressurization.
- For the SFP, all boundaries (e.g., liner, gates) and the SFP cooling system are assumed to be intact. The SFP heat load is assumed to be the maximum design basis heat load. In addition, inventory loss from sloshing during a seismic event does not preclude access to the pool area.

Additional key assumptions associated with implementation of FLEX Strategies are as follows:

- Additional deployment resources are assumed to begin arriving at 6 hours and the site Emergency Response Organization (ERO) will be fully staffed at 24 hours after the event.
- The plant Technical Specifications contain the limiting conditions for normal unit operations to ensure that design safety features are available to respond to a design basis accident and direct the required actions to be taken when the limiting conditions are not met. The result of the BDBEE may place the plant in a condition where it cannot comply with certain Technical Specifications and/or with its Security Plan, and, as such, may warrant invocation of 10 CFR 50.54(x) and/or 10 CFR 73.55(p). (Reference 10)

2.2 Strategies

The objective of the FLEX strategies is to establish indefinite coping capability in order to:

- Prevent damage to the fuel in the reactors
- Maintain the containment function
- Maintain cooling and prevent damage to fuel in the SFP

This indefinite coping capability will address an ELAP – loss of off-site power, emergency diesel generators (EDGs) and any alternate AC source, but not the loss of AC power to buses fed by station batteries through inverters – with a simultaneous Loss of Ultimate Heat Sink (LUHS). This condition could arise following external events that are within the existing design basis with additional failures and conditions that could arise from a BDBEE.

The plant indefinite coping capability is attained through the implementation of FLEX strategies that are focused on maintaining or restoring key plant safety functions. The FLEX strategies are not tied to any specific damage state or mechanistic assessment of external events. Rather, the strategies are based on the evaluation of plant response to the coincident ELAP/LUHS event. A safety function-based approach provides consistency with, and allows coordination with, existing plant emergency operating procedures (EOPs). FLEX strategies are implemented in support of EOPs using FLEX Support Guidelines (FSGs).

The strategies for coping with the plant conditions that result from an ELAP/LUHS event involve a three-phase approach:

- Phase 1 – Initially cope by relying on installed plant equipment and on-site resources.
- Phase 2 – Transition from installed plant equipment to on-site FLEX equipment.
- Phase 3 – Obtain additional capability and redundancy from off-site equipment and resources until power, water, and coolant injection systems are restored.

The transitions to Phase 2 and Phase 3 will occur at different times for different portions of the FLEX strategies.

The strategies described below are capable of mitigating an ELAP/LUHS resulting from a BDBEE by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities at BSEP. Though specific strategies have been developed, due to the inability to anticipate all possible scenarios, the strategies are also diverse and flexible to encompass a wide range of possible conditions. These pre-planned strategies developed to protect public health and safety are integrated into EOPs in accordance with established change processes, and their impacts to the design basis capabilities of the units were evaluated under 10 CFR 50.59.

2.3 Reactor Core Cooling Strategy

2.3.1 Phase 1

Following insertion of all control rods as part of the reactor trip and loss of normal feedwater due to loss of power, the Reactor Core Isolation Cooling (RCIC) pump starts and provides feedwater to the reactor pressure vessel (RPV). Core cooling during an ELAP is via safety-relief valve (SRV) discharge to the suppression pool. The steam from the RPV drives the RCIC turbine, removing heat that would otherwise go directly to the suppression pool via the SRVs. The steam exhaust from the RCIC pump is discharged to the suppression pool to be quenched.

The normal alignment for the RCIC pump is to draw suction from the Condensate Storage Tank (CST). Within one hour, BSEP will swap suction from the CST to the suppression pool to conserve CST inventory. When suppression pool water temperature reaches 190°F, BSEP will swap RCIC pump suction back to the CST. Using this approach, replenishment of the CST inventory will not be required for approximately 52 hours. Maintaining suction temperature below 190°F ensures sufficient net positive suction head (NPSH) for the RCIC pump.

Within one hour after the reactor trip, BSEP will initiate reactor depressurization by cooling down at a rate of approximately 100°F per hour and establishing pressure within the range of 150 psig to 300 psig.

Using electric power from the station batteries and pneumatic supplies from the Nitrogen Backup systems, the SRVs will remain functional following an ELAP.

In addition to powering the SRVs, the station 125/250 VDC Division II batteries will also power the RCIC system and vital instrumentation. BSEP has permanently pre-staged FLEX diesel generators (DGs) that can provide power within 1 hour of event initiation. If these FLEX DGs are not immediately available, BSEP can perform battery load shedding, which will extend availability of DC power from the batteries to two hours and ten minutes.

2.3.2 Phase 2

As necessary, BSEP will transition from the RCIC pump to a portable FLEX pump to provide makeup water to the RPV. One portable pump will be deployed for each Unit. With the RCIC pump no longer operating, BSEP would continue depressurization of the RPV below

150 psig. Credited water sources for the FLEX pump include the CST and the discharge canal. Other sources of water that may be available, but are not credited as part of the FLEX strategy, include the Demineralized Water Tank, the Fire Water Tank, and Condensate Hotwells. BSEP will use sources with higher quality water first. Raw water will be used only if necessary.

The FLEX pump will be aligned to existing systems using hose and FLEX connections.

- The primary flow path for RPV makeup is through a FLEX connection on the Reactor Water Clean-Up (RWCU) system piping, which leads to the RCIC system, the Feed Water (FW) system, and ultimately to the RPV.
- The alternate flow path for RPV makeup is through a FLEX connection on the Integrated Leak Rate Test (ILRT) piping in the Service Air (SA) System, which will be connected to the Residual Heat Removal (RHR) system piping. The flow path proceeds from RHR piping to Reactor Recirculation System (RCR) piping, and ultimately to the RPV.

For electric power, the BSEP FLEX strategy utilizes two 500 kW FLEX Diesel Generators (DGs) that are permanently pre-staged. Associated cabling is also permanently pre-staged so deployment consists only of racking in a 480 VAC breaker at a plant emergency bus and starting the FLEX DGs. The FLEX DGs will supply power to emergency bus E6 and/or E8 (both Division II). Either FLEX DG can be aligned to both emergency busses E6 and E8, energizing both Units' Division II battery chargers. Because only Division II is credited for FLEX strategies, the FLEX DGs are fully redundant. Each FLEX DG on-board fuel tank is maintained at a level sufficient to allow operation for approximately 12 hours before refueling.

In practice, both FLEX DGs will be placed into service and the capacity of both FLEX DGs will enable use of Division I battery chargers and Control Building Heating, Ventilation, and Air Conditioning (HVAC). In this case, FLEX DG alignment will include cross-tying bus E5 to E6 and bus E7 to E8.

2.3.3 Phase 3

The Phase 3 RPV makeup strategy is the same as the Phase 2 strategy. The National SAFER Response Center (NSRC) will supply additional equipment (e.g., pumps, generators) to back up the on-site FLEX equipment. The pumps supplied by the NSRC are compatible with the FLEX connections used at BSEP. The NSRC generators will be connected to the electrical distribution system using BSEP-specific cables and connectors that are stored in the BSEP FLEX Storage Building (FSB).

Pumps, strainers, hoses, and fittings will be used to pump water from the discharge canal to the CSTs of both units, if necessary. The redundant (i.e., N+1) pump and associated equipment stored in the FSB can be used for this purpose. Alternatively, the NSRC will deliver pumps that can be used for replenishing CST inventory from the discharge canal.

If raw water (e.g., from the discharge canal) is injected into the RPV, BSEP will implement the guidance from BWROG-TP-14-006. Specifically, water level will be maintained at the level of the moisture separator drains to ensure core cooling in the event the fuel bundle flow orifices and debris filters become clogged.

2.3.4 Availability of Systems, Structures, and Components

The FLEX strategy for core cooling relies on selected installed systems, structures, and components (SSCs). These SSCs are protected in regard to the applicable extreme external hazards as discussed below.

2.3.4.1 Structures

The FLEX strategy relies on existing and newly-installed site structures to provide protection for components and fluid and electric connections from the applicable extreme external hazards. Specifically, the Reactor Building, the EDG Building and the Control Building are Seismic Category I structures that are designed to withstand the applicable extreme external hazards.

The newly-constructed FLEX DG Enclosure and FLEX Storage Building were also designed to withstand the applicable extreme external hazards. (See Sections 2.7.1 and 2.7.2.)

2.3.4.2 Systems

The FLEX strategy relies on installed piping from various plant systems to deliver water for core cooling. Primarily, BSEP relies on piping and components from the RCR System, the RWCU system, the RHR system, the RCIC system, the FW system, the SA system, the Non-Interruptible Instrument Air (IAN) System, and the Reactor Non-Interruptible Air (RNA) System (including the Backup Nitrogen System). The RCR, RWCU, RHR, FW, IAN, and RNA systems were designed for safety-related service and will be available following a BDBEE.

Although the RCIC system was originally designed and constructed to be seismically qualified, it was not maintained to these qualifications. To support the FLEX strategies, BSEP completed a new evaluation confirming that the RCIC system is seismically robust and will be available following a BDBEE.

The SA system is used for alternate FLEX connection strategy, but it was not designed for safety-related service. BSEP evaluated that the portions of the SA utilized for FLEX strategies satisfy the requirements of NEI 12-06 for alternate injection. (See Section 2.3.5.1 and 2.3.5.3.)

2.3.4.3 Reactor Core Isolation Cooling Pump

The BSEP FLEX strategy relies on the RCIC pump for RPV makeup during Phase 1. The RCIC pump is a seismically-robust component that is located in the Reactor Building, which is a Seismic Category I structure. The RCIC pump is therefore protected from the applicable extreme external hazards.

BSEP analysis concluded that no RCIC pump seal leakage will occur when the temperature of the suction source is less than 190°F. Because the BSEP FLEX strategy transfers suction source from the suppression pool to the CST at 190°F, no leakage from the RCIC pump seals is expected.

2.3.4.4 Safety Relief Valves and Backup Nitrogen Supply

BSEP will utilize SRVs to depressurize the RPV during an ELAP. During an ELAP, BSEP will operate the SRVs using a backup supply of compressed nitrogen gas cylinders. BSEP calculations determined that the backup nitrogen supply has sufficient capacity for at least 24 hours, accounting for potential actuations of the SRVs and other demands for compressed nitrogen (torus vacuum breaker valves, hardened wetwell vent valves), and system leakage. The SRVs and the nitrogen supply are safety-related and located within the Reactor Building, which is a Seismic Category I structure. The SRVs and the backup nitrogen supply are therefore protected from all applicable hazards.

2.3.4.5 Station Batteries and Electrical Distribution System

The BSEP FLEX strategy relies on station batteries and the electrical distribution system to power essential equipment. The electrical distribution system is also used to repower installed components after the FLEX DGs are started. The station batteries and electrical distribution system components are designed for safety-related service and are located in protected structures, including the Reactor Building, the EDG Building, and the Control Building, which are Seismic Category I structures. The FLEX DG Enclosure also contains electrical distribution system equipment, and it was designed to be robust for all applicable hazards. (See Section 2.7.2.) Therefore the station batteries and the electrical distribution system will be available to support the FLEX strategy.

2.3.4.6 Suppression Pool

Shortly after the initiating event, BSEP will transfer suction of the RCIC pump from the CST to the suppression pool to extend the coping capacity of the CST. RCIC pump suction will be aligned to the suppression pool until the temperature reaches 190°F. BSEP analysis indicates that the suppression pool may reach this temperature at approximately three hours. The suppression pool is located inside the Reactor Building, which is a Seismic Category I structure. Therefore, the suppression pool is protected from all applicable external hazards.

2.3.4.7 Condensate Storage Tank

During an ELAP, the CST for each Unit is the primary source of makeup water for the RPV. The CST will initially provide suction to the RCIC pump until BSEP transfers suction to the suppression pool. RCIC pump suction will be transferred back to the CST when the suppression pool temperature reaches 190°F. Using this approach, the CST inventory is expected to support coping for approximately 52 hours following an event. The CST is a preferred source of water, since it is maintained to reactor coolant grade specifications.

Although the CST for Unit 2 is located within the fall zone of the plant stack, BSEP analyses have determined that the stack would not fail under tornado wind loading or two times the safe shutdown earthquake (SSE). Additionally, missile barriers are positioned around the CSTs to provide protection from tornado missiles. Therefore, the CST for each Unit is protected from applicable hazards and will be available following a BDBEE.

The isolation valve on each CST that is the suction connection for the FLEX pump is located approximately 1.5 feet above ground level and is protected from tornado missiles.

The 52-hour coping time is based on an initial inventory of 375,000 gallons of water in each CST. There is a 1-inch diameter CST level instrument pipe that is not missile protected and could be damaged during a BDBEE. BSEP will inspect the CST for damage following a BDBEE and isolate this level instrument pipe within 3 hours if it is damaged. The drainage rate through the small-diameter level instrument pipe is small and does not significantly affect the coping time. Equipment setup for replenishing the CST will be completed well before 52 hours into the event.

2.3.4.8 Discharge Canal

Raw water from the discharge canal would be used for long-term RPV makeup after clean water sources that survived the initiating event have been depleted. Availability of water from the discharge canal will not be adversely impacted by the applicable hazards. Potential damage to the canal from a seismic event is expected to be minor and would not significantly affect its cross-sectional area. BSEP conservatively calculated that the discharge canal contains at least 14,798,000 gallons, which is enough water to support the FLEX strategies for several weeks. During this time, BSEP would restore on-site capabilities for providing clean water makeup or arrange for an off-site water source.

2.3.5 FLEX Connections

FLEX connections are installed on various plant systems to facilitate use of portable equipment for water makeup and electric power. NEI 12-06 (Reference 3) requires primary and alternate connections (or primary and alternate strategies) to provide redundancy. The primary and alternate connections (or strategies), and justification for their protection from the applicable extreme external hazards, are discussed below.

2.3.5.1 FLEX RPV Makeup Connections

If the RCIC pump is not available, BSEP can provide RPV makeup using a portable FLEX pump. BSEP will deploy hoses to connect the FLEX pump to the CST (via an isolation valve) or the discharge canal to establish a suction source. BSEP will also deploy hoses from the pump discharge to installed plant systems to direct cooling water to the RPV. NEI 12-06 requires the locations of the primary and alternate connection points to provide reasonable assurance of at least one connection being available following a BDBEE. Connection points used to establish a flow path from the FLEX pump to the RPV include the following:

- The primary FLEX RPV makeup flow path for each unit includes a series of hoses and connections. The FLEX pump will be deployed outside of the Reactor Building, near the CST. BSEP installed a penetration through the Reactor Building wall (i.e., Secondary Containment) that has connection points for establishing a flow path. BSEP will connect a hose from the FLEX pump discharge to the exterior portion of the Reactor Building penetration. Another hose connects the interior portion of the Reactor Building penetration to a FLEX connection that directs the water into the RWCU piping. Connections inside the Reactor Building are protected from the applicable hazards, since the Reactor Building is a Seismic Category I structure. The connection outside the Reactor Building is also protected from the applicable hazards, as there is a protective enclosure around the exterior connection points that provides protection from tornado missiles, wind, ice storms, and any wave action due to flooding.
- The alternate FLEX RPV makeup flow path for each unit also includes a series of hoses and connections. From the FLEX pump discharge, BSEP will connect a hose to an external ILRT service air connection (located on the Turbine Building north exterior wall for Unit 1, and the Reactor Building northeast exterior wall for Unit 2). Inside the Reactor Building, the ILRT piping can be connected to the RHR system to supply water to the RPV. For Unit 1, BSEP will rotate and fasten a piping elbow to complete the flow path. For Unit 2, BSEP will exchange two blind flanges for flanges with hose connections and then connect a hose to complete the flow path. The ILRT piping is part of the SA system, which is not

safety-related. This alternate flow path is acceptable because the primary strategy is protected from all hazards.

2.3.5.2 Electrical Connections

In the event of an ELAP, BSEP can use FLEX DGs to power essential systems and equipment. The FLEX DG Enclosure is designed to survive all applicable external hazards (see Section 2.7.2). Only one of the two FLEX DGs is required to support the FLEX strategies and each DG has an independent FLEX DG output distribution panel in the FLEX DG Enclosure. One FLEX DG output distribution panel connects to emergency bus E6 and the other FLEX DG output distribution panel connects to emergency bus E8. The two FLEX DG output distribution panels can be cross-tied so that one FLEX DG can supply power to both busses E6 and E8, thereby supporting operation of all key electrical equipment.

Plant personnel can access connection points through seismically robust structures. The FLEX DG Enclosure is sized and designed to house and protect the FLEX DGs and their associated electrical and mechanical components from all applicable hazards. The EDG Building, which houses emergency busses E6 and E8 and the associated FLEX breakers, is a Seismic Category I structure designed to withstand the applicable extreme external hazards.

The generators supplied by the NSRC have an output connection that is not directly compatible with the electrical distribution system at BSEP. To protect the installed plant emergency electrical distribution system, BSEP maintains cables and connectors that are stored in the BSEP FSB. The cabling approach for the NSRC generators includes connections inside the FLEX DG Enclosure, which provides protection from all applicable hazards.

NEI 12-06 states that electrical diversity can be accomplished by providing a primary and alternate method to repower key equipment and instruments utilized in the FLEX strategy. The location of the connection points should provide reasonable assurance of at least one connection being available following a BDBEE. Additionally, the electrical connection points must be suitable for both the on-site and off-site equipment. As discussed above, the BSEP FLEX electrical connections satisfy these requirements.

2.3.5.3 Pneumatic Connections

The backup nitrogen supply that is used to operate the SRVs during an ELAP has a capacity of at least 24 hours. To support continued operation for a duration beyond the installed capacity, BSEP will deploy a FLEX air compressor. Connection points for the compressor include the following:

- The primary connection strategy is to the Division II Nitrogen Backup Remote Supply Line Isolation Valve on the IAN system. This valve is located outside of plant structures in the seismic isolation space between the Reactor Building and the Turbine Building. BSEP evaluation concluded that the primary connection points were robust with respect to seismic, flood, high temperature, and ice storm events. This connection is protected from wind-generated missiles on three sides, but is not fully protected. Therefore, this connection is not credited for airborne missile hazards.
- The alternate connection strategy is to connect air hoses to isolation valves (one for each Unit) in the non-interruptible instrument air (RNA) piping. These connection points are inside the Reactor Building and are expected to survive all

applicable hazards, because the Reactor Building is a Category I structure. BSEP evaluation concluded that this strategy is robust with respect to the wind hazard, flooding, high temperature, and ice storms. The alternate connection strategy uses RNA system piping, which is not safety-related, so the alternate connection strategy is not credited as being protected from the seismic hazard.

The FLEX pneumatic connections are located such that there is reasonable assurance that either the primary or alternate connection strategy will be available following any of the applicable hazards (i.e., the alternate strategy is credited for the wind hazard, and the primary strategy is credited for the seismic hazard). Accordingly, these connections satisfy the requirements of NEI 12-06.

2.3.6 Plant Instrumentation

BSEP will monitor the following parameters to support the FLEX core cooling strategy.

- RPV Level Narrow Range
- RPV Level Wide Range
- RPV Level Fuel Zone
- RPV Pressure Narrow Range
- RPV Pressure Wide Range
- Containment Temperature
- Drywell Pressure
- CST Level

In the event of an ELAP, RPV level, RPV pressure, Drywell Pressure and Containment (Drywell / Suppression Pool) temperature instruments would normally be powered by the Station Batteries. RPV Level Narrow Range and RPV pressure indications can be monitored from the Main Control Room. RPV Level Wide Range, RPV Level Fuel Zone, and Suppression Pool Water Temperature can be monitored from the Remote Shutdown Panel (RSP) in the Reactor Building.

If necessary, BSEP can monitor plant parameters by alternate means, as follows:

- RPV level can be monitored using a pressure test gauge connected to an instrument rack in the Reactor Building. The FSG provides a relationship between differential pressure and RPV level.
- RPV pressure can be monitored directly from instruments on instrument racks in the Reactor Building.
- Drywell pressure can be monitored by connecting a pressure test gauge to a drain valve in the Reactor Building.
- Containment Temperature can be monitored by connecting a Fluke Meter to the RSP.
- CST Level is normally monitored from the control room by RCIC instrumentation, which relies on piping from the CST. BSEP will inspect these lines for damage following a BDBEE. If damaged, BSEP will isolate the CST instrument lines and determine CST level locally by installing a pressure test gauge.

2.3.7 Thermal-Hydraulic Analysis

The RCIC suction source provides RCIC pump cooling. During Phase 1, use of the suppression pool as the suction source depends on having low temperature suppression pool water to support RCIC cooling. BSEP analysis concluded that the RCIC pump can be operated when suppression pool water temperature is at or below 190°F.

BSEP analysis concluded that there is no concern for NPSH for the RCIC pump when suppression pool temperature is less than 193°F. Since BSEP will switch RCIC suction to the CST when suppression pool temperature is 190°F, sufficient NPSH will be present for the RCIC pump throughout the event.

BSEP analysis using the Modular Accident Analysis Program (MAAP) concluded that the CSTs support a coping time of approximately 52 hours given the initial minimum water inventory of 375,000 gallons. The MAAP analysis includes 18 gpm RCR pump seal leakage per pump and 25 gpm primary system leakage. The MAAP analysis indicates that the suppression pool may heat up to 190°F in about 3 hours, at which time RCIC pump suction would be transferred to the CST.

A BSEP decay heat study showed that the RPV at 250 psig, 2 hours after shutdown, would need 269 gpm of RPV makeup to keep the core covered. For hydraulic analyses, BSEP conservatively used a 300 gpm requirement for RPV injection rate. The 2-hour value is appropriate because the RCIC pump will be used for at least the first two hours of the event, while the portable FLEX pump is being deployed.

BSEP performed hydraulic analysis using FATHOM software to verify that the portable pumps designated for FLEX operations are sufficient. BSEP has two different types of portable pumps that are credited for the FLEX strategies: two FLEX pumps and one Extreme Damage Mitigation Guideline (EDMG) pump that was originally designated to support the requirements of 10 CFR 50.54(hh) (i.e., B.5.b). The analysis included a model of the FLEX components (pumps, hoses, connectors) and their interfaces with plant systems to deliver water from the CSTs to the RPV and SFP of both Units 1 and 2 using the primary and alternate strategies. Key conclusions from this calculation included the following:

- The FLEX pump provides the required flow rates to the RPV (and the SFP) for all cases evaluated. The limiting flow rate for the FLEX pump with respect to RPV makeup was 365 gpm at 285 psia discharge pressure. This flow rate exceeds the 300 gpm minimum requirement.
- The EDMG pump provides the required flow rates to the RPV (and the SFP) for all cases evaluated. The limiting flow rate for the EDMG pump with respect to RPV makeup was 310 gpm at 269 psia discharge pressure. This flow rate exceeds the 300 gpm minimum requirement.
- The NSRC pump must be capable of delivering a combined total of 550 gpm to the RPV and SFP at 267 psid. The NSRC pumps are sufficient for delivery of water at these specifications. (See Section 2.3.10.)

To ensure that the NSRC pumps are able to supply water from the discharge canal to the CSTs, BSEP compared the specifications of the NSRC pumps to the specifications of the EDMG pump which has been evaluated as satisfactory for the same configuration. Since the NSRC pumps are rated for higher pressure, and flow rate, (2,500 gpm at 300 psi) than the EDMG pump (500 gpm at 250 psig), and the NSRC has a 12 ft suction lift capability (8.8 ft suction lift required at discharge canal ramp) it is assured that the NSRC pumps will be capable of providing sufficient flow to the CSTs.

2.3.8 Reactor Recirculation Pump Seals

The maximum assumed leak rate from Reactor Recirculation Pump (RRP) Seals at BSEP is a total of 36 gpm. This assumption is based on 18 gpm leakage for each of two RRPs. Seal leakage is a function of reactor pressure and will decrease with depressurization.

2.3.9 Shutdown Reactivity Analysis

At the start of the event, the reactor trips and all rods are inserted. BSEP was designed such that the negative reactivity of the control rods is sufficient to provide satisfactory shutdown margin under all plant conditions. Additional actions to control reactivity are not required, as NEI 12-06 permits an assumption that all rods are successfully inserted following reactor trip.

2.3.10 Pumps

After the RCIC Pump is secured, the BSEP FLEX strategy relies on a portable, diesel-powered pump to provide cooling water from the CST to the RPV. One pump is needed for each Unit. The BSEP FLEX pumps are rated for 2,100 gpm at a pressure of 150 psig. The EDMG pump is rated for 1,500 gpm at a pressure of 150 psig. As discussed in Section 2.3.7, hydraulic evaluation concluded that either a FLEX pump or an EDMG pump can deliver sufficient water for RPV makeup and SFP makeup for a Unit.

BSEP has two portable FLEX Pumps and one EDMG pump for a total of three pumps that can deliver RPV makeup. BSEP also has a hose trailer for each of the three pumps. Therefore, the N+1 equipment redundancy requirement in NEI 12-06 is satisfied.

The NSRC will deliver several additional pumps. The NSRC pumps include an RPV makeup pump rated for 500 gpm at 500 psi, a medium flow pump rated for 2,500 gpm flow at 300 psi, a high capacity pump rated for 5,000 gpm at 150 psi, and a high-pressure injection pump rated for 60 gpm at 2,000 psi. These pumps are sufficient to support the Phase 3 FLEX strategies. In particular, the medium flow pump specifications (2,500 gpm flow at 300 psi) exceed the requirements identified by BSEP hydraulic analysis (550 gpm flow at 267 psi) for RPV and SFP makeup.

Credited water supplies for the FLEX pumps, the EDMG pump, and the NSRC pump include the CST and the discharge canal.

2.3.11 Electrical Analysis

2.3.11.1 Battery Load Shedding

BSEP performed a battery load shedding analysis that concluded that the Division II batteries will remain above the terminal voltage for at least two hours and ten minutes, with the load shedding actions designated by BSEP procedures at specified times. The load shedding actions required to achieve this battery duration will only be performed if the FLEX DGs fail to start as planned. Because the FLEX DGs are permanently pre-staged, they are expected to be available prior to the time required for additional load shedding actions. (See sequence of events in Section 2.9.1.)

The battery load shedding calculation uses the IEEE 485 methodology to validate that BSEP station batteries are capable of supporting initial RCIC system operation during an ELAP, along with all necessary DC powered indicators.

2.3.11.2 Diesel Generators

BSEP has two 480V, 500 kW FLEX DGs that are permanently pre-staged in the FLEX DG Enclosure.

Electrical analysis of the BSEP FLEX strategies determined that a single 500 kW DG can provide power to the key electrical equipment and instruments needed for both BSEP units. BSEP determined that approximately 150 kW is required for the Division II loads from each unit, for a total required capacity of approximately 300 kW. The nominal FLEX DG capacity of 500 kW DG provides considerable margin to this minimum requirement. Additionally, each FLEX DG is installed with the necessary connection capabilities to supply both units' Division II battery chargers and power other equipment necessary for the FLEX strategies. Because only one FLEX DG is required for both units and BSEP has two FLEX DGs, the N+1 equipment redundancy requirement in NEI 12-06 is satisfied.

In the expected configuration each FLEX DG is powering the Division II loads for a single unit. Each FLEX DG is capable of energizing both Division I & II for a single unit with a load of approximately 370 kW. The nominal FLEX DG capacity of 500 kW provides considerable margin to this expected demand.

2.3.11.3 Lighting

The flashlights carried by Operations personnel during normal operations is the credited FLEX strategy.

In addition to this credited lighting, BSEP has the following additional equipment staged in the FSB:

- Spare flashlights and batteries
- Headlamp flashlights
- DC-powered portable LED lighting units
- Diesel-powered light towers

Also, throughout the station, including in the Main Control Room, there is lighting powered by DC distribution or from Emergency Light Units.

As part of Phase 3, the NSRC will deliver additional diesel-powered mobile lighting towers to augment BSEP lighting equipment.

2.4 Spent Fuel Pool Cooling/Inventory Strategy

2.4.1 Phase 1

No manual action is required for SFP cooling or inventory control as part of Phase 1. The SFP will be allowed to heat up and boil. As discussed in the BSEP Updated Final Safety Analysis Report (UFSAR), boiling may occur as soon as 5 hours into the event and the SFP may lose inventory at a maximum rate of 65 gpm. Makeup to the SFP will not be required until approximately 57 hours into the event, which provides ample time to deploy the Phase 2 SFP makeup strategy.

BSEP will open the Reactor Building roof hatch within 2 hours of the initiating event to support Reactor Building cooling and provide a vent path for SFP boil-off.

BSEP will monitor SFP water level using remote SFP level instrumentation (SFPLI). The SFPLI can be powered by its own back-up battery supply until Phase 2 electric power becomes available. Spare batteries for these instruments are staged in the FSB.

2.4.2 Phase 2

To compensate for SFP boil-off and maintain the fuel covered, BSEP will provide SFP makeup using the same FLEX pump that is deployed for the core cooling strategy. Consistent with the discussion in Section 2.3.2, the suction source for SFP makeup could be the CST or the discharge canal.

- The primary makeup strategy uses a FLEX connection on the RHR Fuel Pool Cooling assist line to deliver water from the FLEX pump to the SFP cooling system and ultimately into the SFP.
- For the alternate approach, BSEP will use hose routed from the FLEX pump to the refueling floor to provide makeup directly to the SFP. This approach does not utilize installed system piping. Hoses will be deployed early in the event while the upper elevations of the Reactor Building are accessible.
- BSEP can also deliver SFP makeup via two spray nozzles, using hose routed from the FLEX pump to the spray nozzle location. This approach does not utilize installed system piping. Hoses and nozzles will be deployed early in the event while the Reactor Building is accessible.

During Phase 2, BSEP will continue monitoring SFP water level using SFPLI. The FLEX DGs will be operating during Phase 2 and can power the SFPLI.

2.4.3 Phase 3

The Phase 3 SFP cooling strategy is the same as the Phase 2 strategy. The NSRC will supply additional equipment (e.g., pumps, generators) as a backup.

2.4.4 Availability of Structures, Systems, and Components

2.4.4.1 Structures

The BSEP SFP cooling strategy relies on the Reactor Building, which is addressed in Section 2.3.4.1. The Reactor Building is robust to all applicable external hazards and provides protection for systems required for the SFP cooling strategy.

2.4.4.2 Systems

The SFP cooling strategy relies on installed piping and components from the RHR system and the Fuel Pool Cooling and Cleanup system (FPCC) to maintain SFP cooling capability. The portions of the RHR system and the SFP cooling system required for the FLEX strategy were designed for safety-related service and will be available following the applicable external hazards.

2.4.4.3 CST

The FLEX Pump provides water for makeup to both the RPV and the SFP using the same suction source. The CST will be available as a water source following a BDBEE, as discussed in Section 2.3.4.7.

2.4.4.4 Discharge Canal

A backup suction source for the FLEX Pump is the discharge canal. The discharge canal will be available as a raw water source following a BDBEE, as discussed in Section 2.3.4.8.

2.4.4.5 SFP Makeup Connections

BSEP has two independent flow paths for providing SFP makeup from the FLEX pump. The same pump is used for SFP makeup as for core cooling, so the suction source will also be the same. NEI 12-06 requires that fluid connections for portable equipment have a primary and alternate connection point. Additionally, the location of the connection points should provide reasonable assurance of at least one connection being available following a BDBEE. For SFP makeup, NEI 12-06 also requires a strategy for makeup by spraying water into the SFP. As discussed below, the BSEP FLEX SFP makeup strategies satisfy these requirements.

- The primary FLEX SFP makeup flow path includes a series of hoses and connections. Outside of the Reactor Building, the flow path is common with the core cooling strategy, with hose being connected to a penetration through the Reactor Building wall. On the interior of the Reactor Building, flow into the penetration can be split between two paths; one of which is for RPV makeup and the other for SFP makeup. From this connection point, BSEP will use hose to establish a flow path to a connection on the RHR piping. Valve manipulations will align flow to the SFP via FPCC piping. Connections inside the Reactor Building are protected from the applicable hazards, since the Reactor Building is a Seismic Category I structure. The connection outside the Reactor Building is also expected to be available following any applicable hazard, as it is protected by a robust enclosure.
- The alternate FLEX SFP makeup flow path also includes a series of hoses and connections. From the FLEX pump, BSEP will route a hose through a Reactor Building personnel access to a gated wye. From the wye, BSEP will deliver makeup water to the SFP through pre-staged hoses that will be positioned to deliver water directly into the SFP.
- BSEP can also deliver SFP makeup water through spray nozzles connected to hoses routed to locations adjacent to the SFP.

2.4.5 Plant Instrumentation

The key parameter for the SFP cooling/inventory function is SFP level.

The Spent Fuel Pool Level Indication (SFPLI) utilizes a through-air guided-wave radar system. The system consists of a radar sensor, stainless steel waveguide pipe and a rotatable horn antenna mounted on the edge of the SFP, and local and remote display indicators. The SFP level radar measurement system consists of two redundant channels, which are permanently fixed. Each channel is separated by distance and electrically independent, as each channel is normally powered by separate 120V distribution panels (one is Division I and the other is on Division II). The SFPLI system has replaceable batteries with sufficient capacity to maintain the level indication function until offsite power or other emergency resources become available. Specifically, the SFPLI batteries will power the instrumentation for at least 72 hours. Long-term power to SFP level instrumentation can be provided by FLEX DGs. If necessary, extra SFPLI batteries are available in the FSB.

Each channel is a separate instrument loop system with control and power wiring separated by different conduits and trays.

All components of the SFPLI system are mounted to meet SSE seismic accelerations. Essential components were designed to meet two times SSE seismic accelerations.

The SFPLI equipment was designed to perform its design function at temperature, humidity, vibration, and radiation levels consistent with potential conditions during and following a BDBEE.

Both channels of SFP level can be monitored at Control Room back panels on a digital display or locally inside the Reactor Building.

2.4.6 Thermal-Hydraulic Analysis

The SFP will heat up and begin to boil as early as 5 hours into the event. Maximum boil-off from the SFP could result in an inventory loss rate of 65 gpm. Given these inputs, fuel uncovery would occur approximately 57 hours into the event.

BSEP performed hydraulic analysis using FATHOM software to verify that the FLEX pumps are sufficient for FLEX operations. The analysis included a model of the FLEX components (pumps, hoses, connectors) and their interfaces with plant systems to deliver water from the CSTs to the RPV and SFP of both Units 1 and 2 using the primary and alternate strategies. Key conclusions from this calculation included the following:

- The FLEX pump provided the required flow rates to the SFP (and the RPV) for all cases evaluated. The limiting flow rate for the FLEX pump with respect to SFP makeup using the primary connection strategy (i.e., via FPCC piping) was 66 gpm at 285 psia discharge pressure. For the limiting alternate SFP makeup strategy (i.e., via spray hoses), the FLEX pump provided 250 gpm at 280 psia.
- The EDMG pump provided the required flow rates to the SFP (and the RPV) for all cases evaluated. The limiting flow rate for the EDMG pump with respect to SFP makeup using the primary connection strategy (i.e., via FPCC piping) was 66 gpm at 269 psia discharge pressure. For the limiting alternate SFP makeup strategy (i.e., via spray hoses), the EDMG pump provided 250 gpm at 269 psia discharge pressure.
- The NSRC pump is able to deliver a total of 550 gpm to the RPV and SFP at 267 psid.

2.4.7 Pumps and Water Supplies

BSEP will use the same pump for SFP makeup as for RPV makeup. For SFP makeup, the minimum requirement for providing flow through the FPCC piping is 65 gpm, which will offset the maximum boil-off rate. NEI 12-06 requires that the flow rate through the hoses used for spray makeup should be 250 gpm per unit if overspray could occur. As discussed in Section 2.4.6, a hydraulic analysis concluded that the FLEX pump, EDMG pump and the primary and alternate flow paths are adequate for SFP makeup requirements.

Discussion of the pumps and associated water sources is provided in Section 2.3.10.

2.4.8 Electrical Analysis

SFP level will be monitored by instrumentation installed to satisfy Order EA-12-051. The SFPLI system has replaceable batteries with sufficient capacity to maintain the level indication function until offsite power or other emergency resources become available. Specifically, the SFPLI batteries will power the instrumentation for at least 72 hours.

Long-term power to SFP level instrumentation can be provided by FLEX DGs. If necessary, extra SFPLI batteries are available in the FSB.

2.5 Containment Function Strategy

2.5.1 Phase 1

During Phase 1, BSEP will depressurize the RPV to the range of 150 psig to 300 psig using SRVs, which direct steam into the suppression pool. This action will absorb the heat load in the Primary Containment, limiting the pressure rise and prolonging coping time. The SRVs are powered by the station batteries and the pneumatic motive force is nitrogen backup.

2.5.2 Phase 2

When the nitrogen backup cylinders are depleted, a FLEX air compressor will provide pneumatic motive force for the SRVs.

As the suppression pool heats up, pressure in Containment will rise. BSEP will vent Containment through the Hardened Wetwell Vent prior to reaching the Primary Containment Pressure Limit (PCPL) of 70 psig. The Hardened Wetwell Vent can be powered by the FLEX DGs, which will be operating prior to Containment reaching the pressure limit. BSEP will continue venting through the Hardened Wetwell Vent System, as necessary.

2.5.3 Phase 3

The Phase 3 strategy is a continuation of the Phase 2 strategy. The NSRC will supply additional equipment (e.g., generators) as a backup.

2.5.4 Availability of Structures, Systems, Components

2.5.4.1 Structures

For protection of components, the BSEP Containment Integrity strategy relies on the Reactor Building, which is addressed in Section 2.3.4.1. The Reactor Building is robust to all applicable external hazards and provides protection for systems required for the Containment Integrity strategy.

2.5.4.2 Systems

The Containment Integrity strategy relies on installed piping and components from the Hardened Containment Vent (HCV) system, the PNS system, and the RNA system. The portions of these systems required for the FLEX strategy were designed for safety-related service and will be available following the applicable extreme external hazards.

2.5.4.3 Safety Relief Valves, Hardened Wetwell Vent, and Backup Nitrogen Supply

BSEP will utilize SRVs to depressurize the RPV and the Hardened Wetwell Vent to maintain Containment Integrity. During an ELAP, these components are operated using DC power, AC power (from the FLEX DG's) and pressurized backup nitrogen. BSEP calculations indicate that, accounting for potential actuations of the SRVs and other demands for compressed nitrogen (e.g., torus vacuum breaker valves and hardened wetwell vent valves), the backup nitrogen supply has a capacity of at least 24 hours. The SRVs and the nitrogen supply are safety-related and located within the Reactor Building, which is a Seismic Category I structure and provides protection from all applicable hazards. BSEP specifically evaluated the Hardened Wetwell Vent Pipe as part of FLEX strategy development to confirm that it is robust to all hazards, including tornado missiles. The SRVs, Hardened Wetwell Vent, and the backup nitrogen supply are therefore protected from all applicable hazards.

2.5.4.4 Nitrogen Connections

BSEP will deploy a FLEX air compressor to ensure that pneumatically operated equipment can function beyond the capacity of the backup nitrogen supply. As discussed in Section 2.3.5.3, BSEP has a primary and alternate connection strategy for this equipment. These connection strategies satisfy the requirements of NEI 12-06.

A single FLEX air compressor has enough capacity to supply both Units, and the FSB contains four FLEX air compressors. Three air compressors are considered credited equipment with the fourth air compressor being a spare. This strategy exceeds the equipment redundancy requirements of NEI 12-06 (i.e., only two compressors are required).

2.5.4.5 Ventilation Strategy

When containment pressure reaches 70 psig, BSEP will use the hardened wetwell vent to reduce pressure. BSEP evaluated the HCV system to be robust with respect to seismic events, floods, high winds, and associated missiles.

The hardened wetwell vent will be powered by the FLEX DGs, with motive force from backup nitrogen or FLEX air compressors, which will be available prior to Containment pressure reaching 70 psig.

In June 2013, the NRC issued Order EA-13-109 (Reference 11), which requires Boiling Water Reactor (BWR) licensees with Mark I or Mark II containments to have a reliable hardened vent to remove decay heat and maintain control of containment pressure following events that result in the loss of active containment heat removal capability or prolonged SBO. Order EA-13-109 specified that applicable stations must be in full compliance by the first refueling outage after June 30, 2017 or prior to June 30, 2019, whichever comes first. BSEP submitted an OIP (Reference 12) for conforming to Order EA-13-109 in June 2014.

2.5.4.6 Spray Strategy

Containment spray functionality is not required to support the BSEP FLEX response strategy.

2.5.5 Plant Instrumentation

BSEP will monitor the following parameters to support the FLEX Containment Integrity strategy. Associated instruments are initially powered by the station batteries and subsequently from the FLEX DGs.

- RPV Pressure Narrow Range
- RPV Pressure Wide Range
- Drywell Temperature
- Drywell Pressure
- Suppression Pool Water Temperature
- Suppression Pool Water Level

In the event of an ELAP, RPV pressure, Drywell pressure and Drywell / Suppression Pool temperature instruments would normally be powered by the station batteries. If instruments lost power, BSEP can monitor plant parameters by the alternate means below:

- RPV pressure can be monitored from instruments directly on the instrument racks in the Reactor Building.
- Drywell pressure can be monitored by connecting a pressure test gauge to a drain valve in the Reactor Building.
- Drywell and Suppression Pool temperature can be monitored by connecting a Fluke Meter to the Remote Shutdown Panel.
- Suppression Pool water level can be monitored by connecting a pressure test gauge to a lower drain valve and connecting a pressure test gauge to a vent valve connected to the Suppression Pool air space. Utilizing these two readings the water level can be determined.

2.5.6 Thermal-Hydraulic Analysis

The design pressure and temperature of the drywell containment are 62 psig and 300°F, respectively (although the PCPL is 70 psig and the drywell failure pressure is 170 psig). The design pressure and temperature of the suppression pool are 62 psig and 220°F, respectively.

BSEP performed a MAAP analysis to determine the containment response to a BDBEE. The analysis indicated that the peak suppression pool water temperature is 305°F at a pressure of 84 psia (69 psig) and the drywell pressure peaks at 302°F at a pressure of 84 psia (69 psig). These temperatures and pressures exceed the design basis for the drywell containment and the suppression pool. However, the peak pressures are below the PCPL and have considerable margin to the drywell failure pressure. The peak temperature is less than the limit determined by BSEP for various structural components in containment (limiting value for all components is 350°F). Therefore, the drywell and suppression chamber are not expected to fail.

2.5.7 Electrical Analysis

Vital instrumentation will initially be powered by station batteries. The FLEX DGs will provide power for vital instrumentation, the SRVs, and the hardened wetwell vent after the FLEX DGs are started.

As discussed in Section 2.3.11.2, BSEP performed an analysis of the FLEX DGs which confirmed each FLEX DG has sufficient capacity to support essential loads for the Phase 2 FLEX strategies, including SRVs, the hardened wetwell vent, and instrumentation necessary for monitoring conditions important for containment integrity.

2.6 Characterization of External Hazards

The following extreme external hazards were assessed for applicability for BSEP:

- Seismic events
- External flooding
- Storms such as hurricanes, high winds, and tornadoes
- Extreme snow, ice, and cold
- Extreme heat

2.6.1 Seismic Events

The seismic hazard is applicable for BSEP. Per NEI 12-06, Table 4-2, all sites will consider seismic events.

The BSEP UFSAR, Section 2.5.2 states that the design basis earthquake (DBE) (or SSE) has a horizontal ground acceleration design value of 0.16 g and the operating basis earthquake (OBE) has a horizontal ground acceleration design value of 0.08 g. The FLEX strategies are based on the seismic hazard discussed in the UFSAR.

The NRC requested licensees to re-evaluate the seismic hazards at their sites based on updated seismic hazard information and present-day regulatory guidance and methodologies. BSEP submitted an Expedited Seismic Evaluation Process (ESEP) report to the NRC in December, 2014 (ADAMS Accession No. ML15005A074) (Reference 19), which provides additional assurance of plant safety while a longer-term seismic evaluation is completed to support regulatory decision making. BSEP identified and evaluated the seismic capacity of key installed equipment that is used as part of FLEX strategies. BSEP confirmed that the evaluated equipment can withstand a seismic event at least two times the magnitude of the SSE. In a letter dated November, 2015, (ADAMS Accession No. ML 15313A245), the NRC staff concluded that BSEP responded appropriately to Enclosure 1, Item (6) of the 50.54(f) letter.

Any impact on the FLEX strategies related to the seismic hazard re-evaluation will be addressed separately from this Final Integrated Plan (FIP).

2.6.2 External flooding

The external flooding hazard is applicable for BSEP.

Sections 2 and 3 of the Updated Final Safety Analysis Report (UFSAR) discuss the design basis external flood hazard and the impact to structures that house safety related equipment. At BSEP, the Probable Maximum Hurricane (PMH) defines the Probable Maximum Flood (PMF). The most severe flood conditions are associated with a PMH coinciding with peak local astronomical tides.

From the open coast, the surge water level propagation up the Cape Fear River into the intake canal was evaluated with a resultant level of 22 feet Mean Sea Level (MSL). The nominal plant grade of 20 feet MSL results in two feet of water depth surrounding the plant during maximum surge conditions. All of the safety-related structures are waterproofed to elevation 22 feet MSL. For example, personnel and equipment access doors are provided with sills above the 22-foot still water level, or alternatively are equipped with positive seals and closure devices when the sills are below 22 feet MSL.

The wave action on structures on the ground will depend on the overland water depth caused by flooding. This depth being 2.0 feet maximum, the highest wave that can be sustained will be 1.6 feet high. Larger waves over 1.6 feet coming from any overland direction will break when they reach the 2-foot depth overland. Wave run-up on a vertical wall associated with 1.6-foot waves is about 3.6 feet. Thus the maximum instantaneous water elevation on any of these buildings is 25.6 feet MSL.

Concerning the wave action on the Service Water Intake Structure, waves generated or propagated along the intake canal were conservatively estimated and reported as 3.0 feet high with a period of four seconds. The run-up due to these waves at the Intake Structure resulted in the maximum instantaneous water level of 28.3 feet MSL.

The NRC requested licensees to re-evaluate all appropriate external flooding sources using present-day regulatory guidance and methodologies. During the conduct of the NTTF 2.3 flood protection features walkdowns, BSEP recognized a beyond design basis condition for certain structures when considering the concept of Cliff Edge Effects as described in NEI 12-07, Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features. As part of the response to this request, BSEP assumed a small increase of 5% in the design basis flood hazard of 22 feet MSL which would result in a MSL of 23.1 feet. This Cliff Edge flood level condition is above the operating floor elevation (i.e., 23 feet) of the Control Building and Diesel Generator Building and the entrance to the Service Water Building. In response to the Cliff Edge condition, BSEP proactively designed Cliff Edge barriers that can be temporarily installed at certain entrances to structures housing safety related equipment if a hurricane was approaching the BSEP site.

BSEP submitted the Flood Hazard Reevaluation Report to the NRC in March, 2015 (ADAMS Accession No. ML 15079A385)(Reference 18). The report shows that some PMH flood levels are not bounded by the current design basis levels, however these higher flood levels are well mitigated by installation of the temporary barriers such that safety related equipment continues to be protected. Future NRC guidance will require BSEP to prepare additional documentation on resolution of all of the re-evaluated flood hazards.

2.6.3 Storms such as hurricanes, high winds, and tornadoes

The high wind hazard is applicable for BSEP.

As described in UFSAR Section 2.1.1.1, the BSEP site is located at latitude 33°57'30" N and longitude 78°00'30" W. According to NEI 12-06, the location of BSEP has a peak hurricane wind speed of 210 mph and a recommended tornado wind design speed of 200 mph. Based on the potential for winds in excess of 130 mph, the BSEP site is susceptible to damage from severe winds from a hurricane or tornado.

2.6.4 Extreme snow, ice and cold

The ice hazard is applicable for BSEP. The snow and extreme cold temperature hazard is not applicable.

According to NEI 12-06, the location of BSEP is subject to ice storms that may impact the availability of off-site power. Accordingly, the BSEP FLEX strategies must consider ice storms.

NEI 12-06 states that snowfalls are unlikely to present a significant problem for deployment of FLEX in locations below the 35th parallel. BSEP is located below the 35th parallel, so BSEP FLEX strategies are not required to consider the impedances caused by extreme snowfall. NEI 12-06 states that the same basic trend applies to extreme cold temperatures, so BSEP FLEX strategies are not required to address extreme cold temperatures.

2.6.5 Extreme heat

The extreme heat hazard is applicable for BSEP.

NEI 12-06, states that virtually every state in the lower 48 contiguous United States has experienced temperatures in excess of 110°F and many in excess of 120°F. In accordance with NEI 12-06, all sites will address high temperatures. Therefore, the extreme high temperature hazard is applicable for BSEP.

2.7 Planned Protection of FLEX Equipment

Storage and protection of FLEX equipment is discussed in this section. BSEP evaluated the applicability of external hazards and addressed implementation considerations associated with each including:

- protection of FLEX equipment
- deployment of FLEX equipment
- procedural interfaces
- utilization of off-site resources

2.7.1 FLEX Storage Building

The majority of the FLEX equipment credited for Phase 2 strategies, and also cabling for Phase 3 electrical strategies, is stored in the FLEX Storage Building (FSB), which is a monolithic dome.

The FSB is located on the southeast area of the plant next to the Technical Training Center at an elevation above the maximum flood level for the site.

The FSB was designed to withstand loads associated with the following hazards:

- Seismic loading exceeding the ASCE 7-10 requirement for the Southport location and the BSEP SSE. The FSB will withstand two times the SSE without gross failure.
- High wind loading exceeding the ASCE 7-10 requirement for the Southport location and the requirements found in ASCE paper No. 3269.
- Snow and ice loads on the roof based on the plant design basis and ASCE 7-10.
- Tornado loading based on RG 1.76, Rev. 1 wind speeds and tornado missiles.
- Combined loads as specified in ASCE 7-10 for dead loads, seismic loads, wind loads, wave loads, buoyancy loads, and snow and ice loads.

Equipment stored in the FSB includes the following:

- Two FLEX pumps and one EDMG pump with couplings and hose trailers
- Spare nozzles and fittings for SFP spray makeup strategy
- Spare SFPLI batteries
- FLEX air compressors with equipment trailers to make pneumatic connections
- A CAT 924K loader and a Dodge 5500 flatbed truck for debris removal and equipment towing
- Salt spreader and salt bags for treating ice on deployment paths
- Diesel Fuel Oil (DFO) tank and trailer with transfer pump and hoses
- Discharge Weir/Canal Suction trailer with hoses and fittings
- Control room ventilation trailer with exhaust fans, small portable DGs, and ducting
- NSRC generator cable trailer with cabling to connect the NSRC generators to the BSEP electrical distribution system

2.7.2 FLEX Diesel Generator Enclosure

The FLEX DGs are permanently pre-staged in the FLEX diesel generator enclosure. The FLEX DG enclosure is protected from all external hazards applicable at the BSEP site. The FLEX DG enclosure was designed to be robust to the applicable external hazards as follows:

- Withstands two times the BSEP SSE without gross failure. Additionally, the FLEX DG baseplate frame, the anchorage securing the FLEX DGs to the Diesel Fuel Oil Tank Vault (DFOTV), and the DG exhaust and vent piping are designed for two times the BSEP SSE.
- Constructed at an elevation to maintain FLEX DG equipment and electrical distribution system above maximum flood levels.
- Sealed against external flooding using a combination of welded seams / connections and sealant.
- Includes ventilation louvers that are designed to limit wind-driven rain intrusion.
- Meets the requirements of ASCE 7-10 for hurricane and tornado wind loading and the range of tornado missiles specified in the BSEP UFSAR.
- Meets the requirements of ASCE 7-10 for roof live load of 30 psf, which envelopes the applicable roof loads for BSEP associated with an ice storm.
- Provides structural strength equal to or greater than that required to sustain the combined loads consistent with original design calculations for the DFOTV.

Permanent pre-staging of the FLEX DGs constitutes an alternate approach to NEI 12-06 rev. 0, because the FLEX DGs are not portable. Even with load shedding, the station batteries at BSEP have a limited coping time that is not sufficient for deployment of portable FLEX DGs if stored in the FSB. Use of permanently pre-staged FLEX DGs ensures continuity of power to vital equipment and more rapid re-powering of equipment needed for long-term coping. This alternative to NEI 12-06 is acceptable because the FLEX DG enclosure is a robust structure designed to withstand all applicable hazards, and connection points for both FLEX DGs are accessed through seismically robust structures. Therefore, the FLEX DGs are assured to be available.

The FLEX DGs are staged such that they are not connected to the electrical distribution system during normal operation. This approach ensures that any electrical transient associated with the initiating event does not affect the FLEX DGs.

2.8 Planned Deployment of FLEX Equipment

2.8.1 Haul Paths and Accessibility

The deployment path for FLEX equipment from the FSB is through site parking lots to the sally port, and then between the maintenance shop and Service Building to deployment areas. The deployment path is entirely over paved surfaces.

Analysis supporting Section 2.5.4.8 of the UFSAR has shown that soil liquefaction will not occur in the plant area under dynamic loadings of the SSE. Additional analyses performed assuming an earthquake of two times the SSE indicated liquefaction of loose sands below the site that could result in settlement of the ground surface. However, BSEP concluded that the potential liquefaction and settlement would not result in abrupt ruptures or significant offsets of paved surfaces, so there would not be a disruption to FLEX deployment.

The flooding hazard does not adversely impact the deployment strategy for moving FLEX equipment from the FSB to the planned deployment locations inside the protected area. The deployment path is completely paved, as is most of the site. The paved areas facilitate efficient draining from the site proper to the intake and discharge canals and the surrounding creek systems such that movement of equipment from the FSB can be supported as early as 2 hours after site flooding above grade. There are no deployment requirements this early but flooding would not hinder deployment if desired.

The CAT 924K loader is the primary equipment credited for clearing debris. BSEP can also clear debris with a Dodge 5500 flatbed truck, if necessary.

The Dodge 5500 flatbed truck is the primary equipment credited for towing FLEX equipment into deployment locations. The CAT 924K loader can also be used for towing FLEX equipment.

2.8.2 Deployment of Strategies

At the beginning of the event, BSEP will perform an initial assessment to determine accessibility of FLEX connections, conditions of deployment paths, and availability of equipment staging areas. Debris removal vehicles will be used as necessary to enable FLEX deployment.

2.8.2.1 Water Distribution

The FLEX Pump(s) can be deployed to the east side of the Augmented Off Gas (AOG) Building (Unit 1) and/or to the south side of the Unit 2 CST. Suction hoses will be connected from CST FLEX connections to the intake of the FLEX Pump(s).

If the source of makeup water is the discharge canal, the FLEX pump can be deployed to the discharge weir. In this case, strainers will be placed on the suction hoses to reduce intake of debris.

Several paths for hose deployments have been identified to ensure a water supply for RPV and SFP makeup. As discussed in Sections 2.3.5.1 and 2.4.4.5, connections for water makeup are protected from the applicable hazards. Accordingly, BSEP will be able to deploy all components required for water distribution following any applicable BDBEE.

As discussed in Section 2.8.1, the paved areas needed for FLEX deployment drain efficiently. Locations for pump deployment and hose runs will not be impacted by flooding.

As discussed in Section 2.6.4, extreme cold temperatures are not an applicable hazard. Accordingly, the BSEP FLEX strategy is not required to address accessing the discharge canal through ice.

2.8.2.2 Electrical Distribution

Because BSEP has permanently pre-staged the FLEX DGs and cabling, deployment of the electrical distribution strategy only requires racking in a 480 VAC breaker in the EDG building. The building is protected from all applicable hazards. Therefore, BSEP will be able to deploy all components required for electrical distribution following any applicable BDBEE.

2.8.2.3 Pneumatic Alignment

The backup nitrogen supply used to operate the SRVs has a capacity of at least 24 hours. BSEP will deploy a FLEX air compressor to ensure the SRVs can be operated throughout the response to the initiating event. The FLEX air compressor will be deployed to the area adjacent to the seismic isolation space between the Reactor Building and the Turbine Building. BSEP will route air hoses to the primary or alternate connection points from this location.

As discussed in Section 2.8.1, the paved areas needed for FLEX deployment drain efficiently. The locations for compressor deployment and air hose runs will not be impacted by flooding.

2.8.3 Fueling of Equipment

Each of the EDGs at BSEP has a four-day tank of diesel fuel that is qualified for all design basis hazards. Each tank has a minimum supply of 22,650 gallons of fuel. BSEP will deploy a FLEX fuel trailer to the roof of a four-day tank, open a penetration flange and connect a suction hose to the selected underground tank. BSEP will then use a transfer pump to fill a 1,240-gallon trailer, which will be used to refuel portable equipment. The transfer pump can also be used to directly refuel the FLEX DGs, which are permanently pre-staged nearby.

All FLEX equipment will be stored with a fuel tank at least 3/4-full. BSEP has evaluated the fuel consumption of each piece of FLEX equipment.

- Each FLEX DG consumes approximately 35 gallons per hour (at full load) and can operate for at least 14 hours without refueling.
- Each FLEX pump consumes approximately 25 gallons per hour (at full load) and can operate for at least 14 hours without refueling.
- Each FLEX air compressor consumes approximately 7 gallons per hour (at full load) and can operate for at least 8 hours with a full tank of fuel.

Given the total diesel fuel available in the four-day tanks of approximately 90,000 gallons and the relatively small fuel demand for the Phase 2 FLEX components cited above, BSEP has a sufficient inventory of fuel for diesel-powered equipment required for the FLEX strategy until additional fuel arrives from off-site. BSEP has sufficient inventory to supply diesel fuel for additional demands, including refueling of debris removal equipment, lighting towers, and NSRC equipment (e.g., generators, pumps).

2.9 Sequence of Events and Staffing

2.9.1 Sequence of Events

The table below presents a Sequence of Events (SOE) Timeline for an ELAP/LUHS event at BSEP. Validation of each of the FLEX time constraint actions has been completed and includes consideration for staffing.

Sequence of Events Timeline			
Action	**Start Time**	**Completion Time**	**Remarks / Applicability**
Event Starts	0	N/A	Plant @100% power. Reactor SCRAMs, all auto-actions occur as designed on a LOOP with exception of EDG start and load.
Attempt EDG start. If EDGs fail, place FLEX DG in service.	7 min	46 min	The start time is based on Phase 2 staffing analysis and the completion time is based on FSG time validations. With DC load stripping, the battery coping time is 2 hr 10 min for Unit 1 and 2 hr 15 min for Unit 2.
SBO declared	15 min	N/A	
Monitor critical parameters at Reactor Shutdown Panel	15 min	As needed	
Secure main turbine/generator Emergency Bearing Oil Pump	15 min	16 min	Not required if FLEX DG is started and loaded. There is time margin for this action as battery load shedding calculations assume that this action is not completed until 1 hour into the event.
Secure A and B Reactor Feed Pump Emergency Lube Oil Pump.	15 min	17 min	Not required if FLEX DG is started and loaded. There is time margin for this action as battery load shedding calculations assume that this action is not completed until 1 hour into the event.
Secure 2B UPS	15 min	21 min	Not required if FLEX DG is started and loaded. There is time margin for this action as battery load shedding calculations assume that this action is not completed until 1 hour into the event.
Open control room panel doors	22 min	30 min	This action is not required if control building air conditioning and supply fan are in service.
Secure main turbine / generator Emergency Seal Oil Pump	35 min	36 min	Not required if FLEX DG is started and loaded. There is time margin for this action as battery load shedding calculations assume that this action is not completed until 2 hours into the event.
Align RCIC to suppression pool	35 min	40 min	The 35 minute start time is not a time constraint, although slower alignment to the suppression pool will decrease CST water inventory coping time.
Depressurize RPV to 150-300 psig	1 hr	1 hr 21 min	There is time margin for this action, as the MAAP analysis assumed that this action is not completed until 2 hours into the event.
Start Control Building air conditioning or FLEX supplementary Control Room ventilation	1 hr	3 hr 37 min	Establishing control building ventilation within 4 hours prevents the potential of jeopardizing control room habitability.
Open Reactor Building doors and roof hatch	1 hr 10 min	1 hr 43 min	There is time margin for this action, as opening of the roof hatch is a time sensitive action to be completed by 2 hours into the event. For personnel habitability concerns, SFP spray hoses will also be deployed at this time.
Commence FLEX deployment as prioritized by the control room	as early as 3 hrs	N/A	Based on staffing analysis and operator availability

Sequence of Events Timeline			
Action	**Start Time**	**Completion Time**	**Remarks / Applicability**
Align RCIC to CST	~3 hours	~5 min after started	RCIC is aligned to CST at suppression pool water temperature of 190°F.
ERO personnel commence arriving on-site	6 hr	N/A	
Begin refueling portable equipment	6 to 12 hours	12 hours	FLEX DGs will require re-fueling as early as 14 hours if operated at or near full load.
Vent containment via Hardened Wetwell Vent	≈17 hr 40 min	≈17 hr 50 min	
ERO fully staffed	24 hr	N/A	
Make up to SFP (inject/spray)	24 hr	As needed	There is time margin for this action, as make up to the SFP will not be needed until at least 56.8 hours into the event.
Make up to CST	< 52 hr		Make up to CST will commence upon arrival, deployment, and connection of Phase 3 equipment. In practice, if there are no failures among the three pumps stored in the FSB, BSEP will deploy the redundant pump to the discharge canal to establish CST makeup capability.

2.9.2 Staffing

Using the methodology of (Nuclear Energy Institute) NEI 12-01, (Reference 20), an assessment of the capability of the on-shift staff and augmented ERO to respond to a Beyond Design Basis External Event (BDBEE) was performed.

The assumptions for the NEI 12-01 Phase 2 scenario postulate that the BDBEE involves a large-scale external event that results in:

- An ELAP
- An extended LUHS
- Impact on both units
- Impeded access to the units by off-site responders as follows:
    - 0 to 6 Hours Post Event – No site access.
    - 6 to 24 Hours Post Event – Limited site access. Individuals may access the site by walking, personal vehicle or via alternate transportation capabilities (e.g., private resource providers or public sector support).
    - 24+ Hours Post Event – Improved site access. Site access is restored to a near-normal status and/or augmented transportation resources are available to deliver equipment, supplies and large numbers of personnel.

The on-shift ERO analysis concluded that the current BSEP on-shift staffing present for the initial "no site access" 6-hour time period is sufficient to perform the EOP, SBO, FSG, and emergency response tasks.

The expanded ERO analysis concluded that sufficient personnel resources exist in the current BSEP augmented ERO to fill positions for all of the augmented ERO functions. Thus, ERO resources and capabilities necessary to implement Transition Phase coping strategies performed after the end of the "no site access" 6-hour time period exist in the current program.

To conduct the on-shift portion of the assessment, a team of subject matter experts from Operations, Maintenance, Security, Radiation Protection, Chemistry, Engineering, Emergency Preparedness, Fukushima Response and industry consultants conducted tabletop evaluations. The participants reviewed the assumptions and existing procedural guidance, including applicable draft FSGs for coping with a BDBEE using minimum on-shift staffing. Particular attention was given to the sequence and timing of each procedural step, its duration, and the on-shift individual performing the step to account for both the task and time motion analyses of NEI 10-05,(Reference 21) .

2.10 Offsite Resources

The Strategic Alliance for FLEX Emergency Response (SAFER) team is contracted by the nuclear industry through Pooled Equipment Inventory Corporation (PEICo) to establish NSRCs operated by Pooled Inventory Management (PIM) and in collaboration with AREVA to purchase, store, and deliver emergency response equipment in the case of a major nuclear accident or BDBEE in the United States.

BSEP relies on equipment stored off-site for Phase 3 of the FLEX mitigation strategy. Equipment may be provided from the NSRCs or another nuclear plant, if response would be faster.

The NRC letter dated September 26, 2014 (ADAMS Ascension No. ML14265A107) titled "Staff Assessment of National SAFER Response Centers Established in Response to Order EA-12-049" (Reference 13) endorsed NEI White Paper titled "National SAFER Response Center Operational Status" (Reference 14). NRC concluded that SAFER procured equipment, implemented appropriate processes to maintain the equipment, and developed plans to deliver the equipment needed to support site responses to BDBEEs, consistent with NEI 12-06 guidance and the SAFER Response Plan to meet Phase 3 requirements of Order EA-12-049.

2.10.1 National SAFER Response Center

The SAFER Response Plan for BSEP, (Reference 15) contains (1) SAFER control center procedures, (2) NSRC procedures, (3) logistics and transportation procedures, (4) staging area procedures, which includes travel routes between staging areas to the site, (5) guidance for site interface procedure development, and (6) a listing of site-specific equipment (generic and non-generic) to be deployed for FLEX Phase 3.

NSRCs are located in Memphis, Tennessee and Phoenix, Arizona. The nominal time for driving from either one of the NSRCs exceeds 16 hours, so NSRC equipment is expected to be transported from one of the NSRCs by airplane.

NSRC equipment will initially be delivered to Staging Area C, which is at the Wilmington International Airport. Primary and alternate locations at the airport have been identified for staging NSRC equipment. When BSEP is ready, NSRC equipment will then be transported to Staging Area B, which is an on-site parking lot.

Primary and alternate driving routes from Staging Area C to Staging Area B have been identified (32 miles for the primary route; 53.5 miles for the alternate route). BSEP will coordinate with local and state authorities to assess the condition of roads and bridges along the travel path. If ground transportation from Staging Area C to Staging Area B is not feasible, NSRC equipment can be delivered to Staging Area B by helicopter airlift. BSEP has identified primary and alternate helicopter landing areas. BSEP has identified primary and alternate access routes from Staging Area B into the plant.

The SAFER Response Plan for BSEP does not include a Staging Area D.

The first NSRC equipment will be delivered to the site within 24 hours from initial contact and remaining equipment will be delivered within 72 hours from initial contact.

2.10.2 Equipment

The NSRC will provide equipment as listed in the response plan. The plan identifies 480 V generators, a medium flow pump, a high flow pump, and associated hoses and cables as priority items that will arrive within 24 hours from initial contact unless the site requests another piece of equipment during the initial contact phone call. Additional NSRC equipment includes 4160 V Medium Voltage generators, a 4160 V distribution system, a high pressure injection pump, RPV makeup pump, DFO tank and pumps, DFO containers, lighting towers, and associated hoses and cables. These NRSC equipment items will be provided within 72 hours from initial contact. NSRC equipment connections to applicable hoses and/or plant equipment are compatible with the BSEP FLEX strategy or necessary adapters are available (e.g., for the NSRC generators).

Other offsite resources may be obtained as needed to support the event which may include DFO, equipment from other nuclear plants, and equipment from vendors.

2.11 Habitability and Operations

2.11.1 Equipment Cooling

BSEP performed a GOTHIC evaluation to determine the temperatures in relevant portions of the Reactor Building resulting from heat-up due to loss of ventilation following an ELAP. This evaluation incorporated actions to open the Reactor Building roof hatch and doors to the breezeway after 6 hours, although the BSEP FLEX strategy will complete actions to start ventilating the Reactor Building (e.g., open the roof hatch) within 2 hours to improve habitability, which will also benefit equipment cooling. Therefore, the calculation approach is conservative. The calculation determined that the peak temperature after 6 hours in Reactor Building spaces that contain credited equipment susceptible to overheating is 110°F. After the roof hatch and doors are opened 6 hours into the event, the maximum temperature in Reactor Building spaces that contain credited equipment susceptible to overheating is 131°F. BNP-MECH-FLEX-0001 determined the RHR SE Lower Room (RCIC area) reaches 110°F in 6 hours and the 7 day peak temperature is 131°F. 0EOP-03-SCCP, Secondary Containment Control Procedure, identifies the Max Normal Temperature for SRHR RCIC Equip Room as 165°F. Therefore, these temperatures are adequate for equipment functionality in the Reactor Building.

BSEP evaluated the DG building emergency bus area for temperature increase and determined that the heat load was negligible. No additional ventilation is required.

If control room HVAC is not operating, BSEP will open control room panel doors within 30 minutes to ensure adequate equipment cooling. Additionally, control room doors will be opened and forced ventilation will be established within 4 hours if normal control room ventilation is not started.

2.11.2 Hydrogen Ventilation

When battery chargers are in-service, hydrogen is generated and can accumulate in the battery rooms. BSEP calculations indicate that an explosive mixture would not be generated for at least 8.4 hours without ventilation. The battery room fans can be operated from a FLEX DG; however, the dampers require instrument air and the associated compressor operates on Division I power. As discussed in Section 2.3.2, Division I power would only be available if both FLEX DGs start (i.e., both N and N+1). If only one FLEX DG starts, BSEP will open doors in the battery room to provide a ventilation flow path and minimize hydrogen accumulation.

2.11.3 Personnel Habitability

The Control Room GOTHIC evaluation indicates that, with no operator action, the control room could reach 112°F in 4 hours. If both FLEX DGs start and both Division I (E5 and E7) and Division II (E6 and E8) emergency busses are energized, BSEP will power the control building HVAC system to minimize temperature rise. If only the Division II busses are energized, BSEP will open control building doors and start forced ventilation to maintain main control room habitability. This supplementary Control Room ventilation consists of portable ducting, fans, and small diesel-driven generators from the FLEX storage building to provide forced air ventilation to the control room. With these mitigation actions, the control building GOTHIC evaluation indicates that control room temperature would peak at 116°F and subsequently be reduced to approximately 100°F.

The reactor building GOTHIC evaluation indicates that the peak temperature in the first 6 hours of the event in spaces where operators are required to perform actions is 104°F. After the roof hatch and doors are opened 6 hours into the event, the maximum temperature in the Reactor Building over the next 66 hours where operators are required to perform actions is 124°F. Once phase 2 activities have been put in place, activities in the Reactor Building will be limited to periodic monitoring of Key Parameters at the Remote Shutdown Panel and minor flow adjustments to RPV and SFP injection. Operations has reviewed this item and due to the short durations expected and the limited number of activities there is confidence these activities can be accomplished.

Additionally, once the ERO is staffed (6 to 24 hours) alternate mitigation strategies for high temperatures can be put into service. These strategies could include:

- opening the Reactor Building railroad doors which provides a much larger air turnover capability
- utilization of the HVAC trailer (non-credited equipment maintained in the FSB) as a recovery area
- utilization of ice vests
- establishing forced ventilation

2.12 Water Sources

Discussion of credited water sources for the FLEX strategies is included in the sections above for each individual strategy.

The strategy for water supply to the RPV and the SFP uses a tiered approach so that water is supplied in order of preference based on its purity, temperature, and supply volume. BSEP will determine what water is available and will take steps to put the various sources of water in service in the following order of preference:

- Suppression Pool
- Condensate Storage Tank
- Demineralized Water Tank (not credited, as this source is not protected from all hazards)
- Fire Protection Tank (not credited, as this source is not protected from all hazards)
- Discharge Canal - The redundant FLEX pump (i.e., the N+1 pump) will be deployed to the discharge canal, provided that the other pumps stored on-site function as planned. The NSRC pumps, strainer, hoses, and fittings will be available to pump water from the canal to the CSTs of both units.

2.13 Shutdown and Refueling Analysis

Order EA-12-049 requires that licensees must be capable of implementing the mitigation strategies in all modes. In general, the discussion in this FIP focuses on a BDBEE occurring during power operations. This is appropriate, as plants typically operate at power for 90% or more of the year. If the BDBEE occurs with the plant at power, the mitigation strategy initially focuses on the use of a pump coupled to a steam-powered turbine to provide the water initially needed for decay heat removal. If all or most of the fuel has been placed in the SFP, there is a shorter timeline to implement the strategy for providing SFP makeup water. However, this is balanced by the fact that if immediate cooling is not required for the fuel in the reactor vessel, the operators can concentrate on providing makeup to the SFP and the number of personnel on-site is much greater during an outage. BSEP's analysis shows that following a full core offload to the SFP, at least 56.8 hours are available to implement makeup before boil-off results in the water level in the SFP dropping far enough to uncover fuel assemblies. As previously discussed, BSEP can provide SFP makeup in advance of this timeline.

When a plant is in a shutdown mode and steam is not available to operate the steam-powered pump, another strategy must be used for decay heat removal. On September 18, 2013, NEI submitted to the NRC a position paper entitled "Shutdown Refueling Modes" (Reference 16), which described methods to ensure plant safety in shutdown modes. By letter dated September 30, 2013 (Reference 17), the NRC staff endorsed this position paper as a means of meeting the requirements of the Order. The BSEP FLEX strategies followed the guidance in this position paper.

If an ELAP occurs during cold shutdown, the decay heat will start to pressurize the RPV. SRVs can be used to maintain the RPV at 150 psig to 300 psig. At this pressure, the RCIC pump can be returned to service. Otherwise, the BSEP FLEX strategies can be used in the same manner as if the BDBEE occurred while the plant was at power.

BSEP EOPs are written as symptom-based procedures with guidance for controlling RPV Level, RPV Pressure, Containment Pressure, Containment Temperature, SFP Level and SFP Temperature. This guidance includes the use of FLEX equipment, procedures and strategies as necessary where control of these parameters is challenged. There is no mode determination for use of this guidance; therefore, the appropriate procedures will be used during shutdown and refueling activities if needed.

2.14 Procedures and Training

2.14.1 Procedural Guidance

The inability to predict actual plant conditions that require the use of BDBEE equipment makes it impossible to provide specific procedural guidance. As such, BSEP has added content to existing EOPs and developed new FSGs to provide guidance that can be employed for a variety of conditions. The EOPs and FSGs, to the extent possible, provide pre-planned FLEX strategies for accomplishing specific tasks in support of emergency response. The new FSGs are used to supplement (not replace) the existing procedure structure that establishes command and control for the event.

The EOPs are the command and control structure when entering a plant emergency. FLEX strategies are embedded directly in the EOPs or are referenced by the EOPs.

2.14.2 Training

Programs have been established to develop personnel proficiency in the mitigation of BDBEEs. The Systematic Approach to Training (SAT) process was utilized to analyze, design, develop and implement training for applicable personnel.

Initial training was provided and continuing periodic training will be provided to site emergency response leaders on BDBEEs emergency response strategies and implementing guidelines. Personnel assigned to direct the execution of mitigation strategies for BDBEEs have received the necessary training to ensure familiarity with the associated tasks, considering available job aids, instructions, and mitigating strategy time constraints.

FLEX drills will be scheduled and conducted.

3. Acronyms

AC - Alternating Current
AOG - Augmented Off Gas
BDBEE - Beyond Design Basis External Event
BSEP - Brunswick Steam Electric Plant
BWR - Boiling Water Reactor
CAP - Corrective Action Program
CFR - Code of Federal Regulations
CST - Condensate Storage Tank
DBE - Design Basis Earthquake
DC - Direct Current
DFO - Diesel Fuel Oil
DFOTV - Diesel Fuel Oil Tank Vault
DG - Diesel Generator
EDG - Emergency Diesel Generator
EDMG - Extreme Damage Mitigation Guideline
ELAP - Extended Loss of AC Power
EOP - Emergency Operating Procedure
ERO - Emergency Response Organization
ESEP - Expedited Seismic Evaluation Process
FIP - Final Integrated Plan
FLEX - Diverse and Flexible Coping Strategies
FPCC - Fuel Pool Cooling and Cleanup System
FSB - FLEX Storage Building
FSG - FLEX Support Guideline
FW - Feedwater System
HCV - Hardened Containment Vent System
HVAC – Heating Ventilation and Air Conditioning
IAN - Non-Interruptible Instrument Air System
ILRT - Integrated Leak Rate Testing System
LOOP - Loss of Off-site Power
LUHS - Loss of Ultimate Heat Sink
MAAP - Modular Accident Analysis Program
MSL - Mean Sea Level
NEI - Nuclear Energy Institute
NPSH - Net Positive Suction Head
NRC - Nuclear Regulatory Commission
NSRC - National SAFER Response Center
NTTF - Near-Term Task Force
OIP - Overall Integrated Plan
PCPL - Primary Containment Pressure Limit
PEICo - Pooled Equipment Inventory Corporation
PIM – Pooled Inventory Management

PMF - Probable Maximum Flood
PMH - Probable Maximum Hurricane
PNS - Pneumatic Nitrogen System
RCIC - Reactor Core Isolation Cooling
RCR - Reactor Recirculation System
RHR - Residual Heat Removal System
RNA - Reactor Non-Interruptible Air System
RPV - Reactor Pressure Vessel
RRP - Reactor Recirculation Pump
RSP - Remote Shutdown Panel
RWCU - Reactor Water Clean Up System
SAFER - Strategic Alliance for FLEX Emergency Response
SA - Service Air System
SAT - Systematic Approach to Training
SBO - Station Blackout
SFP - Spent Fuel Pool
SFPLI - Spent Fuel Pool Level Instrumentation
SRV - Safety Relief Valve
SSC - System, Structure, or Component
SSE - Safe Shutdown Earthquake
TIA - Task Interface Agreement
TS - Technical Specifications
UFSAR - Updated Final Safety Analysis Report
UHS - Ultimate Heat Sink

4. References

1. Recommendations for Enhancing Reactor Safety in the 21st Century; The Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, July 12, 2011
2. NRC Order EA-12-049, Issuance of Order to Modify Licenses with regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, March 12, 2012. (ML12054A735)
3. NEI 12-06, Rev. 0, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, August 2012
4. NRC Interim Staff Guidance JLD-ISG-2012-01, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (ML12229A174)
5. Duke Energy (Gideon) letter BSEP 15-0033 dated June 3, 2015, "Notification of Full Compliance with Order EA-12-049, 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond Design Basis External Events' and Order EA-12-051, 'Order to Modify Licenses With Regard to Reliable Spent Fuel Pool Instrumentation' for BSEP, Unit 2." (ML15173A013 in NRC ADAMS Database)
6. Duke Energy (Gideon) letter BSEP 16-0024 dated [Future Revision], "Notification of Full Compliance with Order EA-12-049, 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond Design Basis External Events' and Order EA-12-051, 'Order to Modify Licenses With Regard to Reliable Spent Fuel Pool Instrumentation' for BSEP, Units 1 and 2." (ML[Future Revision] in NRC ADAMS Database)
7. NRC Order EA-12-051, Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation
8. NEI 12-02, Rev. 1, Industry Guidance for Compliance with NRC Order EA-12-051 to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, August 2012
9. NRC Interim Staff Guidance JLD-ISG-2012-03, Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation, August 2012
10. NRC letter dated September 12, 2006, "Final Response to Task Interface Agreement (TIA) 2004-04, 'Acceptability of Proceduralized Departures from Technical Specifics (TSs) Requirements at the Surry Power Station,' (TAC Nos. MC4331 and MC4332)." (ML060590273 in NRC ADAMS Database)
11. NRC Order EA-13-109, Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions, June 6, 2013 (ML13143A321 in NRC Adams Database)
12. Duke Energy (Hamrick) letter BSEP 14-066 dated June 26, 2014, "Phase 1 Overall Integrated Plan in Response to June 6, 2013, Commission Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions (Order Number EA-13-109)." (ML14191A687 in NRC ADAMS Database)
13. NRC (Davis) letter to NEI (Pollock), dated September 26, 2014, "Staff Assessment of National SAFER Response Centers Established in Response to Order EA-12-049." (ML14265A107 in NRC ADAMS Database)

14. NEI (Pollock) letter to NRC (Davis), dated September 11, 2014, "National SAFER Response Center Operational Status," with Enclosure "White Paper; National SAFER Response Centers." (ML14259A222 & ML14259A223 in NRC ADAMS Database)
15. Areva, Inc. Engineering Information Record 38-9233742-000, "SAFER Response Plan for Brunswick Steam Electric Plant," Rev. 002, February 2, 2015
16. NEI Position Paper, "Shutdown / Refueling Modes", Rev. 0, dated September 18, 2013 (ML13273A514 in NRC ADAMS Database)
17. NRC (Davis) letter to NEI (Pollock), dated September 30, 2013. (ML13267A382 in NRC ADAMS Database)
18. Flood Hazard Reevaluation Report to the NRC in March, 2015 (ADAMS Accession No. ML15079A385)
19. Expedited Seismic Evaluation Process (ESEP) report to the NRC in December, 2014 (ADAMS Accession No. ML15005A074)
20. (Nuclear Energy Institute) NEI 12-01, Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities
21. NEI 10-05, Assessment of On-Shift Emergency Response Organization Staffing and Capabilities

ENCLOSURE 4

BSEP, UNITS 1 AND 2, RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION FOR RELIABLE SPENT FUEL POOL LEVEL INSTRUMENTATION

ENCLOSURE 4

BSEP, Units 1 and 2, Response to NRC Request for Additional Information for Reliable Spent Fuel Pool Level Instrumentation

1 Introduction

Note: References are provided in Section 2 of this enclosure.

By letter dated February 28, 2013, Brunswick Steam Electric Plant (BSEP) provided the Overall Integrated Plan (OIP) (Reference 1) for Brunswick Steam Electric Plant, Unit Nos. 1 and 2. By letter dated May 23, 2013, the NRC sent a request for additional information to BSEP (Reference 2). The initial response to the RAI was provided to the NRC on July 22, 2013 (Reference 3).

By letter dated November 18, 2013 (i.e., Reference 4), the NRC provided a Spent Fuel Pool Instrumentation Interim Staff Evaluation (ISE) which included a request for additional information to BSEP. In accordance with Reference 4, BSEP responses to the request for additional information were provided on the ePortal.

Responses to the Spent Fuel Pool Instrumentation ISE request for additional information are provided in Section 3 of this enclosure.

2 References

The following references support the response to NRC requests for additional Information for reliable Spent Fuel Pool Level Instrumentation described in this enclosure.

1. Duke Energy Letter, *Carolina Power & Light Company's Overall Integrated Plans in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051),* dated February 28, 2013, Agencywide Documents Access and Management System (ADAMS) Accession Number ML13086A096
2. NRC Letter, *Brunswick Steam Electric Plant, Units 1 and 2 - Request for Additional Information Regarding Overall Integrated Plan in Response to the Commission Order Modifying Licenses With Regard to Requirements for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051) (TAC Nos. ME9623 AND ME9624),* dated May 23, 2013, ADAMS Accession Number ML13141A622
3. Duke Energy Letter, *Response to Request for Additional Information Regarding Overall Integrated Plan Submitted in Response to the Commission Order Modifying Licenses With Regard to Requirements for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051),* dated July 22, 2013, ADAMS Accession Number ML13219B117
4. NRC Letter, *Brunswick Steam Electric Plant, Units 1 and 2 - Interim Staff Evaluation and Request for Additional Information Regarding the Overall Integrated Plan for Implementation of Order EA-12-051, Reliable Spent Fuel Pool Instrumentation (TAC Nos. MF0973 and MF0974),* dated November 18, 2013, ADAMS Accession Number ML13269A345

3 Response to NRC Requests for Additional Information for Reliable Spent Fuel Pool Level Instrumentation

NRC RAI-1

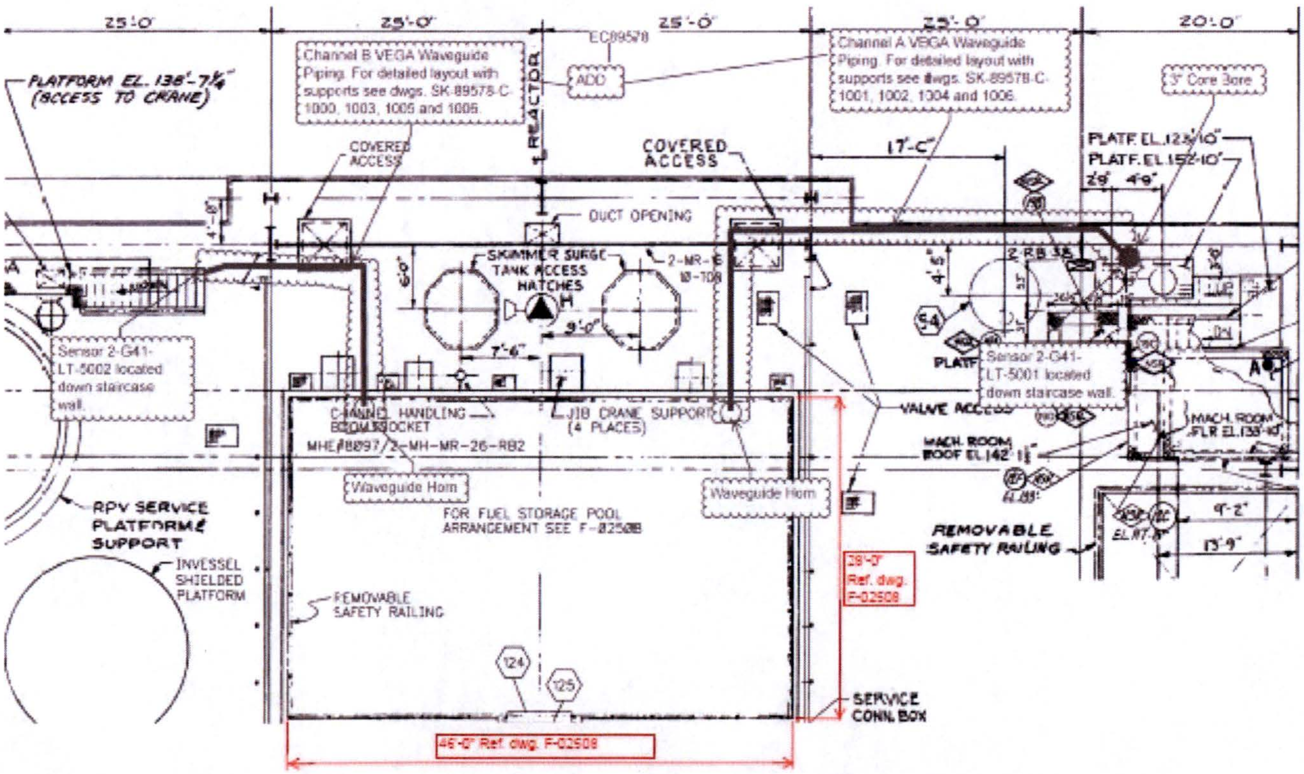
Please provide a clearly labeled sketch or marked-up plant drawing of the plan view of the spent fuel pool (SFP) area, depicting the SFP inside dimensions, the planned locations/placement of the primary and back-up SFP level sensor, and the proposed routing of the cables that will extend from the sensors toward the location of the read-out/display device.

BSEP Response to RAI-1

The Spent Fuel Pool Level Instrumentation (SFPLI) for BSEP is consistent with the guidelines of NRC JLD-ISG-2012-03 and NEI 12-02.

BSEP Units 1 and 2 have similar placement for the SFPLI components. All main components of the Unit 1 system; the waveguide pipe, sensors, and displays locations are similar to Unit 2. The Unit 2 sketches and descriptions are provided below and are representative of both units. Drawing F-02505 is provided in part as sketch SK-89578-M-2000, shown below, which depicts the proposed SFP level channel layout. The primary and back-up SFP level sensors are both new installations per NRC Order EA-12-051 and utilize the same technology. For designation purposes within the RAI responses, Channel A will be called the primary and Channel B will be the back-up level sensor.

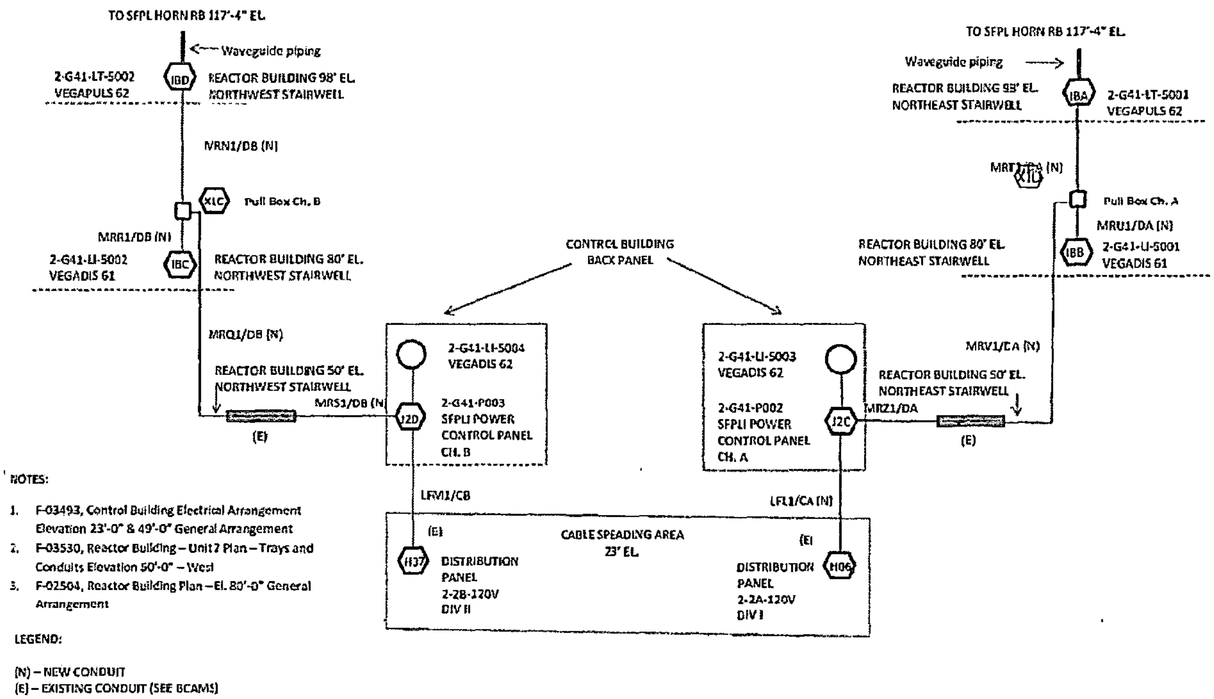
Sketch SK-89578-M-2000



As shown on the sketch listed above, both channels are mounted on the North edge of the SFP and are separated by a distance of 36 feet-4 and 7/8 inches. The primary and back-up systems both route to adjacent East and West stairwells respectively and proceed vertically to the elevation below.

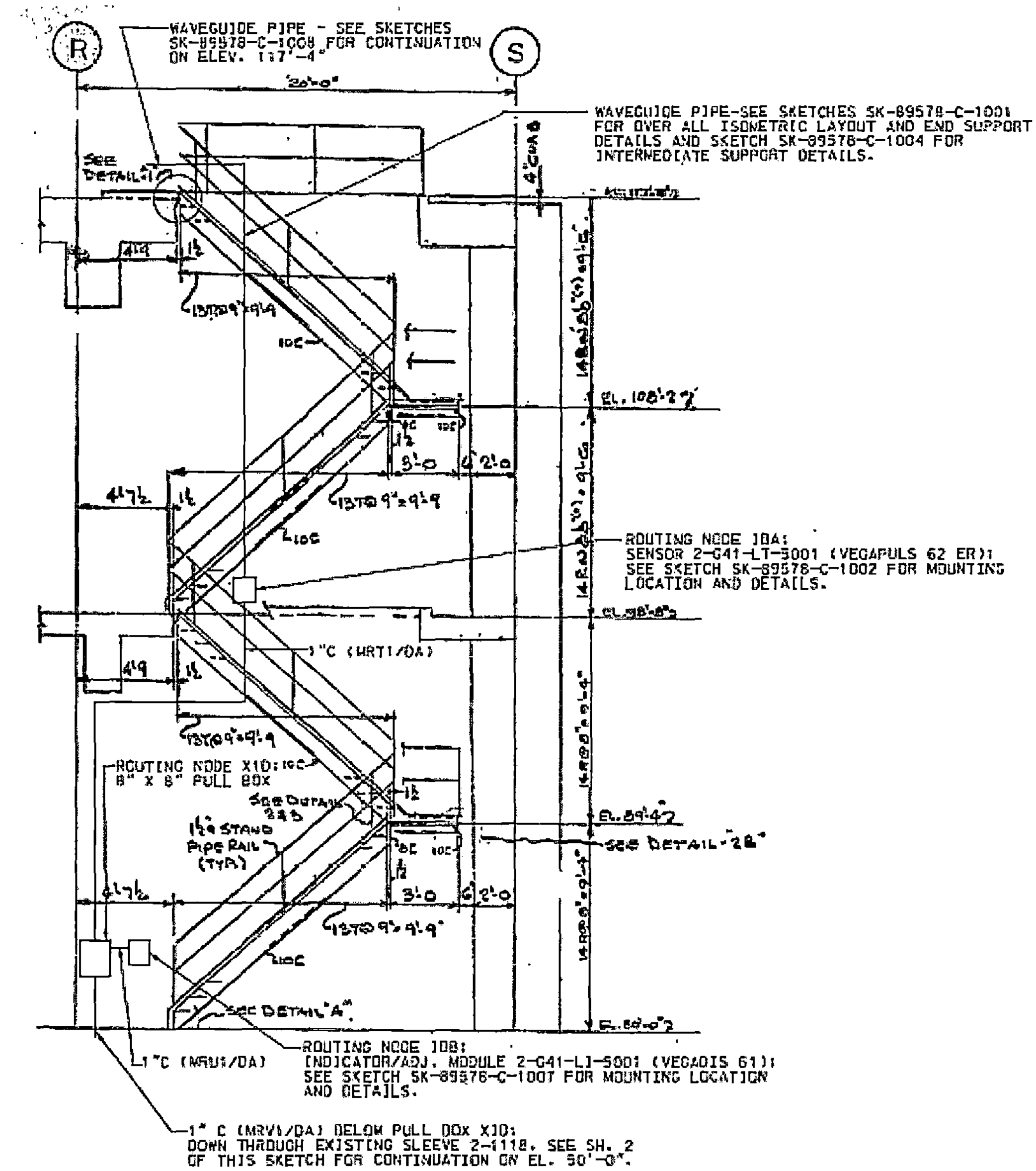
Sketch SK-89578-Z-7012, shown below, provides the overall layout for the conduit routing. The waveguide piping is located on the 117 foot-4 inch elevation of the Reactor Building (RB), also referred to herein as the refuel floor where the SFP is located. The conduit attaches to the electronic sensor (VEGAPULS 62) located in the NE and NW stairwells at elevation approximately 98 feet. The conduit then routes to the local display (VEGADIS 61) at approximately the 80 foot elevation of the respective stairwells. The signal conduit is then routed to the RB 50 foot elevation overhead and is routed through the Reactor Building/Control Building penetrations. There are two separate sets of penetrations: Division I and Division II, where channels A and B route through separately, maintaining separation until located within the Control Room back panel. The remote displays (VEGADIS 62) is located in the Control Room back panel mounted to the South wall for Unit 2 and the North wall for Unit 1.

Sketch SK-89578-Z-7012



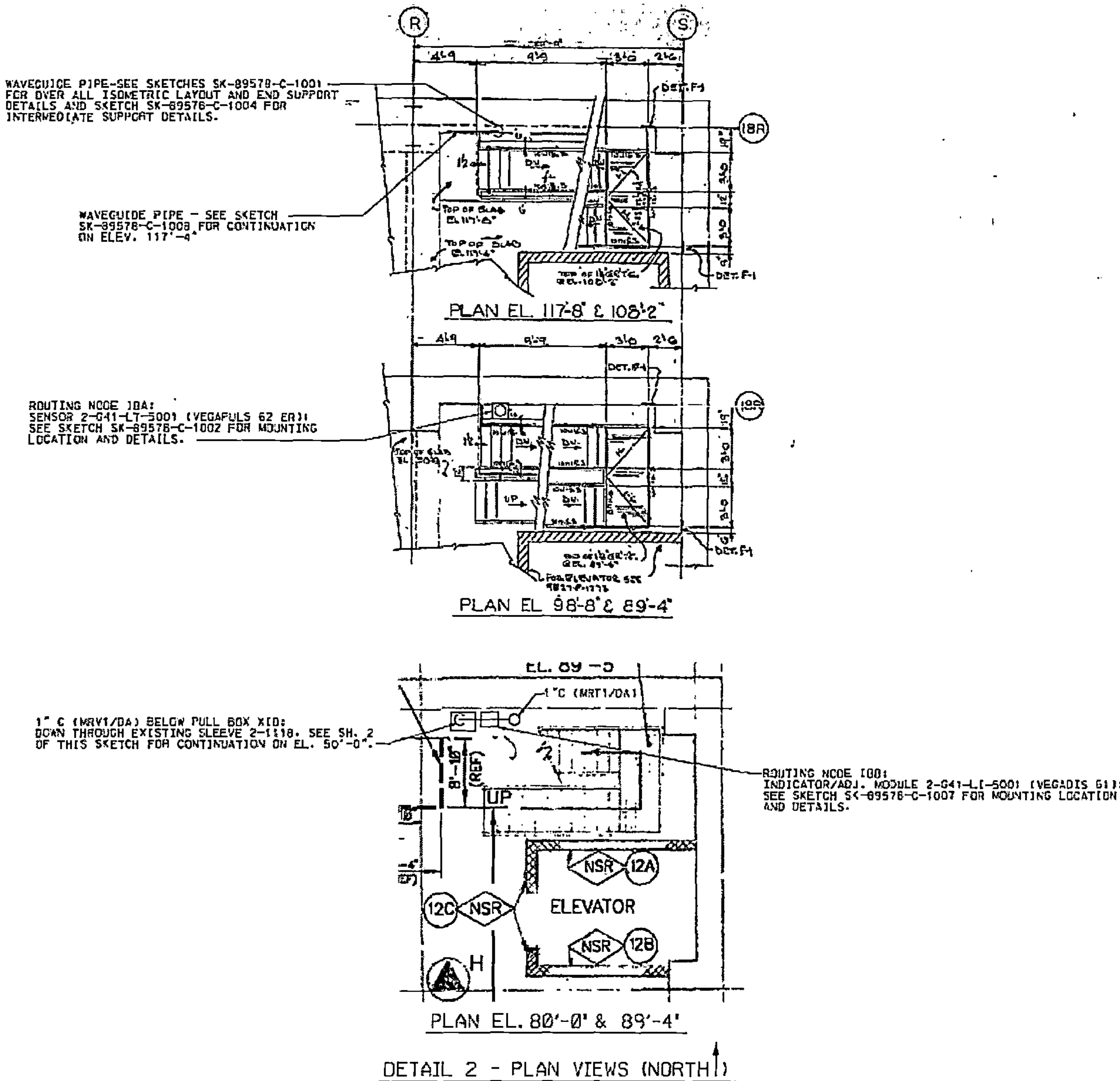
Sketch SK-89578-E-3001 sheet 1 of 2 depicts the primary channel (NE Channel A) routing to the sensor and VEGADIS 61 local display. The sensor is located at approximate elevation 98 feet and the local display is located at approximate elevation 80 feet.

Sketch SK-89578-E-3001 Sheet 1 of 2



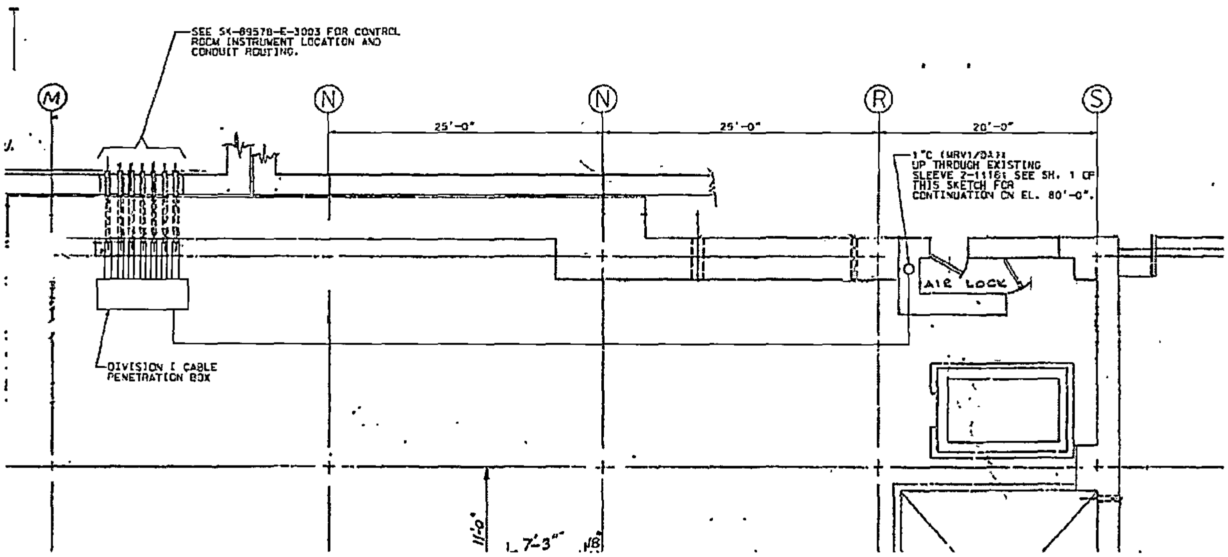
DETAIL - ELEVATION VIEW (EL. 80'-0' & HIGHER LOOKING NORTH)

Sketch SK-89578-E-3001 Sheet 1 of 2 (continued)



Sketch SK-89578-E-3001 sheet 2 of 2 depicts the primary channel routing along the 50 foot elevation overhead to the Division I cable penetration box.

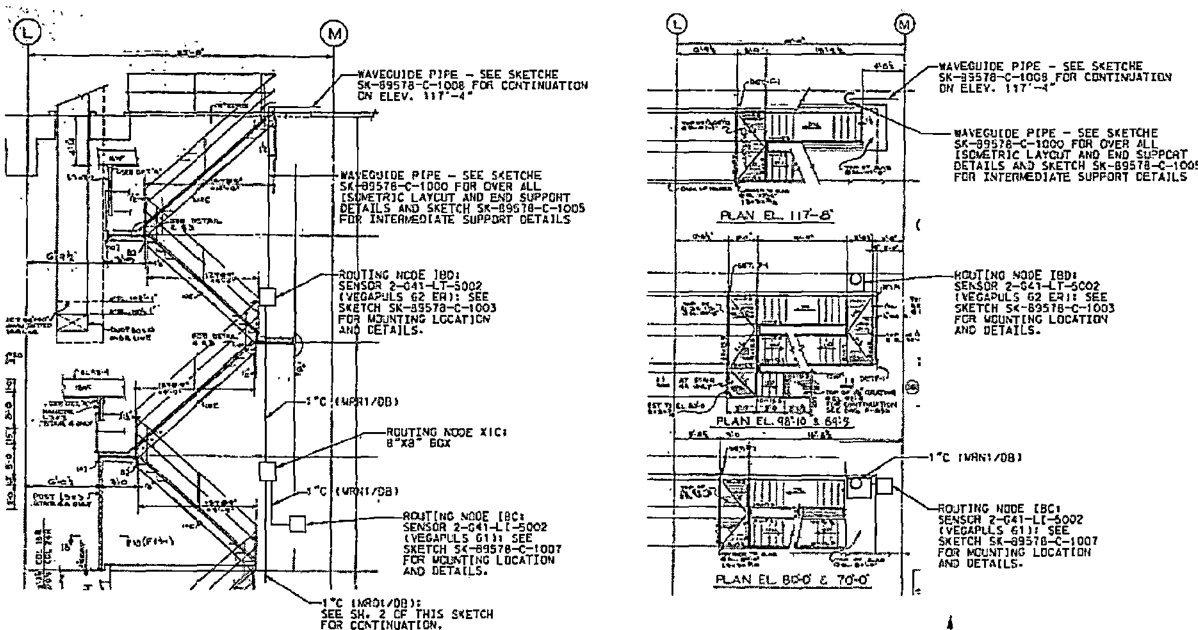
<u>Sketch SK-89578-E-3001 Sheet 2 of 2</u>



DETAIL 1 - PLAN VIEW EL. 50'-0' (NORTH)

Sketch SK-89578-E-3002 sheet 1 of 2 depicts the back-up channel (NW Channel B) routing from the 117 foot-4 inch elevation of the refuel floor to the sensor and local display locations. Routing continues on sheet 2 of 2 and shows the conduit route to the Division II cable penetration box.

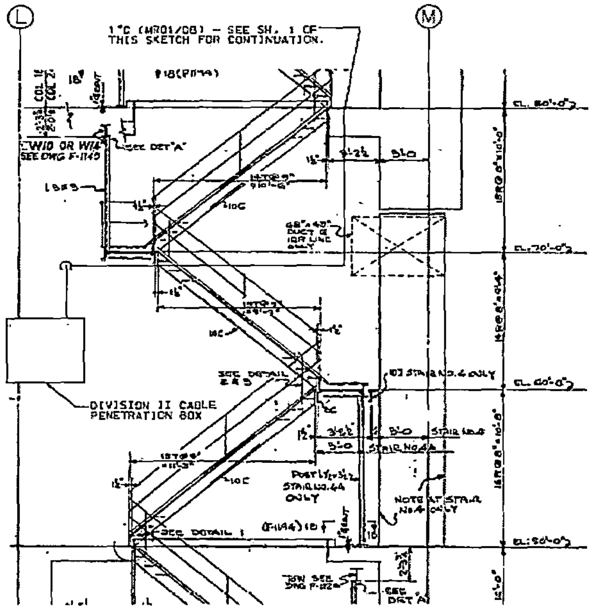
Sketch SK-89578-E-3002 Sheet 1 of 2



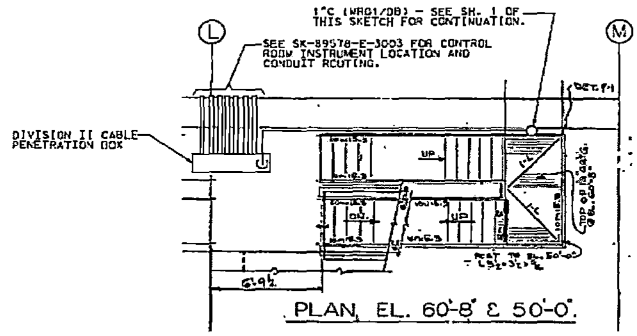
DETAIL - ELEVATION VIEW
(EL. 80'-0" & HIGHER LOOKING NORTH)

DETAIL 2 - PLAN VIEWS (NORTH)

Sketch SK-89578-E-3002 Sheet 2 of 2



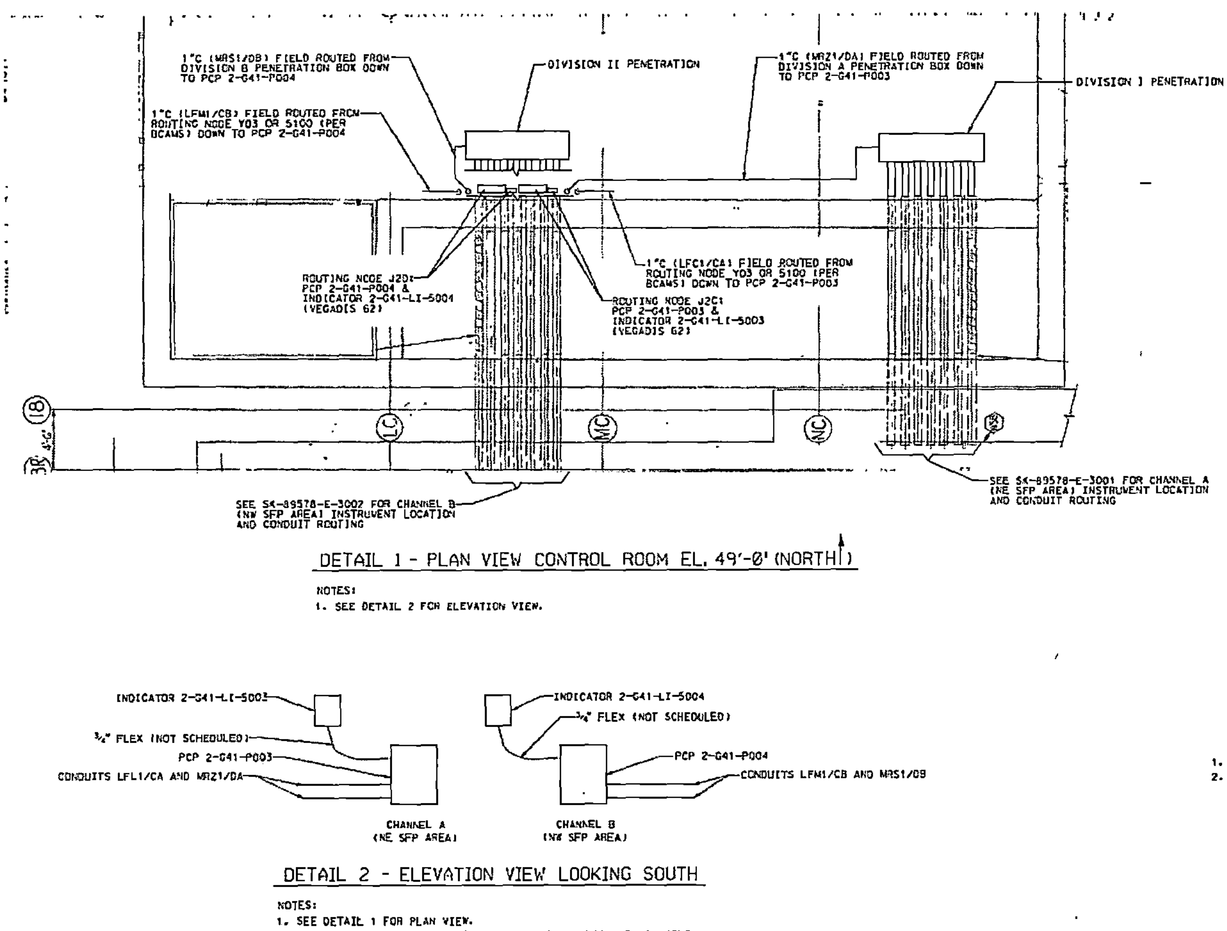
DETAIL 1 - ELEVATION VIEW
(EL. 50'-0" TO BELOW 80'-0" LOOKING NORTH)



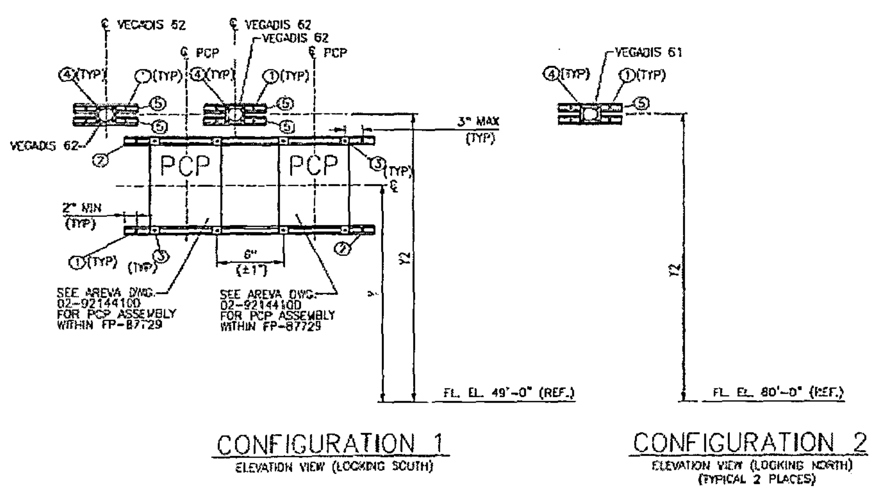
DETAIL 1 - PLAN VIEWS (NORTH)

Sketch SK-89578-E-3003 depicts the conduit routing and remote display locations within the Control Building (CB). The power control panels and remote displays for both channels are mounted as shown in sketch SK-89578-C-1007. The remote displays are within the control room back panel mounted on the South wall for Unit 2.

Sketch SK-89578-E-3003



Sketch SK-89578-C-1007



NRC RAI-2

Please provide the following:

a) The design criteria that will be used to estimate the total loading on the mounting device(s), including static weight loads and dynamic loads. Describe the methodology that will be used to estimate the total loading, inclusive of design basis maximum seismic loads and the hydrodynamic loads that could result from pool sloshing or other effects that could accompany such seismic forces.

b) A description of the manner in which the level sensor (and stilling well, if appropriate) will be attached to the refueling floor and/or other support structures for each planned point of attachment of the probe assembly. Indicate in a schematic the portions of the level sensor that will serve as points of attachment for mechanical/mounting or electrical connections.

c) A description of the manner by which the mechanical connections will attach the level instrument to permanent SFP structures so as to support the level sensor assembly.

BSEP Response to RAI-2a

The primary and back-up channels, which consist of the electronic sensor/transmitter, horn and waveguide piping, are mounted seismically. The mount designs for the electronic sensor support, horn support and intermediate supports were qualified considering total weight of the waveguide piping and its components and the seismic accelerations for the building structure. To meet the design criteria for a beyond design basis (BDB) event, the loading for the mounting supports were generated using a minimum of two times Safe Shutdown Earthquake (SSE) seismic accelerations. Comparisons have been made to ensure the two times SSE accelerations were adequate for plant locations where the SFPLI equipment is installed. The fundamental frequency of installed systems was also calculated to ensure they were 20 Hz or greater. The mounting designs for these supports are qualified per calculations using the Manual of Steel Construction, AISC 8th Edition & 9th Edition, Hilti Product Technical Guides, and site specific specifications.

The electronic sensor and the horn assembly mounts are qualified by generic calculation using AISC 9th Edition design manual for steel construction. All anchorages are qualified using four concrete anchor bolts and the manufacturer's design guide. The generic calculation qualifies a simple C-channel steel section welded centrally on a 1/2 inch steel base plate. The base plate is anchored using four concrete anchor bolts. The mount calculation assumes generic seismic accelerations of 10g (horizontal) and 6.67g (vertical), which readily envelopes the site seismic response spectra. The calculation assumes a maximum height of support to be 15 inches off of the wall/floor. All mounts using a smaller length of C-channel are qualified by comparison.

The intermediate waveguide pipe supports and span lengths are qualified by a site specific calculation. There are two support designs used for mounting the waveguide pipe. A pre-qualified seismic support per BSEP specifications has been re-qualified for use with the increased BDB seismic loading of two times SSE. The second design uses a 3/4 inch thick steel base place with a four bolt anchorage pattern with a W-section column and cantilevered angle which uses a U-bolt configuration for attaching the 1 inch outside diameter (OD) pipe. The intermediate mounts use two times SSE seismic acceleration values at 20 Hz of 1.60g (horizontal) and 0.22g (vertical) per BSEP seismic design criteria specification.

All of the mounting supports for the waveguide piping are attached to either the Reactor Building concrete floor at elevation 117 feet-4 inch or to the Reactor Building north concrete wall. These concrete structures have a minimum concrete strength of 3000 pounds per square inch (psi).

The conduit, local displays (DIS61), remote displays (DIS62), and Power Control Panels (PCP) are designed with the same two times SSE seismic criteria per each components' location within the RB or CB. Mounting calculations consider the total weight of the components and mounting brackets with additional allowances. The components are mounted with concrete anchor bolts to either RB or CB concrete walls rated for a minimum of 3000 psi concrete strength. The conduit along the overhead of the 50 foot elevation of the RB is mounted to existing plant steel girders. Conduit will be mounted using pre-qualified standard seismic supports per BSEP specifications that have been re-qualified to new BDB two times SSE seismic criteria.

The primary and back-up channel horn end mounting was evaluated per the electronic sensor and horn end assembly mount calculation which assumed a sloshing force value. Hydrodynamic loading to the horn assembly due to SFP sloshing from a seismic event has been evaluated per a site specific design calculation. SFP sloshing loads were calculated for wave forces in the horizontal and vertical directions. The calculations concluded that the original assumed sloshing force envelopes the actual calculated force.

BSEP Response to RAI-2b

The Through Air Radar horn antenna and waveguide assembly is attached to a waveguide assembly mounting bracket. Sketches SK-89578-C-1002, SK-89578-C-1003, and SK-89578-C-1010 provide the mounting details for the electronic sensor and pool edge mounting configuration. There is no portion of the Through Air Radar level sensor that contacts the SFP water, nor is there any connection to the pool liner. The horn antenna is cantilevered over the edge of the pool and firmly fixed in a direction perpendicular to the pool water surface, although the horn assembly mounting bolts can be loosened and the horn rotated away from the pool surface for instrument calibration. The mount bracket provides the attachment point for the horn and waveguide assembly to the refueling floor. Four bolts at the base of the bracket fasten the bracket to the refueling floor. Concrete anchor bolts, 3/8 inch in diameter, are used to fasten the baseplate to the concrete floor.

The waveguide pipe mounting locations are depicted on sketches SK-89578-C-1004 and SK-89578-C-1005. Support locations are determined based on existing plant equipment locations combined with calculated span lengths as described in RAI-2a.

BSEP Response to RAI-2c

The waveguide piping that is connected between the waveguide assembly at the pool edge and the remotely located sensor is attached to building structures using site pipe mounting specifications. Spacing of the pipe supports complies with site standards and qualification restrictions for the waveguide pipe.

The waveguide pipe is mounted at the electronic sensor and horn end assembly as shown in the sketches for RAI-2b and as described in RAI-2a. The intermediate supports are shown on sketches SK-89578-C-1006 and SK-89578-C-1009. The support shown on SK-89578-C-1006 is an engineered support with a four bolt 3/4 inch baseplate anchored with 3/8 inch diameter concrete anchor bolts. The waveguide pipe is supported from the cantilevered support by standard U-bolts. This support has been qualified to the two times SSE criteria as mentioned previously. The support shown on SK-89578-C-1009 depicts a BSEP pre-qualified support that has been re-qualified to new two times SSE seismic criteria. It is mounted with two standard 1/2 inch diameter concrete anchor bolts.

Sketch SK-89578-C-1007 depicts the Power Control Panel and display mounting configuration. The larger PCP components are mounted to unistrut with 3/8 inch diameter hex head cap screws. The smaller display components are mounted to unistrut with 1/4 inch diameter hex head cap screws. Each section of unistrut is anchored to the wall with two 3/8 inch diameter concrete anchor bolts.

NRC RAI-3

For RAI 2(a) above, please provide the analyses used to verify the design criteria and methodology for seismic testing of the SFP instrumentation and the electronics units, including, design basis maximum seismic loads and the hydrodynamic loads that could result from pool sloshing or other effects that could accompany such seismic forces.

BSEP Response to RAI-3

The electronic sensor, PLICSCOM display, power control panel, horn end of the waveguide, standard pool end and sensor mounting brackets, and waveguide pipe were successfully seismically tested in accordance with the requirements of the IEEE Standard, IEEE 344-2004[1]. The system was monitored for operability before and after the resonance search and seismic tests. The required response spectra used for the five Operating Basis Earthquakes (OBE) and one SSE in the test were taken from EPRI TR-107330 Figure 4-5, as shown below. This test level exceeds the building response spectra for the locations where the equipment is installed.

[1] IEEE Standard 344-2004, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations"

Figure 4-5 from EPRI TR-107330

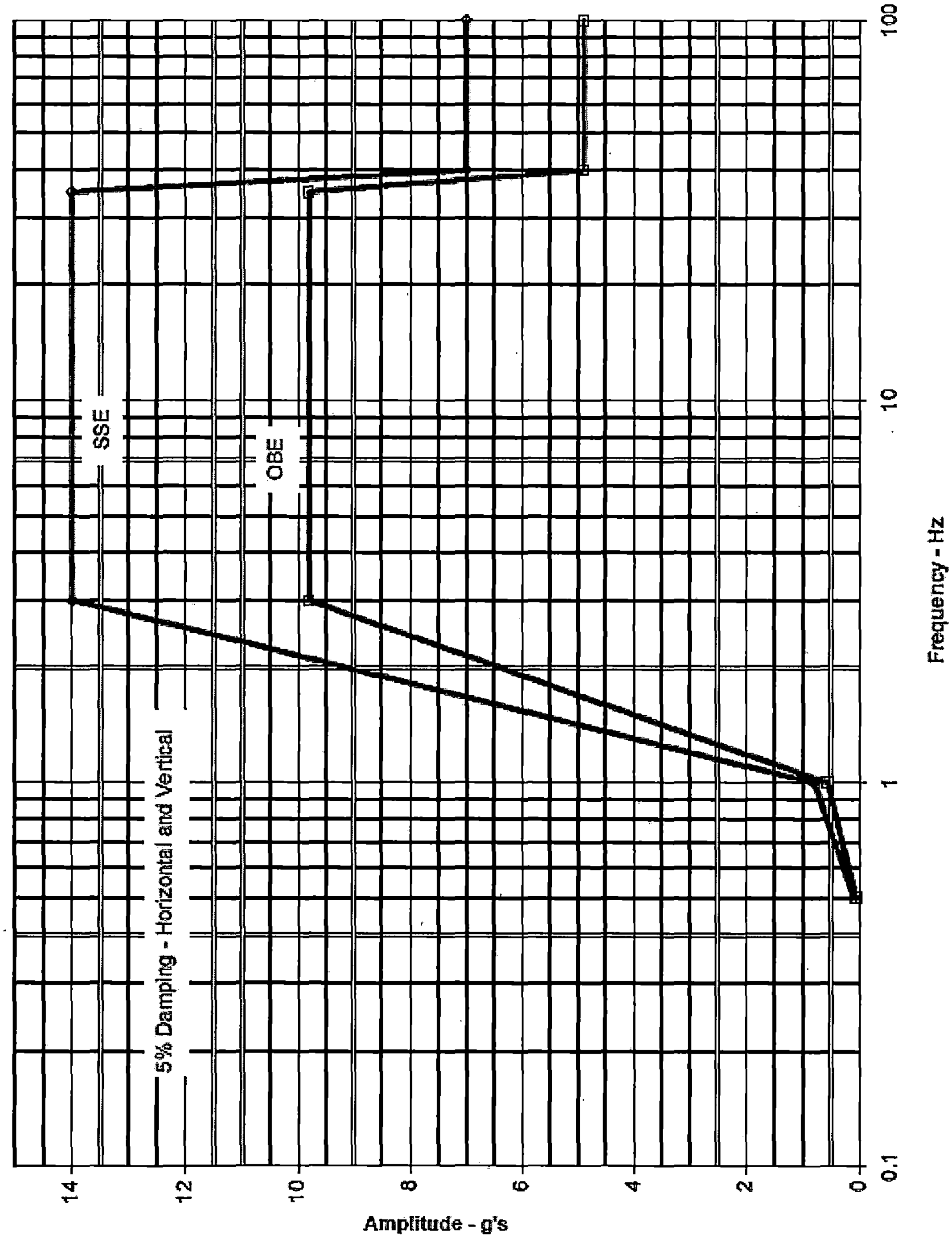


Figure 4-5
Required Response Spectrum

A hydraulic analysis was performed to calculate the forces caused by sloshing of the SFP inventory in response to a seismic event. The seismic spectrum for fuel pool sloshing was obtained by considering the ground motion response spectrum (GMRS) as submitted to the NRC under NTTF 2.1 Seismic. Adequate margin was ensured for this application for consideration of beyond design basis conditions. Acceleration levels at 0.5 percent damping for SSE, applicable to the water in SFP were used for sloshing. The method of analysis is based on TID-7024, Nuclear Reactors and Earthquakes, United States Atomic Energy Commission, along with pool surface profile and fundamental mode. These are used to estimate the impacting fluid velocity and to calculate the horn drag and inertial forces based on a Morison-type equation.

NRC RAI-4

For each of the mounting attachments required to attach SFP level equipment to plant structures, please describe the design inputs and methodology used to qualify the structural integrity of the affected structures/equipment.

BSEP Response to RAI-4

The existing plant structures for attachment of the SFPLI equipment are seismically qualified to the current design basis and can be considered seismically robust. All SFPLI equipment critical to the function of the system in response to a Beyond Design Basis External Event (BDBEE) are attached to either existing plant concrete walls/floors or plant structural steel. The additional load due to the weight of the system components has a negligible impact to the structural integrity of the robust existing plant structures. The supports attached to concrete floors or walls are designed using concrete strength of 3000psi.

Refer to RAI-2a response for further mounting details.

NRC RAI-5

Please provide the following:

a) A description of the specific method or combination of methods you intend to apply to demonstrate the reliability of the permanently installed equipment under BDB ambient temperature, humidity, shock, vibration, and radiation conditions.

b) A description of the testing and/or analyses that will be conducted to provide assurance that the equipment will perform reliably under the worst-case credible design basis loading at the location where the equipment will be mounted. Include a discussion of this seismic reliability demonstration as it applies to (a) the level sensor mounted in the SFP are, and (b) any control boxes, electronics, or read-out and re-transmitting devices that will be employed to convey the level information from the level sensor to the plant operators or emergency responders.

c) A description of the specific method or combination of methods that will be used to confirm the reliability of the permanently installed equipment during and following seismic conditions to maintain its required accuracy.

BSEP Response to RAI-5a

The Through Air Radar system has been qualified for BDB ambient temperature, humidity, shock, vibration and radiation conditions as documented in AREVA's qualification document 51-9202556-005, "Qualification Analysis of VEGAPULS 62 ER Through Air Radar." The instrumentation channels consist of the horn end assembly with cover, waveguide piping, VEGAPULS 62 Extended Range (ER) electronic sensor/transmitter, VEGADIS 61 local display, Power Control Panel, and VEGADIS 62 remote display.

Temperature

The SFPLI system components have been evaluated for temperature from the manufacturers temperature rating compared with the BDB temperatures in the locations of the plant in which they are installed. The BDB temperatures are documented in calculation RWA-1312-001, FLEX Reactor Building GOTHIC Heat Up Analysis. This calculation documents the development and results of a GOTHIC 8.0 model of the BSEP Reactor Building under an Extended Loss of AC Power (ELAP)/FLEX scenario. The model evaluates the building temperatures consistent with the plant's current coping and mitigation strategies and assesses the effect of potential operator actions.

Humidity

The humidity conditions within the locations of equipment placement in the Reactor Building are established by BDBEE assumed conditions of boiling SFP with 100% humidity. Plant document Environmental Qualification Service Conditions (EQSC) imparts the same 100% humidity Worse Case Accident condition. The humidity within the Control Room Envelope (CRE) is controlled between 30% and 60% and is considered a mild environment per EQSC. The SFPLI equipment components are tested by the manufacturer and are shown to withstand BDBEE humidity conditions.

Shock

The VEGAPULS 66 Through Air Radar sensor and PLICSCOM indicating and adjustment module mounted to the sensor were shock tested in accordance with MIL-STD-901D. The test results are also considered applicable to the VEGAPULS 62 ER and PLICSCOM indicating and adjustment module. Differences in construction between the VEGAPULS 66 and VEGAPULS 62 ER are mainly the size, with the VEGAPULS 62 ER being smaller. The shape of the housing, its material construction (precision cast stainless steel), the mass and form factor for the electronics modules, and the materials and method for mounting the electronics into the sensor housing are the same between the VEGAPULS 66 and the VEGAPULS 62 ER.

Vibration

A VEGAPULS 66 Though Air Radar sensor and PLICSCOM indicating and adjustment module mounted to the sensor were successfully vibration tested in accordance with MIL-STD-167-1. The test results are also considered applicable to the VEGAPULS 62 ER and PLICSCOM indicating and adjustment module. Differences in construction between the VEGAPULS 66 and VEGAPULS 62 ER are mainly the size, with the VEGAPULS 62 ER being smaller. The shape of the housing, its material construction (precision cast stainless steel), the mass and form factor for the electronics modules, and the materials and method for mounting the electronics into the sensor housing are the same between the VEGAPULS 66 and the VEGAPULS 62 ER.

Radiation

The SFPLI equipment components are evaluated to radiation conditions consistent with a BDBEE, with spent fuel pool water at Level 3 (i.e., one foot above top of fuel rack). A calculation has been prepared to determine the estimated dose to the equipment from this level combined with a projection for normal dose accumulation. The equipment components are tested by the manufacturer for Total Integrated Dose (TID) thresholds.

BSEP Response to RAI-5b

The sensor, indicator, power control panel, horn end of the waveguide, standard pool end and sensor end mounting brackets, and waveguide piping were seismically tested successfully in accordance with the requirements of the IEEE Standard 344-2004. The system was monitored for operability before and after the resonance search and seismic tests. Equipment testing is documented in AREVA Test Report 174-9213558-006, Seismic Test Report for VEGAPULS, which qualifies the VEGAPULS 62 ER Through Air Sensor, Power Control Panel, and VEGADIS 62 display. The equipment was tested using a shake table with peek horizontal and vertical accelerations at 14g SSE and approximately 10g OBE at 5% damping. This Required Response Spectrum (RRS) bounds BSEP response spectra for Reactor Building, 117 foot elevation per BNP 005-011, Specification for Seismic Design Criteria.

BSEP Response to RAI-5c

The equipment has been shake tested, calibrated at the factory, and calibration re-verified in the installed position. The system will be verified prior to each refueling outage per plant procedures. The power supply is safety-related and the system also has a 7 day back up battery supply. The seismic testing discussed in RAI-5b above included monitoring the read-out indications before, during and after the seismic shake table testing. The post test results demonstrated that the equipment met the required normal accuracy of ±1 inch.

NRC RAI-6

For RAI #5 above, please provide the results for the selected methods, tests and analyses utilized to demonstrate the qualification and reliability of the installed equipment in accordance with the Order requirements.

BSEP Response to RAI-6

The following methods used, and their results, demonstrate the reliability of the permanently installed equipment under the BDB ambient conditions.

Temperature and Humidity

The postulated BDB temperature in the SFP is 100°C (212°F) from a boiling Spent Fuel Pool. The waveguide pipe, horn assembly, mounting supports, and horn cover located on the refuel floor adjacent to the SFP consist of passive metallic and glass components that are not affected by this postulated temperature. In the area where the electronics are located, consisting of the sensor, indicator and power control panel, the temperatures will not exceed the maximum rated temperatures of the electronics. The electronics in the sensor are rated for a maximum continuous duty temperature of 80°C (176°F) on the condition that the process temperature (that which the flange connection is in contact with) is no greater than 130°C (266°F).

The sensors are located as far away from the SFP as practical, which places them within the stairwell on the 98' elevation. Per the FLEX Reactor Building GOTHIC Heat Up Analysis, as described in RAI-5a, the maximum temperature at the 80 foot ceiling elevation (approximately 98 foot elevation) with the plant's coping and mitigation strategies is less than the rating of the electronic sensor.

The sensor has been tested in accordance with IEC 60068-2-30 which varies the temperature from room temperature to elevated temperature at high humidity conditions, to verify that the test item withstands condensation that can occur due to the changing conditions. The sensor has been tested to EN 60529:2000 to achieve the rating IP66/IP68, which signifies totally dust tight housing, protection against string water jets and waves, and protection against prolonged effects of immersion under 0.2 bar pressure. The VEGADIS 61 indicating and adjustment module and VEGADIS 62 display have housings which are similar to the VEGAPULS 62 ER sensor and are therefore considered to be equally covered by the above referenced testing.

The power control panel internal components are rated for a maximum temperature of at least 70°C (158°F). Allowing for 5°C (9°F) heat rise in the panel, the overall panel maximum ambient temperature for operation is 65°C (149°F). The power control panel enclosure is rated NEMA 4X and provides protection to the internal components from the effects of high humidity environments.

The Power Control Panel and VEGADIS62 Display is located within the Control Room envelope (CRE) in the back panel. These components along with the electronic sensor are the electronic components required for system function in a BDB. Per EQSC document DR-227 the CRE is considered a mild environment in which at no time would it be subjected to an environment more severe as that which would occur during normal conditions, including anticipated operational occurrences. The normal temperature of the Control Room is 40°F to 120°F per this EQCS document.

However, per BSEP Control Building FLEX Room Heat-Up Analysis document, the BDBEE temperature without mitigation strategies has been postulated to be higher than 120°F. A FLEX strategy to establish a form of ventilation will maintain temperatures. The limiting component within the CRE is the power control panel as noted above which has a maximum temperature for operation of 149°F, therefore acceptable.

Condensation formation on the inner waveguide pipe walls would require very moist air to enter the pipe at the sensor and travel to an area where the air temperature in the pipe would be at the dew point. This is a highly unlikely occurrence with the horn cover, which blocks airflow through the waveguide pipe. This reduces the potential for transfer of warm moist air to a colder area and therefore reduces the potential for condensation forming in the pipe.

Steam

The maximum humidity postulated for the spent fuel pool room is 100% relative humidity (RH), saturated steam. Due to postulated room temperature, the VEGA electronics must be located away from the steam atmosphere of the spent fuel pool area. Condensation formed in the waveguide tube inner walls in a saturated steam environment can cause a degradation of the reflected echo from the water surface and must be avoided. A horn cover must be used to prevent the intrusion of moisture into the waveguide. The qualification documentation of the horn cover is detailed in AREVA Doc. No. 51-9221032-000, Qualification Analysis for Waveguide Horn Cover.

The ability of the radar to "see through" the steam has been demonstrated by testing performed by AREVA consisting of the sensor and horn mounted above an 8 feet high column of steam surrounded by a 36 inch diameter insulated shroud. The steam was produced by boiling water at a rate of 0.11 foot per hour, similar to the expected boil down rate for a spent fuel pool in an accident scenario. The presence of steam had no discernible impact on accuracy. The test data is contained in AREVA Doc. 66-9200846-002, Test Report for VEGAPULS 62 ER. The report shows the expected effect of steam on accuracy at pressures of 1 bar and 10 bar. In addition to the AREVA test, according to the manufacturer, the VEGAPULS 62 has been used in numerous applications in hot processes like liquid asphalt storage and outdoor steam/humidity applications like hydrologic measurements (rivers and stream monitoring with fog, rain and 100% RH). Therefore, operating experience has shown that the Through Air Radar remains functional at high levels of steam saturation.

To supplement the testing and operating experience reported above, AREVA has developed a methodology for verifying the ability of the VEGAPULS 62 ER to measure through a particular column height of saturated steam for a particular sensor and waveguide combination per

AREVA Doc. No. 51-9220845-000, Methodology for Verifying VEGAPULS 62 ER for Measurements in Saturated Steam. The radar has not been tested for ability to see through water spray. If a water spray is used to provide auxiliary cooling water for the SFP, it should be directed away from the path of the radar beam.

Smoke

In the event of a fire in the spent fuel pool area due to an accident, the level measurement system must be able to perform acceptably in the presence of resulting smoke.

AREVA performed a demonstration of the ability of the Through Air Radar to "see through" dense smoke. The demonstration setup consisted of a VEGAPULS 62 ER sensor and horn mounted above a 36 inch diameter 8 feet tall shroud with a smoke generator placed at the bottom of the shroud. The smoke generator was rated to produce 4000 cubic feet of smoke in a 30 second burning time. The presence of smoke had no discernible impact on the measurement. The application of the smoke was made in the presence of saturated steam. The ability to operate through atmospheres filled with particulates is demonstrated by the advertised application of VEGAPULS 62 for measuring the level of iron flowing from blast furnaces into torpedo cars even when considering the extreme dust and steam generation during the filling process. The VEGAPULS 62 ER provides extended range (75m vs. 35m) over the VEGAPULS 62.

Shock

The VEGAPULS Through Air Radar sensor and PLICSCOM indicating and adjustment module were tested in accordance with MIL-STD-901D as noted in RAI-5a. The MIL-S-901D test consisted of a total of nine shock blows, three through each of the three principal axes of the sensor, delivered to the anvil plate of the shock machine. The heights of hammer drop for the shock blows in each axis were one foot, three feet and five feet.

The VEGAPULS 62 ER Through Air Radar sensor has also been shock tested in accordance with EN60068-2-27 (100g, 6ms), ten shock blows applied along a radial line through the support flange.

Vibration

A VEGAPULS 66 Though Air Radar sensor and PLICSCOM indicating and adjustment module mounted to the sensor were successfully vibration tested in accordance with MIL-STD-167-1. The test results are also considered applicable to the VEGAPULS 62 ER and PLICSCOM indicating and adjustment module. Differences in construction between the VEGAPULS 66 and VEGAPULS 62 ER are mainly the size, with the VEGAPULS 62 ER being smaller. The shape of the housing, its material construction (precision cast stainless steel), the mass and form factor for the electronics modules, and the materials and method for mounting the electronics into the sensor housing are the same between the VEGAPULS 66 and the VEGAPULS 62 ER.

The vibration test procedure described above applies to equipment found on U.S. Naval ships with conventional shafted propeller propulsion. The test frequencies ranged from 4 Hz to 50 Hz with amplitudes ranging from 0.048" at the low frequencies to 0.006" at the higher frequencies. This procedure is not applicable to high-speed or surface effect ships that are subject to vibrations for high-speed wave slap, which produce vibration amplitudes and frequencies in excess of the levels on conventional U.S. Naval ships.

The potential vibration environment around the spent fuel pool and surrounding building structure might contain higher frequencies than were achieved in the testing discussed above. Additional testing of the VEGA PULS 62 ER sensor was performed in accordance with EN

60068-2-6 Method 204 (except 4g, 200 Hz). This additional testing is considered to provide a stand-alone demonstration of the resistance to vibration of the VEGAPULS 62 ER sensor and further substantiates the results of the MIL STD 167-1 testing.

The components used in the power control panel are listed in the table below. The table below provides the shock and vibration test and/or analysis for each component.

Shock and Vibration Testing of Power Control Panel Components

Component Name	Test standard used	Test levels per manufacturer description
Selector switch	Vibration resistance per IEC 60068-2-6	5 gn (f = 2…500Hz)
	Shock per IEC 60068-2-27	30 gn for 18 ms half sine wave acceleration 50 gn for 11 ms half sine wave acceleration
Terminal blocks	Not tested, These are considered suitable for use in the in shock and vibration environments based on their previous use in the manufacturer's mobile remote display.	N/A
Power supply	Vibration tested per IEC 60068-2-6	(Mounting by rail: Random wave, 10-500 Hz, 2g, ea. Along X, Y, Z axes 10 min/cycle, 60 mi)
	Shock tested per IEC 60068- 2-27	Half sine wave, 4g, 22 ms, 3 axes, 6 faces, 3 times for each face
Fuse	Vibration tested per MIL-STD-202	Method 204, Test Condition C (Except 5g, 500 Hz)
	Shock tested per MIL-STD-202	Method 207 (HI Shock)
Indicating light	Not tested for shock or vibration resistance. Failure of light will not impact instrument operability.	N/A
Control relay	Not tested, mounted on dampener (See below)	N/A
Battery	Not tested, mounted on dampener (See below)	N/A
Current isolator	Not tested, mounted on dampener (See below)	N/A
Readouts – See Note	Test standards as described above	Test levels as described above

Note: The VEGA displays are mounted separately from the power control panel. These displays have the same housing, the same material construction (precision cast stainless steel), and the same materials and method for mounting the electronics into the sensor housing as the VEGAPULS 62 ER that has been shock and vibration tested as described above.

Three components that were not shock or vibration tested by the manufacturers were included in a power control panel that was seismically tested successfully in accordance with the requirements of the Institute of IEEE Standard 344-2004. The seismic test levels reached peaks of 19g in the x direction, 20g in the y direction, and 21g in the z direction. The test response spectra exceeded 10g at all upper frequencies up to 100 Hz beyond which they were not recorded. The levels of acceleration to which the power control panel was exposed are considered to exceed the postulated shock environments at the locations where the power control panel is mounted (i.e., concrete walls or rigid metal building structures). Likewise, the levels of acceleration to which the power control panel was exposed greatly exceed the postulated vibration amplitudes at the locations where the control panel is mounted, which are postulated to be minimal since there is no vibration producing machinery in the vicinity.

Also, these components are mounted to vibration dampeners to further minimize the transfer of external vibration to these components. There are no known reasons that would cause vibration to increase in an ELAP event.

Radiation

The area above and around the pool will be subject to large amounts of radiation in the event that the fuel becomes uncovered. The only parts of the measurement channel in the pool radiation environment are the metallic waveguide and horn, which are not susceptible to the expected levels of radiation. The electronics must be located in an area that is shielded from the direct shine from the fuel, and bounce and scatter effects above the pool. For the purpose of the analysis, the radiation levels in the area do not exceed $1x10^3$ rad (i.e., mild radiation environment).

For current generation operating reactors, the staff's definition of a mild radiation environment for electronic components, such as semiconductors, or any electronic component containing organic materials as a total integrated dose of less than $1x10^3$ rad (ref. NUREG-1793, Initial Report, Vol. 1, Section 3.11.3.2.1.)

This is further confirmed in Regulatory Guide 1.209 which states "ionizing dose radiation hardness levels for MOS IC families range from about 10 gray (Gy) or 1 kilorad (krad) for commercial off-the-shelf (COTS) circuits to about 105 Gy (104 krad) for radiation hardened circuits". The $1x10^3$ rad radiation withstand rating of the SFPLI electronics is at the low end of this range, and therefore considered to be a conservative rating.

Dose rates used for testing electronics using MIL-STD-883J, Method 1019.9 are 50 rad per second or greater. The fact that this standard test does not test for dose rates lower than 50 rad per second, except as explained below, indicates that dose rates lower than 50 rad per second are not a concern for electronic devices. At very low dose rates, some electronics that contain bipolar of BiCMOS or mixed-signal devices can be susceptible to Enhanced Low Dose Rate Sensitivity (ALDRS). For these devices MIL-STD-883J, Method 1019.9 also requires testing at low dose rates (i.e., ≤0.01rad per second). However, it has been shown in Sandia National Laboratories Document SAND-2008-6851P, "Radiation Hardness Assurance Testing of Microelectronic Devices and Integrated Circuits: Radiation Environments, Physical Mechanisms, and Foundations for hardness Assurance" that at dose levels up to 104 rad there are no true dose rate effects. Therefore, at the total integrated dose estimated for the area where the electronics are located, low dose rate sensitivity is not a concern.

A Total Integrated Dose Calculation for BSEP has been performed which analyzes the BDBEE initiated dose and normal operational dose at the proposed location for the Spent Fuel Pool level transmitters (electronic sensors). The resulting total integrated dose (event-initiated plus normal dose) is used to assess the viability of the transmitter location. A five (5) year data set of Radiological surveys was acquired for normal dose rates and used as a basis for projecting future dose accumulation. Based on the TID calculation with a limiting threshold of 1000 rads, the East side transmitter lifetime is computed to be approximately 53 years, while the West side transmitter lifetime is computed to be approximately 8 years. The difference in lifespan projections is a reflection of the normal dose rates surveyed in those areas, where the East side sensor location has very minimal normal dose and the West side is known to have two prominent point sources nearby. These sensor lifetimes are accounted for by periodic replacement to comply with two channel functionality. The VEGADIS 62 display and Power Control Panel electronic components located within the CRE, which are required for BDBEE system function, are outside the radiological boundary and are therefore qualified.

NRC RAI-7

Please provide the following:

a) A description of how the two channels of the proposed level measurement system meet this requirement so that the potential for a common cause event to adversely affect both channels is precluded.

b) Further information on how each level measurement system, consisting of level sensor electronics, cabling, and readout devices will be designed and installed to address independence through the application and selection of independent power sources, the use of physical and spatial separation, independence of signals sent to the location(s) of the readout devices, and the independence of the displays.

BSEP Response to RAI-7a

VEGADIS 61 display independence is established in accordance with the guidance in NRC JLD-ISG-2012-03 and NEI 12-02. The design of the instrument channels for the SFP Level Indication is of the same technology, permanently installed, separated by distance, and electrically independent of one another. The channels have their own sensing components separated in accordance with NEI 12-02, separate cable routes, and separate electronics.

Instrument channels are each powered normally by a separate station power source and upon loss of this power are powered by replaceable batteries. These batteries have sufficient capacity to maintain the level indication function until the normal power is restored, consistent with the guidance in NEI 12-02.

The potential for a common cause event to adversely affect both channels is prevented since each channel maintains the separation of Division I and II, physically and by power source. Each channel is a separate instrument loop system, from the waveguide horn to the level sensor to the two level indications. Control and power wiring for each channel are separated by different conduits and trays. There is no common housing for channel indication or power.

BSEP Response to RAI-7b

The VEGAPULS 62 ER Through Air Radar SFP level measurement system consists of a radar sensor, waveguide pipe and rotatable horn antenna mounted at the edge of the SFP, power control panel, and associated flanges and seismic mounts. The stainless steel waveguide allows the sensor to be located in a mild environment away from potential temperature, saturated steam, and/or radiation conditions around the SFP which could result from a postulated SFP cooling loss accident.

The VEGAPULS 62 ER sensor measures the water level and regulates the current in the loop by adjusting its internal impedance to provide an accurate level signal. The sensor is powered from a power control panel containing an AC-DC converter that converts the AC voltage from the normal power supply to the DC voltage required by the sensor. A backup battery source in the power control panel provides power to the sensor in the event that AC power is lost.

The local level indicator is provided by the VEGADIS 61 display which houses the PLICSCOM indication and adjustment module. It provides digital level indication in feet and inches and a 0-100% bar graph. The VEGADIS 61 display is being located approximately 20 feet from sensor, within its required limit of within 25 meters (82 feet) of the sensor. Its electrical connection is provided by a four conductor Inter-Integrated Circuit (I2C) bus connection. The VEGADIS 61 display provides sensor setup, calibration, and diagnostic functions.

The VEGADIS 62 is used as the remote display in the Control Room back panel area. The display operates from a two wire, 4 – 20 mA connection to the sensor current loop and displays level based on the loop current measurement. The VEGADIS 62 provides digital level indication in feet and a 0-100% bar graph.

BSEP Response to RAI-8

The VEGAPULS 62 ER Through Air Radar system is designed to maintain its accuracy after a power interruption. If a loss of 120 volt AC power occurs, the power control panel automatically switches over to battery backup, resulting in a momentary loss of power to the radar sensor. After a short period of time required to re-boot, the sensor will continue to perform its measurement function.

The Power Control Panel contains eight Tadiran Model TL-5920 C-cell lithium batteries that provide backup power when normal 120 volt AC power is not available. The battery storage life is reported by the manufacturer to be up to 20 years; however, the replacement interval recommended by AREVA is coincident with mandated surveillance of the level instrument. The battery life for the worst case condition of a 20 mA discharge rate is derived from the manufacturer technical data sheet in Appendix C of AREVA Document 51-9202556-004. Examining the Capacity vs. Current curve for a 20 mA discharge rate, it is seen that for -30°C (--22°F), the lifetime is 2.7 Ah, or 135 hours. Because the chart considers discharge is when voltage drops from the nominal 3.6 volts down to 2.0 volts, a correction factor must be applied to determine lifetime to the point when voltage begins to significantly drop below nominal (considered to be below the full voltage point). The Discharge Characteristics at 25°C curve shows that at a 20 mA discharge rate, discharge to 2 volts occurs at 6.8 Ah whereas the voltage starts to significantly drop at approximately 6.6 Ah, or 97% of total discharge. Applying this factor to the lifetime determined above, the corrected lifetime is 131 hours at -30°C. The lifetime increases significantly at lower discharge rates or at higher temperatures. Lifetimes at the temperatures from the curves in Appendix C for a 20 mA discharge rate are summarized in the table below.

Backup Battery Lifetimes vs. Temperature

Temperature	Ampere-Hours to 2.0 volts	Lifetime to 2.0 volts at 20 mA (hours)	Lifetime at full voltage at 20 mA (hours)
-30°C (-22°F)	2.7	135	131
0°C (32°F)	4.8	240	233
25°C (77°F)	6.8	340	330
55°C (131°F)	7.2	360	349
75°C (167°F)	4.3	215	209

NRC RAI-9

Please provide the following:

a) An estimate of the expected instrument channel accuracy performance under both (a) normal SFP level conditions (approximately Level 1 or higher) and (b) at the BOB conditions (i.e., radiation, temperature, humidity, post-seismic and post-shock conditions) that would be present if the SFP level were at the Level 2 and Level 3 datum points.

b) A description of the methodology that will be used for determining the maximum allowed deviation from the instrument channel design accuracy that will be employed under normal operating conditions as an acceptance criterion for a calibration procedure to flag to operators and to technicians that the channel requires adjustment to within the normal condition design accuracy.

BSEP Response to RAI-9a

The estimated accuracy of the Through Air radar instrument including waveguide is ±1 inches at normal SFP conditions and ±3 inches at BDB conditions including radiation, temperature, humidity, post-seismic, and post-shock conditions that would be present if the SFP level were at the Level 2 and Level 3 datum points. The required ±1 foot described in NEI 12-02 will be achieved under all conditions.

BSEP Response to RAI-9b

The maximum allowed deviation from the instrument channel design accuracy that will be employed under normal operating conditions as an acceptance criterion for a calibration procedure to flag to operators and to technicians that the channel requires adjustment to within the normal condition design accuracy is based upon the difference between readings from the two level instrument channels. The estimated design accuracy for each instrument is ±1 inches. The combined deviation between the two instruments after which calibration is needed is therefore ±2 inches based on a still water level in the pool. A change to the design accuracy discussed above will likewise cause a proportionate change to the maximum allowable deviation

NRC RAI-10

Please provide the following:

a) A description of the capability and provisions the proposed level sensing equipment will have to enable periodic testing and calibration, including how this capability enables the equipment to be tested in-situ.

b) A description of how such testing and calibration will enable the conduct of regular channel checks of each independent channel against the other, and against any other permanently-installed SFP level instrumentation.

c) A description of how functional checks will be performed, and the frequency at which they will be conducted. Describe how calibration tests will be performed, and the frequency at which they will be conducted. Provide a discussion as to how these surveillances will be incorporated into the plant surveillance program.

d) A description of what preventive maintenance tasks are required to be performed during normal operation, and the planned maximum surveillance interval that is necessary to ensure that the channels are fully conditioned to accurately and reliably perform their functions when needed.

BSEP Response to RAI-10a

In accordance with the NRC Order EA-12-051, the Installed equipment will be surveillance tested to validate functionality of an installed instrument channel within 60 days of a planned refueling outage considering normal testing scheduling allowances (e.g. 25%). This is not required to be performed more than once per 12 months in accordance with NRC Order EA-12-051. Periodic testing (as required by NRC Order EA-12-051) requires the measurement of two different points for validating accuracy and performing any adjustments to bring accuracy to within the required tolerances. In accordance with the vendor operating manual, the two points of measurement must be a minimum of 2 inches apart. In order to obtain two points of measurement, the actual water level will be used for one point and a metal calibration target will be used to obtain a simulated second point. Calibration procedure 0LP-LT008, "VEGAPULS 62 LEVEL TRANSMITTER CALIBRATION" has been prepared for calibration of the SFPLI Radar Measurement System.

SFPLI Setup and Calibration

The SFPLI scaling is from the top of the fuel racks or 16'-8" (0% indicated level) pool level up to a pool level of 37'-11" (100% indicated level). SFP level range meets the requirements of NRC Order EA-12-051.

A calibration tolerance of ±1 inch was used as the acceptance criteria for the Factory Acceptance Testing (FAT). This tolerance was also used for the Site Acceptance Testing (SAT) and is used when performing the periodic instrument calibrations prior to planned refueling cycles, as discussed above.

BSEP Response to RAI-10b

Procedure 0LP-0028 "VEGAPULS 62 ER Level Transmitter Calibration" provides the instructions for testing and calibrating the SFPLI equipment. This procedure performs Removal from Service, Backup Battery Test, Calibration Check, Calibration, Return to Service, and Post Maintenance Activities. Within this procedure, the SFPLI indication levels are verified against the SFP ruler gauge level and against each other to ensure level instrumentation accuracy. Level indication for channels A and B shall be within ±1 inch of the ruler gauge level and the Channel A & B indications shall be within ±1 inch of each other.

Weekly channel checks will be performed using plant procedures to ensure the Channel A and Channel B local and remote indications are aligned.

Reactor Operator Daily Checks, performed once per 7 days, compare new control room SFP level indicator readings to each other (i.e., ± 2 inch).

Reactor Building Auxiliary Operator Daily Checks, performed once per 7 days, compare new reactor building SFP level indicator readings to each other (i.e., ± 2 inch).

BSEP Response to RAI-10c

Channel checks performance and frequency are discussed in 10.b above. In accordance with the NRC Order EA-12-051, the Installed equipment will be surveillance tested to validate functionality of an installed instrument channel within 60 days of a planned refueling outage, considering normal testing scheduling allowances (e.g. 25%). This is not required to be performed more than once per 12 months, in accordance with NRC Order EA-12-051. Periodic testing (as required by NRC Order EA-12-051) will require the measurement of two different points for validating accuracy and performing any adjustments to bring accuracy to within the required tolerances. In accordance with the vendor operating manual, the two points of measurement must be at least 2 inches apart. In order to obtain two points of measurement if the actual water level cannot be adjusted, the actual water level will be used for one point and a metal calibration target will be used to obtain a simulated second point.

Calibration procedure 0LP-LT008 is prepared for calibration of the SFPLI Radar Measurement System.

A preventative maintenance request is created to perform calibration of the SFPLI equipment on a 2 year basis, prior to scheduled refueling cycles. This PM will validate the level instrumentation values against the SFP Ruler Gauge and against each other to ensure functionality of the system. Procedure 0LP-LT008, "VEGAPULS 62 ER LEVEL TRANSMITTER CALIBRATION" will be performed in accordance with the PM requirements.

BSEP Response to RAI-10d

Optimal preventive maintenance (PM) strategy uses a combination of monitoring, predictive, preventative and replacement actions to ensure reliable equipment operation. This graded approach balances the potential for failure, the risk of failure against the risk of replacement, and/or maintenance induced failures. Plant processes use Critical Component Classification to determine the risk and replacement strategy. There are no components that are considered critical (Critical Component Classification "C"). PMs are not required for Critical Component Classification run-to-maintenance ("R") and not applicable ("NA") categories, so the PM strategy addresses Critical Component Classification "I" Important Components.

Important "I" components are classified based on the "Failure may lead to regulatory consequences." The SFPLI is required by NRC Order EA-12-051, so the level sensors, power control panels, and the remote control room indicators are classified as "I". The local Reactor Building indicators are designated as run-to-maintenance "R," and a failure will not impact the remainder of the system from functioning.

The plant practices of validating indications and initiating corrective action when appropriate supplements the PM program. Therefore, these failures will be evaluated for impact on SFPLI availability. An "R" Critical Component Classification is appropriate for those components with a minimal impact to plant operation. The intent on "R" classified equipment is to do maintenance on these components when corrective action is required. Run-to-Maintenance "R" components and Not Applicable "NA" components are classified based on the "Failures have minimal impact to plant operation or failure can be acceptably managed." The component should be run until corrective maintenance is required.

Critical Component Classification "R":

SFP LEVEL INDICATORS CH A & CH B (Reactor Building 80' elevation)
SFPLI POWER CONTROL PANEL CH A & CH B FUSE

Critical Component Classification "I":

SFP LEVEL TRANSMITTER CH A
SFP LEVEL TRANSMITTER CH B
SFP DIGITAL LEVEL DISPLAY CH A & CH B (Control Room Back Panel)
SFPLI POWER CONTROL PANEL CH A & CH B

The PM strategy is derived as no PMs for those components classified "N" or "R" and selected PMs for those components classified as "I." New preventive maintenance requests (PMR) have been initiated for periodic calibration of the new instruments, sensor service life replacement, and replacement of the Power Control Panel batteries.

1) The recommended PM action for periodic calibration of SFPLI level sensors and indicators is every refueling cycle. A new plant procedure provides instructions for this calibration.
2) The recommended PM action for battery replacement is performance at every refueling cycle.
3) The recommended PM action for sensor replacement is every eight (8) years. This PM action only applies to one of the two sensors on each BSEP unit due to higher radiation exposure levels at its installed Reactor Building location.
4) The recommended PM action for measurement of AC voltage ripple and DC output voltage is every 3 years.

A preventive maintenance request (PMR) is created to address the following maintenance.

1) The periodic calibration of the SFPLI level sensors, and level indicators at the frequency of every refueling cycle.
2) The periodic replacement of level sensors at the frequency of eight (8) years.
3) The periodic replacement of Power Control Panel (PCP) batteries at the frequency of every refueling cycle.
4) The periodic measurement of AC voltage ripple and DC output voltage for power supplies at the frequency of every refueling outage. This frequency, which differs from the recommended PM action of every 3 years, aligns this PM frequency with those performed every refueling cycle.

NRC RAI-11

Please provide the following:

a) The specific location for the primary and backup instrument channel display.

b) If a display will be located somewhere other than the control room or alternate shutdown panel, please describe the evaluation used to validate that the display location can be accessed without unreasonable delay following a BDB event. Include the time available for personnel to access the display as credited in the evaluation, as we as the actual time (e.g., based on walk-throughs) that it will take for personnel to access the display. Additionally, please include a description of the radiological and environmental conditions on the paths personnel might take. Describe whether the display location remains habitable for radiological, heat and humidity, and other environmental conditions following a BDB event. Describe whether personnel are continuously stationed at the display or monitor the display periodically.

BSEP Response to RAI-11a

Unit 2 Locations:

Reactor Building, Refueling Floor

The horn/antenna and the waveguide piping are located in the Reactor Building, Refueling Floor at the 117 foot-4 inch elevation, north end of the SFP. The waveguide piping isometrics (reference drawings 2-FP-87726 and 2-FP-87727) show the configuration of the waveguide piping and horn.

Reactor Building, Northwest and Northeast Stairwells

The level sensors are mounted in the northwest and northeast stairwells in the Reactor Building, approximately 4' above the 98' elevation, or at approximately the 103' elevation. Reactor Building elevation (Northwest stairwell col. line L-M / 18R-19R, Northeast stairwell col. line R-S / 18R-19R) as shown on EC Sketches (Ref. SK-89578-E-3001-1 and SK-89578-E- 3002-1). New conduit and cable is installed from each electronic sensor to the SFPLI Power Control Panels (PCPs) and VEGADIS 62 remote display indicators (Channels A and B). These components are located in the back panel of the Control Room on the 49' elevation as shown on EC Sketch (Ref. SK-89578-E-3003). The VEGADIS 61 local display indicators will be installed below the electronic level sensors in the northwest and northeast stairwells on the 80' elevation of the Reactor Building. These locations have been agreed upon by BSEP Operations as a suitable placement.

Control Room

The SFPLI PCP and VEGADIS 62 remote display indicators, Channels A and B, are installed on the south wall of the back panel of the Control Room. The VEGADIS 62 remote indicators are mounted above the PCPs. The mounting configurations are shown on EC Sketch SK- 89578-C-1007.

Unit 1 Locations:

Unit 1 Locations are similar to the Unit 2 locations, with the exception that Control Room indication is on the North Wall and not the South Wall.

BSEP Response to RAI-11b

Displays are available in the control room back panels; no additional evaluations are required.

NRC RAI-12

Please provide a list of the procedures addressing operation (both normal and abnormal response), calibration, test, maintenance, and inspection procedures that will be developed for use of the spent SFP instrumentation. The licensee is requested to include a brief description of the specific technical objectives to be achieved within each procedure.

BSEP Response to RAI-12

The following procedures are prepared in response to this modification to the plant:

1. Periodic calibration of the SFPLI measurement (once every refueling cycle).
2. Periodic replacement of level sensors at the recommended frequency of eight (8) years. (Based on Calculation DPC-1229.00-00-0012, Section 6.3 recommended replacement frequency).
3. Periodic replacement of PCP batteries at the recommended frequency of every refueling cycle (Based on AREVA Document 51-9202556-004 recommended replacement frequency).
4. Periodic calibration of AREVA SFPLI Radar Measurement System.
5. Revision to add SFPLI to 0PLP-37, Equipment Important To Emergency Preparedness and ERO Response, prior to implementation of NEI 99-01 Revision 6 EAL scheme revision.

Procedure 0PIC-LT008 (i.e., calibration procedure) will perform the testing required for ensuring the instrument is properly calibrated within 60 days of a planned refueling outage, as required per NEI 12-02. The procedure provides a means of detection of channel drift and/or malfunction.

NRC RAI-13

Please provide the following:

a) Further information describing the maintenance and testing program the licensee will establish and implement to ensure that regular testing and calibration is performed and verified by inspection and audit to demonstrate conformance with design and system readiness requirements. Include a description of your plans for ensuring that necessary channel checks, functional tests, periodic calibration, and maintenance will be conducted for the level measurement system and its supporting equipment.

b) A description of how the guidance in NEI12-02 section 4.3 regarding compensatory actions for one or both non-functioning channels will be addressed.

c) A description of what compensatory actions are planned in the event that one of the non-functioning instrument channel cannot be restored to functional status within 90 days.

BSEP Response to RAI-13a

Refer to SFPI RAI.10 which addresses preventative maintenance request and weekly channel checks.

Refer to Enclosure 2 audit open item response for SFP.10, SFPLI maintenance and testing, which provides a summary description of operating, calibration, test, and maintenance procedures.

BSEP Response to RAI-13b

The primary or back-up instrument channel can be out of service for testing, maintenance, and/or calibration for up to 90 days provided the other channel is functional. Additionally, compensatory actions must be taken if the channel is not expected to be restored or is not restored within 90 days.

If both channels become non-functioning, then initiate actions within 24 hours to restore one of the channels to service and implement compensatory actions (e.g., supplemental personnel) within 72 hours.

The Manager-Engineering is designated responsibility to identify the appropriate compensatory measures which are necessary during FLEX equipment or component unavailability.

The Corrective Action Program (CAP) would further establish appropriate procedural and process controls to ensure performance of any required compensatory measures. The CAP would formally evaluate functionality for the SFP level channels and establish appropriate compensatory measures. The CAP would further establish appropriate procedural and process controls to ensure performance of any required compensatory measures.

Spare parts availability supports component restoration. A spare sensor is stored at the vendor nuclear warehouse. Upon request, and using the serial number of the sensor to be replaced, the vendor will provide a replacement sensor programmed with the site-specific configuration (i.e., settings). In the event of damage of the waveguide pipe, replacement pieces of the waveguide pipe may be ordered through the vendor, or fabricated on-site. The plant will maintain one spare sensor per Unit for replacements. No Power Control Panels or displays will be ordered as spares. The vendor will stock a spare set of all the electrical components in their Nuclear Warehouse and, if needed, can be readily supplied to the plant. The recommended minimum stocking level of batteries is two (2) sets per Power Control Panel.

<u>BSEP Response to RAI-13c</u>

Refer to SFPI RAI.10.b above.

Refer to Enclosure 2 audit open item response for SFP.10, SFPLI maintenance and testing, which provides a summary description of operating, calibration, test, and maintenance procedures.

Refer to Enclosure 2 audit open item response for SFP.13, SFPLI out-of-service administrative controls, which provides a summary description of procedure 0PLP-01.4, Fukushima FLEX System Availability, Action, and Surveillance Requirements.

ENCLOSURE 5

BSEP, UNITS 1 AND 2, BRIDGING DOCUMENT BETWEEN VENDOR TECHNICAL INFORMATION AND BSEP SPECIFIC CONSIDERATIONS FOR SPENT FUEL POOL LEVEL INSTRUMENTATION

ENCLOSURE 5

BESP, UNITS 1 AND 2, BRIDGING DOCUMENT BETWEEN VENDOR TECHNICAL INFORMATION AND BSEP SPECIFIC CONSIDERATIONS FOR SPENT FUEL POOL LEVEL INSTRUMENTATION

<table>
<tr><th>#</th><th>Topic</th><th>Parameter Summary</th><th>Vendor Design Document #</th><th>Additional Comments</th></tr>
<tr><td rowspan="5">1</td><td>Design Specification</td><td>Customer Technical Requirements Specification for SFPLI.</td><td>Duke Energy Specification
NCP-Z-0006</td><td>EA-12-051,
NEI 12-02</td></tr>
<tr><td colspan="4">Test or Analysis Result</td></tr>
<tr><td colspan="4">N/A</td></tr>
<tr><td colspan="4">Licensee Evaluation</td></tr>
<tr><td colspan="4">The vendor instrumentation design was reviewed and determined to adequately meet the specification requirements.</td></tr>
<tr><th>#</th><th>Topic</th><th>Parameter Summary</th><th>Vendor Design Document #</th><th>Additional Comments</th></tr>
<tr><td rowspan="5">2</td><td>Test Strategy</td><td>Qualification is based on a combination of tests and analyses or similarity.

Qualification tests and analyses are summarized in qualification analysis report 51-9202556-005.</td><td>Qualification Analyses Doc.
51-9202556-005</td><td>EA-12-051,
Att. 2, 1.4
NEI 12-02, 3.4</td></tr>
<tr><td colspan="4">Test or Analysis Result</td></tr>
<tr><td colspan="4">Test and analyses results meet requirements of EA-12-051, JLD-ISG-2012-03, and NEI 12-02 Rev. 1.</td></tr>
<tr><td colspan="4">Licensee Evaluation</td></tr>
<tr><td colspan="4">The vendor qualification documentation was reviewed and concluded to adequately demonstrate the instrumentation could reliably function in its installed environment(s) during a postulated Beyond Design Bases External Event (BDBEE).</td></tr>
<tr><th>#</th><th>Topic</th><th>Parameter Summary</th><th>Vendor Design Document #</th><th>Additional Comments</th></tr>
<tr><td rowspan="5">3</td><td>Environmental qualification for electronics enclosure with display</td><td>Temperature and humidity.</td><td>Qualification Analyses Doc.
51-9202556-005, Section 2.3</td><td>NEI 12-02, 3.4</td></tr>
<tr><td colspan="4">Test or Analysis Result</td></tr>
<tr><td colspan="4">The Power Control Panel internal components are rated for a maximum temperature of at least 158°F. Allowing for 9°F heat rise in the panel, the overall panel maximum ambient temperature for operation is 149°F.

The Power Control Panel enclosure is rated NEMA 4X and provides protection to the internal components from the effects of high humidity environments (i.e., and moisture intrusion).</td></tr>
<tr><td colspan="4">Licensee Evaluation</td></tr>
<tr><td colspan="4">The primary channel instrumentation electronics are located outside the SFP area. The vendor instrumentation design</td></tr>
</table>

	temperature, humidity, and dose limits bound the expected environmental conditions during a postulated BDBEE. The Power Control Panels (PCP) are located in the mild environment of the Control Room Back Panel wall away from potential temperature, steam and radiation condition around the pool. The only SFPLI equipment installed in the SFP area is the horn, horn cover, waveguide and supporting structural components, composed of materials unaffected by these service conditions. No electrical and/or electronic components are installed in the SFP area.			
#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
4	Environmental testing for level sensor components in SFP area - Saturated Steam and Radiation	Measurement capability through saturated steam and smoke. Testing performed to demonstrate the radar horn cover was effective at preventing moisture intrusion within the horn and wave guide pipe. Radar horn cover (fused silica glass), metal waveguide pipe and horn are not susceptible to radiation degradation. Manufacturer test data supports acceptable radiation degradation resistance for the radar horn cover adhesive.	Qualification Analyses Doc. 51-9202556-005, Section 2.3, 2.4, 2.5, 2.7, Appendix B, and supporting references 66-9200846-002 51-9220845-001 51-9221032-000 66-9225632-000	EA-12-051, 1.4 NEI 12-02, 3.4
	Test or Analysis Result			
	Initial testing (without horn cover) demonstrated successful measurement capability through steam and smoke. Subsequent testing of the radar horn and cover demonstrated adequate operation during sustained simulated SFP boiling conditions, and that the horn cover was effective in preventing moisture intrusion within the horn and wave guide pipe. The horn cover adhesive is a silicone elastomer manufactured by Dow Corning (Sylgard 170). The adhesive manufacturer radiation test data adequately demonstrates the adhesive would not experience unacceptable degradation for exposures up to 1.64×10^{8} Rads. The maximum humidity postulated for the spent fuel pool room is 100% RH, saturated steam. Due to postulated room temperature, the VEGA electronics must be located away from the steam atmosphere of the spent fuel pool area. Condensation formed in the waveguide tube inner walls in a saturated steam environment can cause a degradation of the reflected echo from the water surface and must be avoided. A horn cover must be used to prevent the intrusion of moisture into			

	the waveguide. The horn cover is qualified for use. The ability of the radar to "see through" the steam has been demonstrated by test. The presence of steam had no discernible impact on the measurement. The ability of the radar to "see through" dense smoke has been demonstrated by test. The presence of smoke had no discernible impact on the measurement.			
	Licensee Evaluation			
	The SFPLI channels shall be reliable at temperature, humidity, and radiation levels consistent with the spent fuel pool water at saturation conditions for an extended period. The only SFPLI equipment installed in the SFP area is the horn, horn cover, waveguide, and supporting structural components, composed of materials unaffected by these service conditions. The horn cover is qualified. No electrical and/or electronic components are installed in the SFP area. The horn cover adhesive manufacturer radiation test data adequately demonstrated the adhesive would not experience unacceptable degradation for radiation exposure in excess of that expected for the postulated beyond design bases event over the required mission time. The spent fuel pool level indication will function following a beyond-design-basis event and extended loss of all electrical power based on AREVA Qualification Analysis which documents qualification testing that included seismic, shock and vibration, temperature and humidity, and radiation conditions. Testing included subjecting the sensor and horn to steam with no discernible impact on accuracy.			
#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
5	Environmental testing for level sensor electronics housing – outside SFP	Temperature and humidity testing and analysis of sensor and indication.	Qualification Analyses Doc. 51-9202556-005, Section 2.3, 2.5, Appendix A, and supporting references IEC 60068-2-30, 38-9218218-000, EN 60529:2000, 38-9218214-000, USNRC Bulletin 79-01B Table C-1,	NEI 12-02, 3 .4

			NUREG-173, Vol.1, Section 3 .11.3.2.1 Reg. Guide 1.209	
	Test or Analysis Result			
	Sensor and indication are demonstrated to withstand the manufacturer ratings 80°C (sensor) and 70°C (indication), 100% RH. The sensor has been tested in accordance with IEC 60068-2-30 which varies the temperature from room temperature to elevated temperature at high humidity conditions, to verify that the test item withstands condensation that can occur due to the changing conditions. The sensor has been tested to EN 60529:2000 to achieve the rating IP66/IP68, which signifies totally dust tight housing, protection against string water jets and waves, and protection against prolonged effects of immersion. The VEGADIS 61 indicating and adjustment module and VEGADIS 62 display have housings which are similar to the VEGAPULS 62 ER sensor and are therefore considered to be equally covered by the sensor test. The VEGAPULS 62 ER sensor, VEGADIS 61 indicating and adjustment module, and VEGADIS 62 indicator have enclosures with a rating IP66/IP68, which signifies totally dust tight housing, protection against string water jets and waves, and protection against prolonged effects of immersion. The enclosure rating provides the necessary protection for high humidity levels and subsequent condensation that can occur due to the changing conditions.			
	Licensee Evaluation			
	The spent fuel pool level indication will function following a beyond-design-basis event and extended loss of all electrical power based on AREVA Qualification Analysis which documents qualification testing that included seismic, shock and vibration, temperature and humidity, and radiation conditions. Testing included subjecting the sensor and horn to steam with no discernible impact on accuracy. The VEGAPULS 62 ER sensor and VEGADIS 61 will meet the environmental requirements for both Normal and BDBEE temperatures and humidity.			
#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
6	Thermal and Radiation Aging – organic components in SFP area	Radar horn cover (fused silica glass), metal waveguide pipe and horn are not susceptible to radiation degradation. Horn cover adhesive manufacturer radiation test data and temperature withstand	Qualification Analyses Doc. 51-9202556-005, Section 2.5 51-9221032-000 66-9225632-000	EA-12-051, 1.4 NEI 12-02, 3.4

		specifications.		
	Test or Analysis Result			
	Thermal and radiation aging not applicable to metal waveguide in SFP area. The horn cover is made of used silica glass, which is inorganic and not sensitive to radiation. The horn cover adhesive is a silicone elastomer manufactured by Dow Coming (Sylgard 170). The adhesive manufacturer radiation test data adequately demonstrates the adhesive would not experience unacceptable degradation for exposures up to 1.64×10^8 Rads. Manufacturer's radiation test data for the Dow Corning Sylgard 170 silicone elastomer shows test data for exposures up to 7.13×10^8. At 1.64×10^8 rads the elastomer still showed some flexibility, but continued to become more brittle with higher exposure. Change in brittleness is not considered to be a significant factor as this level of exposure is not anticipated during a boiling pool scenario. The silicone adhesive is rated to withstand temperatures extremes of -45°C to 200°C, which adequately bound the postulated temperatures for sustained SFP boiling conditions.			
	Licensee Evaluation			
	The glass and metallic instrumentation components located within the SFP area are not susceptible to aging due to thermal and/or radiation effects. The horn cover adhesive manufacturer radiation test data adequately demonstrated the adhesive would not experience unacceptable degradation for radiation exposure in excess of that expected for the postulated beyond design bases event over the required mission time. The horn cover adhesive temperature ratings are acceptable and readily bound the expected conditions for the postulated beyond design bases event. The spent fuel pool level indication will function following a beyond-design-basis event and extended loss of all electrical power based on AREVA Qualification Analysis which documents qualification testing that included seismic, shock and vibration, temperature and humidity, and radiation conditions. Testing included subjecting the sensor and horn to steam with no discernible impact on accuracy.			
#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
7	Basis for Dose Requirement	SFPLI remote transmitter and power control panel qualified to 1×10^3 Rads based on industry operating experience.	Qualification Analyses Doc. 51-9202556-005, Section 2.5. Qualification Analysis of	NEI 12-02, 3.4

		Based on engineering judgment, the expected total integrated dose for the radar horn cover adhesive would not exceed $1x10^8$ over the required mission time for the instrumentation.	VEGAPULS 62 ER Through Air Radar 51-9221032-000	
	Test or Analysis Result			
	Analyses based on operating experience concludes the electronics are not susceptible to degraded performance up to this dose threshold. The adhesive manufacturer radiation test data adequately demonstrates the adhesive would not experience unacceptable degradation for exposures up to $1.64x10^8$ Rads. The horn cover is made of fused silica glass, which is inorganic and not sensitive to radiation. Manufacturer's radiation test data for the Dow Corning Sylgard 170 silicone elastomer shows test data for exposures up to 7.13×10^8 rads. At 1.64×10^8 rads the elastomer still showed flexibility, but continued to become more brittle with higher exposure. Change in brittleness is not considered to be a significant factor as this level of exposure is not anticipated during a boiling pool scenario.			
	Licensee Evaluation			
	The only parts of the measurement channel in the pool radiation environment are the metallic waveguide, horn, and fused silica glass horn cover which are not susceptible to the expected levels of radiation, and silicone elastomer moisture seal for the horn cover. The silicon elastomer test data demonstrates that the silicon is acceptable for the expected radiation dose for this application. A location specific dose calculation was performed for the remote electronics, which demonstrated the sensor total integrated dose (TID) over its required mission time is enveloped by the vendor instrumentation design limit of $1x10^3$ rads. However, the combined normal and BDBEE radiation dose is postulated to exceed the equipment rating. To mitigate this condition, the locations of the devices were reanalyzed using a point dose calculation to determine a more accurate TID. This analysis shows the combined Normal and BDBEE for the east stairwell devices (Channel A) will be below the equipment rating; however, the west stairwell (Channel B) VEGAPULS 62 ER will require replacement every 8 years. Based on an 8-year replacement cycle for the VEGAPULS 62 ER device located in the west stairwell, the radiation environmental design requirement is met.			

The horn cover adhesive manufacturer radiation test data adequately demonstrated the adhesive would not experience unacceptable degradation for radiation exposure in excess of that expected for the postulated beyond design bases event over the required mission time.

The area above and around the pool will be subject to large amounts of radiation in the event that the fuel becomes uncovered. The only parts of the measurement channel in the pool radiation environment are the metallic waveguide, horn, and fused silica glass horn cover which are not susceptible to the expected levels of radiation, and silicone elastomer moisture seal for the horn cover, which has associated radiation test data from the manufacturer. The silicon elastomer test data demonstrates that the silicon is acceptable for the expected radiation dose for this application.

#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
8	Seismic Qualification	Seismic withstand of VEGAPULS 62 ER sensor, indicators, power control panel, waveguide assembly, waveguide piping, and mounting brackets.	Qualification Analyses Doc. 51-9202556-005, Section 2.1, Appendix D, and supporting references 11-9203036-002 IEEE STD 344-2004 EPRI TR-107330 174-9213558-006 32-9221237-003 51-9221032-000 32-9221971-000 32-9225638-000 32-9233615-001 32-9225159-001 32-9232986-003	NEI 12-02, 3.4

Test or Analysis Result

The equipment qualified includes the VEGAPULS 62 ER sensor, PLICSCOM indicating and adjustment module, VEGADIS 62 display, Power Control Panel, rotatable horn waveguide assembly, waveguide piping including standard and repair flanges, and pool end and sensor end mounting brackets.

This includes the VEGADIS 61 indicating and adjustment module based on the physical similarity of its housing and electronics module to the tested VEGADIS 62 display.

#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
	The equipment is seismically qualified to seismic required response spectra (RRS) from EPRI TR-107330.			
	Licensee Evaluation			
	The vendor instrumentation seismic testing adequately demonstrates the equipment is capable of reliably operating during a seismic event. The seismically qualified design provides assurance that the SFPLI instrumentation is capable of surviving a design basis seismic event and remaining in place without damage or imposing damage to adjacent SSCs. The qualification testing demonstrates instrument channel reliability and complies with NEI 12-02 requirements. The spent fuel pool level indication will function following a beyond-design-basis event and extended loss of all electrical power based on AREVA Qualification Analysis which documents qualification testing that included seismic, shock and vibration, temperature and humidity, and radiation conditions. Testing included subjecting the sensor and horn to steam with no discernible impact on accuracy.			
#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
9	Sloshing	Loads due to sloshing action of the spent fuel pool water must be considered in addition to seismic loads on any SFPLI equipment that could be impacted.	Qualification Analyses Doc. 32-9223694-001 32-9232272-001 32-9221237-003	N/A
	Test or Analysis Result			
	The analysis calculates the forces on the SFPLI horn end assembly caused by sloshing of the Spent Fuel Pool during a seismic event. Loads due to sloshing on the SFPLI horn end assembly have been evaluated and are shown to be acceptable.			
	Licensee Evaluation			
	Sloshing analyses determined seismic induced wave would not impact radar horn. The horn assembly and support are qualified to withstand seismic accelerations and the effects of sloshing water against the horn end assembly.			
#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
10	Spent Fuel Pool instrumentation system functionality	Functionality testing was performed during the factory acceptance test. See Topic #16. Site acceptance testing confirmed SFPLI	VEGA Test Procedure AREVA Doc. 66-9200846-002, Factory Acceptance Test	N/A

#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
	test procedure	functionality.	Report 66-9227206-000 66-9227813-000 66-9225632-000	
	Test or Analysis Result			
	Test demonstrates the functionality and accuracy for each SFPLI channel at the vendor factory.			
	Licensee Evaluation			
	The vendor factory acceptance test demonstrated reliable operation of the SFP level instrumentation under normal conditions and under various simulated test conditions (e.g. boiling pool and saturated steam conditions). The testing demonstrated the instrumentation met design accuracy and repeatability specifications. Site acceptance testing confirmed SFPLI functionality.			
#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
11	Boron Build-Up	N/A	N/A	N/A
	Test or Analysis Result			
	N/A			
	Licensee Evaluation			
	By design, boron is not present in Boiling Water Reactor SFP water. Boron material in the SFP fuel racks is contained.			
#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
12	Pool-side Bracket Seismic Analysis	See Topic #8, Seismic Qualification. Seismic withstand of pool end and sensor end mounting brackets.	Qualification Analyses Doc. 51-9202556-005, Section 2.1, Appendix D, and supporting references 11-9203036-002 IEEE STD 344-2004 EPRI TR-107330 32-9221237-003 51-9221032-000 32-9225159-001 32-9232986-003	NEI 12-02, 3.4
	Test or Analysis Result			
	The equipment is seismically qualified to seismic required response spectra (RRS) from EPRI TR-107330.			

#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
	The equipment qualified includes the pool end and sensor end mounting brackets.			
	Licensee Evaluation			
	The vendor instrumentation seismic testing adequately demonstrates the equipment is capable of reliably operating during a seismic event. The seismically qualified design provides assurance that the SFPLI instrumentation is capable of surviving a design basis seismic event and remaining in place without damage or imposing damage to adjacent SSCs.			
13	Additional Brackets (Sensor Electronics and Electronic Enclosure)	See Topic #8, Seismic Qualification. Seismic withstand of sensor brackets and electronic enclosure mounting.	Qualification Analyses Doc. 51-9202556-005, Section 2.1, Appendix D, and supporting references 11-9203036-002 EPRI TR-107330 174-9213558-006 32-9225638-000 32-9233615-001	NEI 12-02, 3.4
	Test or Analysis Result			
	The equipment is seismically qualified to seismic required response spectra (RRS) from EPRI TR-107330.			
	Licensee Evaluation			
	The vendor instrumentation seismic testing adequately demonstrates the equipment is capable of reliably operating during a seismic event. The seismically qualified design provides assurance that the SFPLI instrumentation is capable of surviving a design basis seismic event and remaining in place without damage or imposing damage to adjacent SSCs. The Power Control Panel and digital display mounting and anchorage are designed and qualified for normal loading and seismic loading conditions.			
#	**Topic**	**Parameter Summary**	**Vendor Design Document #**	**Additional Comments**
14	Shock and Vibration	Shock and vibration withstand testing and analyses for sensor, displays, power control panel. .	Qualification Analysis Doc. 51-9202556-005, Section 2.2 and supporting references MIL-S-901D	NEI 12-02, 3.4

			MIL-STD-167-1 38-9193058-000 EN 60068-2-27 38-9218022-000 EN 60068-2-6 38-9218023-000 51-9221032-000 32-9221237-003	
	Test or Analysis Result			
	Sensor, displays, and power control panel have been tested and/or analyzed for shock and vibration. The VEGAPULS 66 Through Air Radar sensor and PLICSCOM indicating and adjustment module mounted to the sensor were successfully shock tested in accordance with MIL STD 901D, and were successfully vibration tested in accordance with MIL STD 167-1. The test results are considered applicable to the VEGAPULS 62 ER and PLICSCOM indicating and adjustment module. Differences in construction between the VEGAPULS 66 and VEGAPULS 62 ER are mainly the size, with the VEGAPULS 62 ER being smaller. The shape of the housing, its material construction (precision cast stainless steel), the mass and form factor for the electronics modules, and the materials and method for mounting the electronics into the sensor housing is the same between the VEGAPULS 66 and the VEGAPULS 62 ER. The VEGADIS 61 and VEGADIS 62 displays feature housings that are similar in size, materials, and form factor to the VEGAPULS 62 ER sensor, contain a terminal base attached with two screws similar to the electronics module in the VEGAPULS 62 ER, and contain a LCD display module that installs into the housing similar to the PLICSCOM in the VEGAPULS 62 ER. Therefore, these devices are considered to have the same resistance to shock and vibration as the VEGAPULS 62 ER and PLICSCOM. The waveguide piping, and sensor and waveguide end mounting brackets are not shock or vibration sensitive; therefore, shock and vibration testing is not applicable. Testing and analyses of horn cover and adhesive support the components can tolerate horizontal arid vertical accelerations up to 100g and SFP sloshing loads up to 3.37 psi. The power control panel is shock tested per EN 60068-2-27 and vibration tested per EN 60068-2-6. Testing demonstrates the power control panel is resistant to shock and vibration.			
	Licensee Evaluation			

	The shock and vibration testing performed for the SFP level instrumentation adequately demonstrates the sensor and power control panel will be reliable in the installed design location. The instrumentation is rigidly mounted to the Seismic Category I Reactor Building wall and the Seismic Category I Control Building wall and would not be subjected to any significant shock or vibration during a postulated beyond design bases event, or during normal operation. The instrumentation is located within the Seismic Category I Reactor Building and the Seismic Category I Control Building and is protected from external wind borne missile threats. The instrumentation installed design location is not susceptible to vibration from surrounding rotating equipment. The radar sensor and power control panel design location provides spatial separation from surrounding SSCs, such that potential seismic interaction with surrounding SSCs is also not a concern. The post modification testing demonstrated reliable operation of the instrumentation. The spent fuel pool level indication will function following a beyond-design-basis event and extended loss of all electrical power based on AREVA Qualification Analysis which documents qualification testing that included seismic, shock and vibration, temperature and humidity, and radiation conditions. Testing included subjecting the sensor and horn to steam with no discernible impact on accuracy.			
#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
15	Requirements Traceability	Not required by order.	N/A	N/A
	Test or Analysis Result			
	N/A			
	Licensee Evaluation			
	The Engineering Change process provides the Engineering Change (EC) Package (EC) required to support the design and installation of the Spent Fuel Pool Level Instrumentation (SFPLI) equipment. The EC documents that the instrumentation selected meets the requirements set forth in the NRC Order EA 12-051, along with subsequent documents NEI 12-02 and JLD-ISG-2012-03 as endorsed by the NRC. The EC documents the equipment meets the site requirements per applicable procedures. The vendor instrumentation design was reviewed and determined to adequately meet the specification requirements.			
#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
16	Factory Acceptance Test	Inspection of waveguide, test of functionality of power transfer to battery, verification of sensor measurement accuracy including steam/smoke.	VEGA Test Procedure AREVA Doc. 66-9200846-002, Factory Acceptance Test Report AREVA Doc. 66-9227206-000	N/A

#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
		The Factory Acceptance Test (FAT) performed testing of each system, including VEGAPULS 62 ER Sensor, VEGADIS 61 with PLICSCOM indicating and adjustment unit, VEGADIS 61, VEGADIS 62, horn assembly, waveguide piping, qualified mounts, and Power Control Panel.	66-9227813-000 66-9225632-000	
	Test or Analysis Result			
	Test demonstrates the functionality and accuracy for each SFPLI channel at the vendor factory.			
	Licensee Evaluation			
	The vendor factory acceptance test demonstrated reliable operation of the SFP level instrumentation under normal conditions and under various simulated test conditions (e.g., boiling pool and saturated steam conditions). The testing demonstrated the instrumentation met design accuracy and repeatability specifications.			
#	**Topic**	**Parameter Summary**	**Vendor Design Document #**	**Additional Comments**
17	Channel Accuracy	Normal and accident conditions SFP level measurement accuracy.	AREVA Instruction Manual 01-9223096-000, Section 11.6	EA-12-051, Att. 2, 1.7 NEI 12-02, 3.7
	Test or Analysis Result			
	The specified normal accuracy of the new SFPLI measurement system is ±1 inch and includes the accuracy with the waveguide. Each SFPLI radar measurement system will maintain its accuracy after a loss of its 120 VAC power supply. The instrument channel automatically switches to battery backup, and the sensor continues to perform its measurement function. Testing has demonstrated the SFPLI can reliably measure SFP water level under Extended Loss of AC Power (ELAP) conditions including boiling pool and saturated steam conditions. Testing included subjecting the sensor and horn to steam with no discernible impact on accuracy. Functionality and accuracy for each SFPLI channel verified during vendor factory acceptance testing.			
	Licensee Evaluation			
	The vendor factory acceptance test demonstrated reliable operation of the SFP level instrumentation under normal conditions and under various simulated test conditions (e.g., boiling pool and saturated steam conditions). The testing demonstrated the instrumentation met design accuracy and repeatability specifications.			

#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
18	Power consumption	Lifetime of battery backup at full load.	Qualification Analyses Doc. 51-9202556-005, Section 2.9, AREVA Instruction Manual 01-9223096-000, Section 11.7	EA-12-051, Att. 2, 1.6, NEI 12-02, 3.6
	Test or Analysis Result			
	Battery capacity at full load is expected to readily exceed 7 days.			
	Licensee Evaluation			
	Based on vendor analyses the battery capacity is deemed sufficient to support reliable instrument channel operation until off-site resources can be deployed by the mitigating strategies in response to Order EA-12-049. The SFP level instrument channels meet the requirements for separate power supplies with alternate sources (battery backed and FLEX diesel generator availability). The permanently installed SFPLI channel A and B will have backup power from their batteries and can also be powered from the new FLEX diesel generators. The Power Control Panels are arranged in a manner that will allow change out of the backup batteries following a BDBEE, readily accessible by personnel to read indication and to change the batteries. An adequate supply of batteries is stored in the FLEX Storage Building, so that they are available in the event of a BDBEE.			
#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
19	Technical Manual	Application-specific information on the installation, operation, and maintenance of the VEGAPULS 62 ER Through Air Radar SFP level measurement.	AREVA Doc. 01-9223096-000 01-9226142-000 01-9226200-000 01-9226201-000 01-9226199-000	N/A
	Test or Analysis Result			
	N/A			
	Licensee Evaluation			
	The vendor technical manuals have been reviewed, accepted and incorporated in the engineering change package.			
#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
20	Calibration	Periodic indication checks, calibration checks,	AREVA Instruction Manual	EA-12-051,

#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
		calibration.	01-9223096-000 Sections 7.0, 9.0	Att. 2, 1.8 NEI 12-02, 3.8, 4.3.
	Test or Analysis Result			
	Based on the extensive operating experience of the VEGAPLUS sensors, the expected calibration drift is negligible. Functional verification can be achieved using cross channel checks and functional checks per vendor manual.			
	Licensee Evaluation			
	Calibration testing of the instrumentation requires the measurement of two different Spent Fuel Pool levels, and one of those measurements will be obtained with the use of a calibration target to simulate Spent Fuel Pool level. Periodic testing requires the measurement of two different points for validating accuracy. In accordance with the AREVA operating manual, the two points of measurement must be at least 2 inches apart. The actual water level will be used for one point and (as allowed by the AREVA operating manual) a metal target will be used to obtain a simulated second point.			
#	**Topic**	**Parameter Summary**	**Vendor Design Document #**	**Additional Comments**
21	Failure Modes and Effects Analysis (FMEA)	N/A	N/A	NEI 12-02, 3.0, 4.0
	Test or Analysis Result			
	N/A			
	Licensee Evaluation			
	The SFP level instrumentation is required to function to provide SFP level indication for a beyond design basis external event. Performance of an FMEA is not warranted for this type of an application. Reasonable assurance that both channels are not susceptible to a common mode failure is provided by meeting NEI 12-02 guidance requirements. Reliable level indication is provided for use in responding to beyond design basis external events. The instrumentation consists of two independent instrument systems (i.e., instrument channels). A spent fuel pool level instrument system is considered reliable when the instrument system satisfies the design elements and has fully implemented the programmatic features listed in NEI 12-02. SFPLI systems are two independent systems and a failure on one system will not impact the operation of the other system and SFPLI will still be available to operators. The SFPLI system is supplied by a reputable vendor and has been designed, qualified, tested, and specifically approved for this design function. Single Failure Analysis and/or Failure Mode and Effects			

	Analysis are not required.			
#	Topic	Parameter Summary	Vendor Design Document #	Additional Comments
22	EMI Testing	Emissions and susceptibility testing for VEGAPULS 62 ER.	Qualification Analysis Doc. 51-9202556-005, Section 2.6 and supporting references EN-61000-4 MIL-STD-461E EPRI TR-102323 58-9214362-000 38-9219863-000 38-9218965-000 38-9218966-000 38-9219862-000 38-9218967-000 38-9218968-000 38-9218969-000 38-9218970-000 38-0218964-000	N/A
	Test or Analysis Result			
	VEGAPULS 62 ER has been tested for emissions to both MIL and IEC standards and for susceptibility to IEC standards.			
	Licensee Evaluation			
	The EMI/RFI susceptibility and emissions testing provides adequate assurance the instrumentation will be compatible in the design location. The testing was conservatively performed with unshielded interconnecting wiring. The testing included the VEGAPULS 62 ER sensor, VEGADIS 62 display and power control panel. The testing for the VEGADIS 62 display envelopes the similar construction and LCD display technology of the VEGADIS 61.			