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Eric W. Olson
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RBG-47618

September 29, 2015

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
11555 Rockville Pike
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SUBJECT: Completion of Required Action by NRC Order EA-12-049, Issuance of Order to Modify Licenses With Regard To Requirements for Mitigation Strategies for Beyond-Design-Basis External Events
River Bend Station – Unit 1
Docket No. 50-458
License No. NPF-47

REFERENCE: NRC Order Number EA-12-049, dated March 12, 2012 (ML12054A736)

Dear Sir or Madam:

On March 12, 2012, the 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 (referenced above), to Entergy Operations, Inc. (Entergy). This Order was effective immediately and directed Entergy to develop, implement, and maintain guidance and strategies to restore or maintain core cooling, containment, and spent fuel pool cooling capabilities in the event of a beyond-design-basis external event at River Bend Station (RBS). This letter, along with its enclosures, provides the notification required by Section IV.C.3 of the Order that full compliance with the requirements described in Attachment 2 of the Order has been achieved for RBS.

This letter contains no new regulatory commitments. Should you have any questions regarding this submittal, please contact Joey Clark at 225-381-4177.

I declare under penalty of perjury that the foregoing is true and correct; executed on September 29, 2015.

Sincerely,

Eric W. Olson

EWO/dhw

Attachments:
1. Compliance with Order EA-12-049
2. Order EA-12-049 Compliance Elements Summary
3. Audit Open Item Reconciliation
4. Interim Staff Evaluation Confirmatory Items Reconciliation
5. Final Implementation Plan

A151
NRR

cc: Regional Administrator
U. S. Nuclear Regulatory Commission, Region IV
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NRC Senior Resident Inspector
River Bend Station

U. S. Nuclear Regulatory Commission
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Attachment 1

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Compliance with Order EA-12-049

1) Compliance with Order EA-12-049:

On March 12, 2012, the 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 to Entergy Operations, Inc. (Entergy). This Order was effective immediately and directed Entergy to develop, implement, and maintain guidance and strategies to restore or maintain core cooling, containment, and spent fuel pool (SFP) cooling capabilities in the event of a beyond-design-basis external event at River Bend Station (RBS).

RBS developed an Overall Integrated Plan (OIP) for documenting the diverse and flexible strategies (FLEX) in response to Order EA-12-049. The information provided herein documents full compliance with the Order for RBS.

a. Interim Staff Evaluation (ISE) open items – All ISE open Items have been closed.
b. ISE Confirmatory Items – All ISE confirmatory items have been closed. See Attachment 4 for a summary of RBS responses to those items.
c. Licensee-identified open items – All open items are complete.
d. Audit questions / open items – All items were closed during the October 2014 onsite audit, with three exceptions. See Attachment 3 to this letter concerning the reconciliation of those three items.

2) Milestone Schedule – Items Complete:

Milestone	Completion Date
Submit 60-day status report	May 10. 2012
Submit Overall Integrated Plan	Feb. 28, 2103
Submit 6-month updates:	
Update 1	Aug. 28, 2013
Update 2	Feb. 26, 2014
Update 3	Aug. 28, 2014
Update 4	Feb. 25, 2015
Update 5	Aug. 26, 2015
Perform staffing analysis	Oct. 9, 2014
FLEX equipment procurement completed	January 2015
FLEX storage buildings completed	February 2015
Modifications completed	March 2015

Attachment 2

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Order EA-12-049 Compliance Elements Summary

Order EA-12-049 Compliance Elements Summary

The elements identified below, as well as the RBS Overall Integrated Plan (Reference 1), the 6-month status reports (References 3 through 6), and any additional docketed correspondence, demonstrate compliance with Order EA-12-049.

Strategies – complete

FLEX strategies are in compliance with Order EA-12-049. There are no strategy-related open items, confirmatory items, or audit questions / audit report open items.

Modifications – complete

The modifications required to support the FLEX strategies have been fully implemented in accordance with the station design control process.

Equipment – complete

The equipment required to implement the FLEX strategies has been procured in accordance with NEI 12-06, Section 11.1 and 11.2, received at the site, initially tested / performance verified as identified in NEI 12-06, Section 11.5, and is available for use. Maintenance and testing will be conducted through the use of the RBS preventative maintenance program such that equipment reliability is achieved.

Protected storage – complete

The storage facilities required to implement the FLEX strategies have been completed and provides protection from the applicable site hazards. The equipment required to implement the FLEX strategies is stored in its protected configuration.

Procedures – complete

FLEX Support Guidelines (FSGs) have been developed and integrated with existing procedures. 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 has been completed in accordance with an accepted training process as recommended in NEI 12-06, Section 11.6.

Staffing – complete

The staffing study for RBS has been completed in accordance with 10CFR50.54(f), "Request for Information Pursuant to Title 10 of the Code of Federal 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, as documented in Reference 8.

National Safer Response Centers – complete

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

Validation – complete

RBS 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 Plan (OIP) / Final Integrated Plan (FIP) for Order EA-12-049.

FLEX program document – complete

The RBS FLEX program document has been developed in accordance with the requirements of NEI 12-06 and issued in accordance with site procedure controls.

References:

The following references support the River Bend Station FLEX Compliance Document:

1. RBS 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)," letter no. RBG-47329, dated Feb. 28, 2013 (ML13066A738).

2. NRC Order Number EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012 (ML12054A736).

3. First 6-Month Status Report, letter no. RBG-47389, dated Aug. 28, 2013 (ML13247A414).

4. Second 6-Month Status Report, letter no. RBG-47445, dated Feb. 26, 2014 (ML14064A202).

5. Third 6-month Status Report, letter no. RBG-47502, dated Aug. 28, 2014 (ML14253A210)

6. Fourth 6-month Status Report, letter no. RBG-47546, dated Feb. 25, 2015 (ML15062A032)

7. 10CFR50.54(f), "Request for Information Pursuant to Title 10 of the Code of Federal 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 (ML12056A046).

8. RBS Phase 2 Staffing Study, letter no. RBG-47501, dated Oct. 9, 2014 (ML14297A160).

9. River Bend Station, Unit 1 - Report For The Audit Regarding Implementation Of Mitigating Strategies And Reliable Spent Fuel Pool Instrumentation Related To Orders EA-12-049 and EA-12-051, Feb. 18, 2015 (ML15026A645)

10. NRC Email, from John Hughey (NRC) to Danny Williamson (Entergy), dated May 29, 2015.

11. NRC Email, from John Hughey (NRC) to Danny Williamson (Entergy), dated July 27, 2015

Attachment 3

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Audit Open Item Reconciliation

An onsite audit of the implementation of Orders EA-12-049 and EA-12-051 was conducted by NRC during the week of October 20, 2014. The three items described below remained open at the time of the audit debrief meeting. RBS provided additional information for review by the audit team, and, as documented by References 10 and 11 in Attachment 2 above, those items were subsequently closed. A summary of the response to those items is provided here.

Audit report item OIP-11 (11-C)

"The need for evaluation of the seismic robustness of non-safety related class 4 piping located in RBS piping tunnels utilized in the FLEX strategy is identified on pages 20 and 21 of the OIP. The completed evaluation has confirmed that there are a number of pipe lines in the tunnels, including sections that are not considered process. The evaluation also identified that these piping sections can be isolated by closing five individual valves if the ELAP is initiated by a seismic report. RBS FLEX procedures will include directions to isolate the valves following a seismic event."

RBS response:

The safety related tunnels are below grade and contain a large number of pipes that require evaluation for flooding concerns in accordance with NEI 12-06, "Diverse And Flexible Coping Strategies (FLEX) Implementation Guide." While there is a second independent reactor vessel injection path available that is completely independent of this path and not subject to internal flooding concerns, it is still prudent to evaluate flooding concerns. Seismically robust pipes are not assumed to fail following a beyond design basis external event (BDBEE). However, there are a number of non-seismically robust lines that could potentially fail following a BDBEE.

A review and assessment of piping in the RBS tunnels was conducted. The initial screening identified 23 out of 120 lines in four tunnels which are potentially large internal flooding sources. All 23 of those lines were found to be seismically robust per the seismic screening and, therefore, of no concern. Eighty of the remaining lines were eliminated because they are seismically robust or flooding was determined not possible (e.g., line is fed from a sump). The remaining 17 lines were determined to be potential flooding sources if there is no manual action to isolate the lines. A subsequent review and walk-down determined that two of these lines should have been identified as seismically robust since they were seismically analyzed and supported with robust pipe supports. This left 15 lines as potential sources of flooding. The water source for 10 of the lines is the condensate storage tank (CST). The water source for the five remaining lines is the demineralized water system. Four manual valves in the yard (two near the CST and two near the demineralized water storage tanks) are capable of isolating these lines should such action be warranted for any reason. Based on guidance from Seismic Qualification Utility Group GIP 3A, manually operated valves are inherently rugged and need not be evaluated for seismic adequacy. A walk-down was performed to review the valve locations for potential seismic spatial interaction of miscellaneous equipment and structures in the vicinity of the valves. It was determined that there are no Seismic II/I concerns for the subject valves. Each of the valves is ruggedly supported by a structural frame anchored to a concrete base and is judged to be free from any spatial interaction from adjacent equipment or structures. The valves are located in areas considered accessible following a seismic event; therefore, procedurally closing them, as required following a seismic FLEX event is an acceptable strategy which meets the guidance of NEI 12-06.

Regarding the final closeout of this audit item after the onsite debrief, the following comments were provided by the audit team leader in Reference 11 in Attachment 2 above:

"We have 2 comments regarding the 11-C (tunnel flooding) evaluation:

1. The 11-C flooding evaluation included in the e-mail dated June 22, 2015, below states that a 16 minute or 20% margin is available to identify and isolate the two valves. It appears that the margin is actually 16 minutes or 17% (16/95 = 0.168)? At any rate the NRC staff agrees with the 16 minutes of margin but it isn't clear how RBS arrived at the 20% margin characterization.

2. The 'Final Validation Doc Excerpt' file on the ePortal states that a 'drill motor' is provided as a resource for closing the valves. If a drill motor was used to close the valves in the validation exercise, then the drill motors will need to be protected from all hazards along with the required motive power source and available for use immediately after the BDBEE."

The disposition of those comments is as follows:

1. Sequence of task steps:
    a. Task start time is T+30 min.
    b. Task time constraint is T+111 min.
    c. Task success criteria (time constraint minus start time) is = 81 min.
    d. Results of validations (sum of times measured during validation process) = 65 min.
    e. Total margin is 81 min – 65 min = 16 min.
    f. Margin is 16 min or 20% (16/81 = 0.197)

Table "A" - Excerpt from the RBS Final Validation Document:

Table A - Validated Item Results					
Item: *Isolate flooding in the tunnel*		Level: *C*		Time Constraint: *111 minutes*	
ACTION ITEM #	TASK	START TIME	TIME CONSTRAINT	SUCCESS CRITERIA *(TIME CONSTRAINT MINUS START TIME)*	RESULTS *(SUM OF TIMES MEASURED DURING VALIDATION PROCESS)*
15	Isolate flooding in the tunnel	0.5 hrs.	111 minutes	81 minutes	65 minutes
Margin = 16 minutes					

2. Drill motors and supporting equipment are arranged as follows:
   a. The drills are stored in the emergency plan lockers In the Technical Support Center and Operations Support Center.
   b. Two batteries are provided and charged for each drill.
   c. Battery chargers are stored in these lockers and plugged in.
   d. The appropriate attachments for the drills are also stored in these lockers.
   e. Use of the drill motors is addressed in FSGs.
   f. Drills, chargers, and batteries are protected from all BDBEEs and are readily available following any such event.

Audit report item OIP-13 (13-C)

"While the following is not a change in the compliance strategy described in the OIP, it is a clarification with regard to the RBS FLEX strategy and the guidance of NEI 12-06. NEI 12- 06 Section 3.2.2, Consideration 13 states that regardless of installed coping capability, all plants will include the ability to use portable pumps to provide RPV / RCS / SG makeup as a means to provide a diverse capability beyond installed equipment. The RBS FLEX strategy does not include this capability, and thus, the crediting of installed SPC pumps for the RBS FLEX Phase 2 strategy is an alternative method tor satisfying the NEI 12-06 guidance. The use of the installed SPC pumps to provide RPV makeup is an acceptable alternative to a portable FLEX pump for the transitional phase of FLEX. The guidance states that the ELAP response is to be addressed with a combination of three categories of equipment: installed plant capability, portable on-site equipment, and off-site equipment resources. Only one phase of the response is limited to utilizing equipment from just one of the equipment categories. To ensure that there is enough time to deploy and implement portable equipment, Phase 1 can only use installed plant equipment. Even though Phase 2 and Phase 3 will utilize portable equipment (onsite for Phase 2 and offsite from RRC for Phase 3), there is no prohibition against the use of permanently installed equipment in those two phases, as long as it is robust with respect to design-basis external events."

RBS response:

The Phase 2 core cooling strategy has been revised to no longer consider the suppression pool cooling (SPC) pumps as two independent RPV injection sources. As such the revised strategy now includes the use of a portable pump and independent flow path to provide water to the RPV in addition to the existing primary core cooling strategy, which uses the installed SPC pumps. The alternate method makes use of a three inch flushing connection on the low pressure core spray (LPCS) injection line as the connection point to the RPV. This connection point is located on a platform (elevation 133') in the northwest crescent of the Auxiliary Building 114' elevation. However, the connection point is accessed from above by removing grating on the 141' elevation. Two and one-half inch hose is routed from this connection point out door AB98-06 and along the Auxiliary and Fuel Buildings to the deployment location of the FLEX 3 pump. The primary function of the FLEX 3 pump is to provide makeup water from the standby cooling tower (SCT) basin to the spent fuel pool (SFP). The pump design includes a discharge manifold with four outlets (each with a shutoff valve) and can accommodate an individual hose connection to support both the SFP cooling and core cooling functions. The required flow for both functions is 35 gpm to the SFP (normal operation) or 60 gpm (refueling) and 200 gpm for core cooling for a total of ~235 to 260 gpm. These flow rates are well within the capability of the FLEX 3 pump.

The alternate core cooling strategy will be used should the SPC core cooling path be unavailable. As in the primary strategy, the alternate strategy will be placed into service following depletion of the upper containment pool (UCP) water source for RCIC and the subsequent depressurization of the RPV. This is expected to occur approximately 34 hours following the ELAP / loss of ultimate heat sink. With a core cooling flow of 200 gpm, the water level in the RPV will slowly increase to the level of the main steam lines and will begin to flow to the suppression pool. The alternate strategy provides a core cooling method that is diverse and completely independent of the primary SPC strategy. The FLEX 3 pump pumps water through fire hose to a LPCS flushing line connection, through valves E21-VF025 and E21-MOVF005 and on to the RPV for core cooling. The flushing connection is located on a platform (elevation 133') in the northwest crescent of the Auxiliary Building 114' elevation and is therefore protected from all hazards

Audit report item SE #3 (3-E):

"Discuss strategy for swapping RCIC suction from SP to the UCP and justify that the strategy will be effective under ELAP conditions."

RBS response:

The OIP states that operators will align the upper containment pool (UCP) suction path to RCIC prior to the suppression pool (SP) reaching 185°F. The flow path for this alignment is through two normally-open containment isolation valves, SFC-MOV121 (outside) and SFC-MOV139 (inside). As stated in NEI 12-06, "At the time of the postulated event, the reactor and supporting systems are within normal operating ranges for pressure, temperature, and water level for the appropriate plant condition. All plant equipment is either normally operating or available from the standby state as described in the plant design and licensing basis." The initial assumption goes on to state an ELAP with failure of the onsite AC power occurs. Given these provided conditions no containment entry is required to support transfer of RCIC suction to the UCP to support the FLEX strategy as the required valves are normally open and would remain open.

While outside the initial conditions of the FLEX regulatory guidance, RBS has developed procedural guidance to open or verify open these valves, if required, in order to provide defense in depth. These steps are included in FLEX guideline FSG-002, "Alternate RCIC Suction Source," and Abnormal Operating Procedure (AOP)-0065, "Extended Loss of AC Power (ELAP)." These procedures require operators to open the circuit breakers for the valves and verify that both valves are open. Depending on the specific conditions, it may be necessary to enter the containment to verify that SFC-MOV139 is open.

An evaluation of the ability to enter the containment to perform the procedural actions to verify open or open a closed isolation valve concluded that neither the expected containment environmental conditions, the design of the containment personnel air lock, nor the loss of the instrument air system will impact the ability of operators to enter containment to open valve SFC-MOV139 during a FLEX event. The containment function will also be maintained during and after this evolution.

While not explicitly described in the strategy, RBS has the capability to adequately respond to an ELAP event even if the ability to provide RCIC suction from the UCP is not available. The only difference from the existing strategy would be maintaining RCIC suction on the SP. RCIC can continue to provide core cooling in this configuration at least as long as it would when taking suction from the UCP in accordance with the primary FLEX strategy. Should RCIC fail or become unavailable, RBS would then revert to the current strategy which requires full RPV depressurization and realignment of SPC to inject into the RPV.

Attachment 4

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Interim Staff Evaluation Confirmatory Item Reconciliation

On Feb. 25, 2014, NRC issued "River Bend Station – Interim Staff Evaluation Regarding Overall Integrated Plan in Response to Order EA-12-049" (ML13365A271). As described in that document, 17 confirmatory items were specified for review by the team conducting the onsite audit during the week of October 20, 2014. Listed below are those confirmatory items, along with the responses provided by RBS prior to the audit. All these items were closed during the course of the audit, as reported in "River Bend Station, Unit 1 - Report for the Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Pool Instrumentation Related to Orders EA-12-049 and EA-12-051" (ML15026A645), dated Feb. 18, 2015.

Confirmatory Item 3.1.3.1.A:

Confirm that the 2,700-foot separation distance between FLEX storage facilities will be sufficient to ensure that that a single tornado would not impact both locations when considering the local tornado data, the actual separation distance, and axis.

RBS response:

An analysis of historical tornado data for the region surrounding the RBS site has been performed. Using the tornado widths and paths from NOAA's Storm Prediction Center for 1950 – 2013, tornado data was collected for the area surrounding the RBS site. For this analysis, the surface area upon which a tornado strike probability is based is a 1 degree longitude by 1 degree latitude box surrounding the site. Generally, for eastern and central US sites, a 1 degree longitude by 1 degree latitude box surrounding the site should provide sufficient data to be statistically significant. The results of this analysis concluded that a reasonable separation distance that bounds a large majority of tornadoes in the region would be based on the 90th percentile tornado width value of 490 feet. Based on historical records, the axis of separation used at RBS should consider a tornado path from southwest to northeast. Separation of storage locations by this distance and perpendicular to this direction will provide reasonable assurance that one set of FLEX equipment will remain deployable through most tornadoes. Therefore, based on the results of this analysis, the 2,700-foot separation distance between FLEX storage facilities will be sufficient to ensure that a single tornado would not impact both locations when considering the local tornado data, the actual separation distance, and axis.

Confirmatory Item 3.2.1.1.A:

Confirm that benchmarks are identified and discussed which demonstrate that Modular Accident Analysis Program (MAAP) is an appropriate code for the simulation of an ELAP event at RBS, consistent with the NRC endorsement (ADAMS Accession No. ML 13275A318) of the industry position paper on MAAP.

RBS response:

Calculation G13.18.14.1-048, MAAP 4.0.7 Analysis of Containment Conditions for Extended Loss of AC Power (FLEX), determines the conditions in the RBS containment, drywell, and the reactor vessel for 180 hours following a beyond design basis external event (BDBEE) resulting in an extended loss of AC power (ELAP). The Modular

Accident Analysis Program (MAAP), Version 4.0.7, BWR (Boiling Water Reactor) code is used for this analysis. Additionally, this calculation was developed consistent with the guidelines contained in the 2013 EPRI Technical Report 3002001785, with regards to the use of MAAP4 in support of post-Fukushima applications.

The primary outputs of interest are containment and drywell pressure, containment, drywell, and suppression pool temperature, and the maintenance of the reactor pressure vessel (RPV) water level over top of active fuel (TAF).

Attachment 3 of the calculation contains a RBS response to the letter of October 3, 2013 from Jack Davis (NRR) to Joe Pollock (NEI) (Accession Number ML13275A318) regarding use of MAAP4 in simulating ELAP events for BWRs, addressing each one of the limitations stated on the NRC endorsement letter.

This calculation analyzes containment conditions following a BDBEE, including drywell pressure and temperature, suppression pool temperature, containment pressure and temperature, and reactor water level. The analysis time of 180 hours is used to verify that the FLEX strategies are effective and to demonstrate a downward trend in containment and suppression pool temperatures following initiation of Phase 3 at 72 hours. Two scenarios are evaluated in this calculation: 1) SPC heat exchanger (SPC-E1) with no fouling; and 2) SPC heat exchanger (SPC-E1) with reduced heat transfer due to fouling. The peak containment pressure for both scenarios is 10 psig, which is less than the design basis pressure of 15 psig. This is in reasonable agreement with calculation G13.18.12.4-039. The peak drywell differential pressure is 5.7 psid positive pressure and 14.3 psid negative pressure, which is less than the design-basis positive differential pressure of 25 psid and 20 psid negative pressure. These pressures are in reasonable agreement with calculation G13.18.12.4-039. The peak containment temperature is 169°F which is less than the design basis containment temperature of 185°F. This is in reasonable agreement with, but lower than, the corresponding value in calculation G13.18.12.4-039. The peak drywell temperature is 268°F which is less than the design basis drywell temperature of 330°F. Discrepancies between this calculation and calculation G13.18.12.4-039 can be attributed to calculation G13.18.12.4-039 assuming 66 gpm leakage from the reactor coolant pump seals throughout the event, while this calculation assumes an initial reactor coolant pump seal leakage of 66 gpm that varies with RCS pressure. This leads to a reduced leakage into containment, thereby reducing temperature and pressure in containment.

The peak suppression pool temperature is 208°F which is greater than the design basis suppression pool temperature of 185°F. However, this is considered acceptable for a BDBEE since the 185°F limit was established for design basis events in which containment integrity is challenged by internal containment pressure. The maximum number of SRV actuations is 119. This value is significantly different than the results of calculation G13.18.12.4-039. This difference is noted for multiple reasons:

1) calculation G13.18.12.4-039 maintained RPV level between Level 2 and Level 8, while this calculation assumes operators will manually maintain reactor water level constant which increases the number of SRV actuations;

2) calculation G13.18.12.4-039 did not take into account low-low set following the first SRV actuation while this calculation does consider low-low set. Low-low set has a

tighter pressure boundary compared to the normal opening and closing pressure of the SRVs;

3) the most significant difference is that calculation G13.18.12.4-039 assumes a rapid depressurization from ~1000 psi to 100 psi by opening a single SRV until pressure reaches 100 psi. However, the NRC has stated that the 100°F/hr Technical Specification limit must be maintained throughout the event. Therefore, this calculation assumes a single SRV is cycled to reduce pressure from low-low set to 100 psi and maintains pressure in the 100 – 200 psi band. This cycling of the SRVs adds a significant number of SRV actuations; and,

4) MAAP does not have as sophisticated modeling of SRV actuations as does GOTHIC. The GOTHIC model used in calculation G13.18.12.4-039 was benchmarked against CONSBA and was in agreement for SRV actuations for LOCA. Further, the GOTHIC SRV model was based on steam discharge flowrates provided by GE.

This analysis also demonstrates that the RPV water level is always maintained above the top of active fuel. Based on the results of this calculation, all of the containment design limits are maintained throughout the event with the exception of the suppression pool temperature, which, as stated above, is considered acceptable.

Confirmatory Item 3.2.1.1.B:

Confirm that the collapsed RPV level remains above top of active fuel and the reactor coolant system cool down rate is within technical specifications limits.

RBS response:

Calculation G13.18.14.1-048 documents the RBS MAAP 4.0.7 analysis for FLEX. Attachment 3 of the calculation confirms that the collapsed level remains well above TAF for the duration of the analysis. The results show that the collapsed RPV level remains 8 feet above TAF.

Confirmatory Item 3.2.1.1.C:

Confirm that MAAP is used in accordance with Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013 position paper (ADAMS Accession No. ML 13190A201).

RBS response:

Calculation G13.18.14.1-048 documents the RBS MAAP 4.0.7 analysis for FLEX. Attachment 3 of the calculation contains an RBS response to the letter of October 3, 2013 from Jack Davis (NRR) to Joe Pollock (NEI) (Accession Number ML13275A318) regarding use of MAAP4 in simulating ELAP events for BWRs, addressing each one of the limitations stated on the NRC endorsement letter.

The MAAP analysis performed for RBS was carried out in accordance with the quality assurance process delineated in Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013 position paper, EPRI Technical Report 3002001785, "Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications".

Confirmatory Item 3.2.1.1.D:

Confirm that, in using MAAP, the subset of key modeling parameters cited from Tables 4-1 through 4-6 of the "MAAP Application Guidance, Desktop Reference for Using MAAP Software, Revision 2" (Electric Power Research Institute Report 1020236, available at www.epri.com). 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 RBS.

RBS response:

Calculation G13.18.14.1-048 documents the RBS MAAP 4.0.7 analysis for FLEX. Attachment 3 of calculation G13.18.14.1-048 identifies and justifies the subset of key modeling parameters cited from Tables 4-1 through Table 4-6 of the "MAAP4 Application Guidance, Desktop Reference for Using MAAP Software, Revision 2" (Electric Power Research Institute Report 1020236), as well as other parameters considered important in the simulation of the ELAP event.

Confirmatory Item 3.2.1.2.A:

Confirm that the details of the seal qualification tests, the seal leakage rate models, and supporting test data and any conservative margin support the 66 gallons per minute recirculation pump seal leakage assumed in the ELAP analysis.

RBS response:

Calculation G13.18.14.1-048, Rev. 0, MAAP 4.0.7 Analysis of Containment Conditions for Extended Loss of AC Power (FLEX), determines a wide range of physical quantities and properties at various time points. Two cases were run in this analysis: one case with un-fouled SPC heat exchangers performance, and a second case with fouled SPC heat exchanger performance. Both cases modeled 66 gpm of leakage from the RCS. This value is the same as that for the BWR/6 Mark III analysis presented in NEDC-33771P. Rev. 1, GEH Evaluation of FLEX Implementation Guidelines. The primary system leakage is assumed to start at the time zero and vary with reactor pressure. The primary system leakage is initially 66 gpm but increases to a maximum of about 100 gpm during the first hour as amount of RPV subcooling increases due to RCIC injection. The leakage then decreases when the RPV is depressurized at one hour and is maintained between about 20 to 40 gpm.

The parameters of primary interest for the scenario in this calculation are the drywell and containment temperatures and pressures. The results of the calculation show that the drywell temperature increases rapidly for about the first 3 hours and continues to increase at a lower rate reaching a maximum of about 268°F at 55 hours. After this time the drywell temperature decreases rapidly since the temperature of the RPV/primary system leakage flow decreases when SPC is aligned to inject into the RPV. The drywell temperature continues to decrease until it stabilizes at about 75 hours to a value below 200°F.

Since the results of the MAAP analysis show that the maximum drywell temperature does not exceed the design value of 330°F, then the drywell penetration and seals are not compromised and the containment functions are maintained in all phases of an ELAP.

Confirmatory Item 3.2.1.4.A:

Confirm that the seismic evaluation of SPC system components, the spent fuel pool cooling piping, and the battery bus crosstie electrical cabinet used to support FLEX coping strategies are completed with acceptable results.

RBS response:

The non-safety related installed equipment used in the RBS FLEX strategies are installed in Seismic Category I structures. In addition to the seismic hazard, these structures provide protection from external flood, ice, high wind and extreme high temperature hazards.

An evaluation of the SPC system components and piping has been completed which concluded that the SPC components credited for use in FLEX are justified as having a high confidence of component functionality following a seismic event and can be credited for use during a post-earthquake FLEX event.

An evaluation of the seismic qualification of electrical panel BYS-SWG01D and battery charger BYS-CHGR1D was performed. This evaluation confirmed that both the panel and charger, including modifications that altered and/or replace components and sub-components, are qualified to the RBS design requirements for seismic equipment.

The non-safety SFC piping which is part of the RCIC suction path from the upper containment pools have been evaluated for the seismic hazard as part of EC 44960. The evaluation demonstrates the piping is seismically robust. Based on this review, the associated supports have adequate margin to qualify as seismic II/I and will sustain a seismic event.

Confirmatory Item 3.2.1.4.B:

Confirm that the allowable minimum system pressure required to open the SRVs in relation to the RPV pressure during the depressurization and the RPV fill evolution is adequately determined.

RBS response:

The SRVs are opened by air cylinder actuators. No credit is taken for RPV pressure assist in determining the minimum air pressure required to fully open the SRVs and the volume of air required for valve operation during a FLEX scenario. The minimum system pressure required to open the SRV during a FLEX event was conservatively assumed to be 110 psig at the actuator inlet. This pressure was determined based on the combination of the pressure required at the actuator to fully open the valve with no back pressure (88 psig) and the pressure in the drywell during the FLEX event (14.8 psig) plus additional margin. Both of these values are discussed below. The minimum required air pressure and the number of SRV actuations were used to determine the number of air cylinders required for Phase 2 of the FLEX strategy.

The use of 88 psig is based on the testing performed by Wyle Labs. This testing showed that the minimum actuator supply pressure required to fully open the SRVs with zero under-seat pressure is 80 psig (average) for the 8 SRVs tested. Each SRV was tested at least twice, first with the top solenoid-operated air valve and again with the lower solenoid-operated air valve. A total of 23 tests were conducted on these 8 SRVs. The tests were performed for both the pressure-rising and pressure-lowering conditions; however, it is the pressure-rising condition that more accurately represents the SRV actuation condition.

Wyle Labs also recorded the subject pressure at 2 discrete points of the opening and closing motion: (1) with the valve seat lifted to 1.060 inches open, and, (2) with the valve seat lifted to 1.145 inches open. The value 1.145 inches is the minimum lift criteria used for the emergency operability test and is the lift required to conservatively ensure that the valve achieves rated discharge capacity. The value 1.060 inches is the actual minimum lift required to ensure rated discharge capacity based on an engineering evaluation documented in ER-RB-2001-0433-000.

Therefore, the use of the 88 psig is justified. It is also conservative because the testing demonstrated that actuator supply pressure as low as about 74 psig is sufficient to ensure adequate valve opening (1.060 inches) that is necessary to achieve rated capacity.

The value of 14.8 psig represents the maximum drywell pressure following a BDBEE resulting in an extended ELAP. This value was part of the results calculated by the MAAP analysis of containment conditions during an ELAP event.

Calculation G13.18.2.6-192 (EC44959) determined the number of air cylinders required to support FLEX Phase 2 strategy for operation of SRVs and SP level instrumentation. This calculation assumed a value of 110 psig as the minimum air system pressure required at the actuator inlet to the SRV during a FLEX event. This assumed value added a conservatism to the combination of the values described above (88 psig+14.8 psig = 102 psig).

Confirmatory Item 3.2.1.4.C:

Confirm that the stresses associated with passing liquid phase water through the SRV tail pipe, including those on the tail pipe, the tail pipe supports, the quencher and the quencher supports are evaluated with acceptable results.

RBS response:

The Reactor Vessel Injection section on page 21 of 60 of the RBS OIP provides a description of maintaining reactor water level following the depletion of UCP water. The described method is pumping suppression pool water with a SPC pump to the vessel and then out of the vessel to the suppression pool via open SRV relief valves. This flow path is essentially the same as the design basis alternate shutdown cooling mode that is described in RBS USAR sections 5.4.7.1.5 and 5.2.2.4.1. As indicated in Section 5.2.2.4.1, the effect of the alternate shutdown cooling mode on SRV discharge piping has been considered. The resultant load distribution is within the design capacity of the spring hangers and other support structures. The completed analysis shows that the stresses for all normal, upset, emergency and faulted conditions are within acceptable limits of the ASME Boiler and Pressure Vessel Code.

Confirmatory Item 3.2.1.7.A:

Confirm the ability to supply cooling water to the upper containment pool when it is being used for fuel storage during refueling. This capability should be consistent with the NEI paper entitled "Shutdown/Refueling Modes" (ADAMS Accession No. ML 13273A514), which has been endorsed by the NRC in a letter dated September 30, 2013 (ADAMS Accession No. ML 13267 A382), and which the licensee has indicated will be followed.

RBS response:

RBS has the ability to supply cooling water to the upper containment pool when it is being used for fuel storage during refueling. This can be accomplished with the same method for RPV makeup/cooling (SPC pump and FLEX portable diesel generator) that is used during Phase 2 and 3 in the response to a FLEX event during power operation.

Confirmatory Item 3.2.1.8.A:

Confirm the acceptability of the alternate approach for use of the installed SPC pumps for RPV makeup. Specifically, confirm the ability of the backup portable pump's capacity to provide both RPV injection and makeup water to the SFP concurrently.

RBS response:

In the initial response to this audit question, Entergy identified the RBS FLEX core cooling strategy as a deviation from the guidance of NEI 12-06. Upon on further review, Entergy now considers the strategy an alternate method, as allowed by the guidance of NEI 12-06, for compliance with Order EA-12-049. Further, the strategy does not require or include a portable pump for core cooling. The ISE (ML13365A281) identified a confirmatory item (3.2.1.8.A) that is also related to the use of the SPC pumps for the core cooling. While Confirmatory Item 3.2.1.8.A also implied that RBS would include a portable pump for both core cooling and spent fuel pool makeup, which is not the case. The core cooling function will be provided by the SPC pumps and a separate portable pump will provide makeup to the spent fuel pool.

Confirmatory Item 3.2.3.A:

Confirm that the licensee completes an acceptable MAAP analysis to demonstrate that containment functions are maintained in all phases of an ELAP, with particular regard to the qualification of drywell penetrations and seals at elevated temperatures.

RBS response:

Calculation G13.18.14.1-048, Rev. 0, MAAP 4.0.7 Analysis of Containment Conditions for Extended Loss of AC Power (FLEX), determines a wide range of physical quantities and properties at various time points. Two cases were run in this analysis: one case with un-fouled SPC heat exchangers performance and a second case with fouled SPC heat exchanger performance. Both cases modeled 66 gpm of leakage from the RCS. This value is the same as that for the BWR/6 Mark III analysis presented in NEDC-33771P. Rev. 1, GEH Evaluation of FLEX Implementation Guidelines. The primary system leakage is assumed to start at the time zero and vary with reactor pressure. The primary system leakage is initially 66 gpm but increases to a maximum of about 100 gpm during the first hour as amount of RPV subcooling increases due to RCIC injection. The leakage then decreases when the RPV is depressurized at one hour and is maintained between about 20 to 40 gpm.

The parameters of primary interest for the scenario in this calculation are the drywell and containment temperatures and pressures. The results of the calculation show that the drywell temperature increases rapidly for about the first 3 hours and continues to increase at a lower rate reaching a maximum of about 268°F at 55 hours. After this time the drywell temperature decreases rapidly since the temperature of the RPV/primary system leakage flow decreases when SPC is aligned to inject into the RPV. The drywell temperature continues to decrease until it stabilizes at about 75 hours to a value below 200°F.

Since the results of the MAAP analysis show that the maximum drywell temperature does not exceed the design value of 330°F, then the drywell penetration and seals are not compromised and the containment functions are maintained in all phases of an ELAP.

Confirmatory Item 3.2.3.B:

Confirm that the 209°F suppression pool temperature reached in the ELAP event (which is over the 185°F design limit) does not adversely impact the structural integrity of the containment.
RBS response:

RBS has performed a MAAP analysis (G13.18.14.1-048) in addition to the GOTHIC analysis (G13.18.12.4-039) discussed in the original response to this question. The MAAP analysis results are in reasonable agreement with those of G13.18.12.4-039; however, peak temperatures and pressures for both the containment and drywell for the MAAP analysis were lower than the corresponding valves from the GOTHIC analysis. The differences between the two analyses can be attributed to calculation G13.18.12.4-039 assuming 66 gpm leakage from the reactor coolant pump seals throughout the event, while the MAAP analysis assumes an initial reactor coolant pump seal leakage of 66 gpm that varies with RCS pressure. This leads to a reduced leakage into containment, thereby reducing temperature and pressure in containment.

The maximum suppression pool temperature for the MAAP analysis is slightly lower than the GOTHIC analysis (208°F versus 209°F). While the peak temperature is above the design limit of 185°F, it is only above that limit for approximately 8 hours. The containment pressure remains at least 5 psi below the design pressure of 15 psi for the time that suppression pool temperature is above the design limit of 185°F as well as throughout the whole scenario. Based on an existing containment fragility evaluation which demonstrates containment pressure limits much greater than 15 psig at 300°F, slightly exceeding the suppression pool temperature design limits will not have an effect on containment integrity.

Confirmatory Item 3.2.4.4.A:

Confirm that any planned changes described in the NRC's communications assessment (ADAMS Accession No. ML 13130A068) are completed.

RBS response:

As documented in audit report dated Feb. 18, 2015, NRC staff discussed the licensee's implementation status of the RBS communication assessment reviewed in NRC safety evaluation (SE) dated May 24, 2013 (ADAMS Accession No. ML 13130A068). The associated FLEX Support Guideline (FSG)-FSG-101, was in draft form and the communications equipment was in the process of being purchased and staged. These activities are being tracked to completion in the RBS corrective action program.

As of the date of this letter, the installation and testing of the communications equipment is complete, and FSG-101 has been issued for use.

Confirmatory Item 3.2.4.8.A:

Confirm that supporting analyses related to the final size/loading of FLEX generators is completed with acceptable results.

RBS response:

Calculation G13.18.3.6-023 (EC44959), Flex Strategy – Portable Diesel Generator System Sizing, has been approved. The discussion in the previous response remains valid.

Confirmatory Item 3.2.4.10.A:

Confirm that the final minimum DC bus voltage is determined as part of the evaluation of an acceptable battery and DC loading profile for the ELAP event.

RBS response:

Calculations E-143, Standby Battery "ENB-BAT01A" Duty Cycle, Current Profile and Size Verification, and E-144, ENB-BAT01B Duty Cycle, Current Profile and Size Verification, have been completed. The minimum voltage required at ENB-MCC1 is 105 VDC. These calculations confirm that the lowest voltage at ENB-MCC1 exceeds the minimum voltage of 105 VDC.

Additionally, the FLEX audit report addressed this item as follows:

"NRC staff discussed the key assumptions and conclusions of the direct current (dc) bus voltage calculations to confirm that the final minimum dc bus voltage was determined as part of the evaluation of an acceptable battery and dc loading profile for the ELAP event. However, during discussions with NRC staff, the licensee stated that the review identified a discrepancy in modeling an electrical load in the dc voltage drop calculation. Therefore, the dc voltage drop calculation is under further review by the RBS engineering staff. The licensee issued RBS Licensing Action Request (LAR) LR-LAR-2013-0131, CA 45 in the RBS Corrective Action Program (CAP) under which this discrepancy will be resolved. Associated confirmatory item CI 3.2.4.10.A has been closed to RBS action item LR-LAR-2013-0131, CA 45." This item was subsequently completed on March 13, 2015.

Confirmatory Item 3.4.A:

Confirm that the licensee has fully addressed the provisions of NEI 12-06, Sections 5.3.4, 6.2.3.4, 7 .3.4, 8.3.4, and 12.2, regarding considerations in using offsite resources.

RBS response:

In reference to the considerations in using offsite resources stated in Sections 5.3.4, 6.2.3.4, 7.3.4 and 8.3.4, RBS will utilize the industry Regional Response Center located in Memphis, TN. for Phase 3 equipment. Equipment will initially be moved from the RRC to a local staging area, established by the SAFER team and the utility. The equipment will be prepared at the staging area prior to transportation to the site. The equipment transported to the site will be either immediately staged at the point of use location for pumps and generators or temporarily stored at the lay down area shown on Figure 3 of the Integrated Plan until moved to the point of use area and that the deployment paths identified on Figure 3 will be used to move equipment. Delivery of RRC FLEX equipment may require alternative transportation such as the use of helicopters and that equipment can be airlifted to the Baton Rouge or the False River airports, and on-site deployment routes have been identified.

In reference to the provisions stated in NEI-12-06, Section 12.2, Entergy is actively involved in industry initiatives to establish the Regional Response Centers (RRC) which are described in the OIP and required for implementation of Phase 3 per the RBS FLEX strategy. The industry has contracted with the Strategic Alliance for FLEX Emergency Response (SAFER) organization through Pooled Equipment Inventory Company (PEICo) to establish and operate the Regional Response Centers as part of the PEICo's existing Pooled Inventory Management (PIM) Program. The SAFER proposal, as well as its subsequent acceptance by the industry and implementation, is based on the Phase 3 requirements of NEI 12-06.

The SAFER site-specific response plan will contain information on the specifics of generic and site specific equipment obtained from the RRC. It will also contain the logistics for transportation of the equipment, staging area set up, and other needs for ensuring the equipment and commodities sustain the site's coping strategies. Offsite equipment will be procured through the SAFER organization. SAFER plans to align with the EPRI templates for maintenance, testing and calibration of the equipment.

Attachment 5

RBG-47618

Final Implementation Plan

FINAL INTEGRATED PLAN DOCUMENT

RIVER BEND STATION

September 2015

Table of 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 and 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 US Nuclear Regulatory Commission (NRC) assembled a Near-Term Task Force (NTTF) to advise the Commission on actions the US 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 3.1) 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 3.2) on March 12, 2012 to implement mitigation strategies for BDBEEs. The order provided the following requirements for strategies to mitigate BDBEEs:

1) 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.

2) These strategies must be capable of mitigating a simultaneous loss of all AC power and loss of normal access to the normal heat sink 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.

3) 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.

4) Licensees must be capable of implementing the strategies in all modes.

5) 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 - The initial phase requires the use of installed equipment and resources to maintain or restore core cooling, containment and spent fuel pool (SFP) cooling capabilities.
- Phase 2 - The transition phase requires providing sufficient, portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from off site.
- Phase 3 - The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely.

NRC Order EA-12-049 (Reference 3.2) required licensees of operating reactors to submit an overall integrated plan (OIP), including a description of how compliance with these requirements would be achieved by February 28, 2013. The Order also required licensees to complete implementation of the requirements no later than two refueling cycles after submittal of the OIP or December 31, 2016, whichever comes first.

The Nuclear Energy Institute (NEI) developed NEI 12-06 (Reference 3.3), 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 3.4), dated August 29, 2012, which endorsed NEI 12-06 with clarifications on determining baseline coping capability and equipment quality.

NRC Order EA-12-051 (Reference 3.5) required licensees to install reliable SFP instrumentation with specific design features for monitoring SFP water level. This order was prompted by NTTF Recommendation 7.1 (Reference 3.1).

NEI developed NEI 12-02 (Reference 3.6) which provides guidance for complying with Order EA-12-051. The NRC issued Interim Staff Guidance JLD-ISG-2012-03 (Reference 3.7), dated August 29, 2012. The NRC determined that, with the exceptions and clarifications provided in JLD-ISG-2012-03 conformance with the guidance in NEI 12-02 is an acceptable method for satisfying the requirements in Order EA-12-051.

2. NRC Order EA-12-049 – Mitigation Strategies (FLEX)

2.1 General Elements

2.1.1 Assumptions

The assumptions used for the evaluations of a River Bend Station (RBS) ELAP / loss of ultimate heat sink (LUHS) event and the development of FLEX strategies are stated below.

Key assumptions associated with implementation of FLEX Strategies for RBS are described below:

- Flood and seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 have been completed and therefore assumed in this submittal.
- The following conditions exist for the baseline case:
  - Seismically designed DC battery banks are available.
  - Seismically designed AC and DC distribution systems are available.
  - Plant initial response is the same as station black-out (SBO) event.
  - Best estimate analysis and decay heat is used to establish operator time and action.
  - No single failure of SSC assumed, except those in the base assumptions, i.e. emergency diesel generator (EDG) operation. Therefore, reactor core isolation cooling (RCIC) will perform as intended per the guidance in NEI 12-06.
- Installed non-safety related SSCs used in the Phase 1 coping strategy will be verified by analysis or test to meet or exceed the current plant design basis for the applicable external hazards. The designed hardened connections are protected against external events or are established at multiple and diverse locations.
- FLEX components will be designed to be capable of performing in response to “screened in” hazards in accordance with NEI 12-06. Portable FLEX components will be procured commercially.

- Margin will be added to design FLEX components and hard connection points to address future requirements as re-evaluation warrants. This margin will be determined during the detailed design or evaluation process. Phase 2 FLEX components stored at the site will be protected against the "screened in" hazards in accordance with NEI 12-06. At least "N" sets of equipment will be available after the event they were designed to mitigate.

- Deployment strategies and deployment routes are assessed for hazards impact.

- The emergency response organization (ERO) is expected to begin reporting 6 hours after the event.

- Maximum environmental room temperatures for habitability or equipment availability is based on NUMARC 87-00 (Reference 3.8) guidance if other design basis information or industry guidance is not available. Extreme high temperatures are not expected to impact the utilization of off-site resources or the ability of personnel to implement the required FLEX strategies.

- This plan defines strategies capable of mitigating a simultaneous loss of AC power and loss of normal access to the ultimate heat sink resulting from a BDBEE by providing adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities. Though specific strategies are being 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 responsive (symptom based) strategies will be incorporated into the unit emergency operating procedures/guides in accordance with established emergency procedure/guide change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59. 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. 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 3.9).

2.2 Strategies

The objective of the FLEX strategies is to establish an indefinite coping capability in order to 1) prevent damage to the fuel in the reactors, 2) maintain the containment function and 3) maintain cooling and prevent damage to fuel in the SFP using installed equipment, on-site portable equipment, and pre-staged off-site resources. This indefinite coping capability will address an ELAP – loss of off-site power, emergency diesel generators and any alternate AC source (as defined in 10 CFR 50.2) but not the loss of AC power to buses fed by station batteries through inverters – with a simultaneous 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 pre-determined strategies (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 developed to maintain the key plant safety functions 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 or commissioned.

The duration of each phase is specific to the installed and portable equipment utilized for the particular FLEX strategy employed to mitigate the plant condition.

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. 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 the public health and safety are incorporated into the River Bend EOPs in accordance with established procedure change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59.

2.3 Reactor Core Cooling and Heat Removal Strategy

Immediately after a shutdown caused by the BDEEE, the reactor remains isolated and pressurized with RCIC providing core cooling and initially taking suction from the suppression pool (SP). The safety relief valves (SRVs) control reactor pressure. One hour after the event, operators initiate a controlled reactor cooldown and manual depressurization of the reactor pressure vessel (RPV) to achieve a pressure band of 200 to 400 psig.

The operator is directed to perform deep DC load shed to minimize the load on the station batteries. Load shedding is completed within 1.5 hours ensuring the station batteries are available for a minimum of 8 hours at which time the FLEX portable generator is available to repower a station battery charger.

Between 4 and 5 hours after the event, RCIC suction is transferred from the SP to the upper containment Pool (UCP) to provide a cooler source of water for extended operation of RCIC. After approximately 8 hours, the suppression pool cleanup and cooling (SPC) pumps are placed into service (powered directly from a FLEX diesel generator) in order to establish SP cooling for containment heat removal. One of two FLEX pumps (either a motor driven powered from a FLEX diesel generator or a diesel engine driven pump) provide cooling water to the SPC heat exchanger with suction from the standby service water (SSW) system. Upon depletion of the water supply in the UCP, the discharge of the SPC heat exchanger is realigned from the SP to inject directly into the RPV for core cooling.

The FLEX pumps, with suction from SSW, can continue to provide core cooling past 72 hours. With the arrival of additional FLEX equipment from the National SAFER Response Center (NSRC) the reactor core cooling strategy is to continue operation of the SPC equipment by repowering the standby cooling tower (SCT) fans using an NSRC portable diesel generator (PDG). Makeup water to the SCT basin will be provided by a contractor initially using tanker trucks and followed by pumping water from the Mississippi River through hose to the basin.

2.3.1 <u>Phase 1 Strategy</u>

At the initiation of the BDBEE, the reactor scrams, main steam isolation valves (MSIVs) automatically close, feedwater is lost, and SRVs automatically cycle to control pressure, causing reactor water level to drop. When reactor water level reaches -43 inches, RCIC automatically starts. Since the condensate storage tank (CST) is assumed to be unavailable, RCIC suction will immediately swap to the SP due to low CST level, as sensed by E51-LT-N035A (E), located on safety related piping. The instrument loop and the suction valves are DC-powered, and the valves will change position as designed to align to the SP. Injection recovers the RPV water level to the normal band. The SRVs, cycling in low-low set mode, control RPV pressure between 956 and 1063 psig (Reference 3.11, SR 3.3.6.4.3). SP temperature and level begin to increase due to the heat addition from the SRV discharge and the RCIC turbine exhaust. Water will begin to spill into the drywell when SP level reaches the top of the weir wall in approximately 3 hours.

After the determination that the EDGs cannot be restarted, at approximately t=1 hour during performance of the SBO procedure, the operating crew concludes that the event is a BDBEE and the plant will have a loss of power for an extended period of time. RCIC is maintained feeding the reactor vessel with suction from the SP. Operators will have overridden RCIC high area temperature isolation interlocks as part of the operator immediate actions of the SBO procedure. They will also override the other RCIC trip signals and isolation signals that could possibly prevent operation when needed during the ELAP. Instructions are provided in plant procedure EOP-0005 (Reference 3.12).

Once it is determined that a BDBEE has occurred, the operators will depressurize the RPV in a controlled manner using SRVs in accordance with existing procedures and cooldown limits until RPV pressure is between 200 and 400 psig. This pressure range will also allow continued operation of RCIC (the only vessel injection source available) above its stall pressure of ~60 psig.

At approximately t=4 hours, as determined by the containment analysis (Reference 3.15), SP temperature reaches ~175 – 180°F. As the SP temperature approaches this point, several challenges arise. Calculations for RCIC indicate that RCIC net positive suction head (NPSH) may begin to be challenged (Reference 3.16). NPSH will be adequate at normal SP level until SP temperature exceeds 200°F, at which time cavitation may occur. Further, the elevated temperature may impact the RCIC equipment.

As SP temperature increases, the current Heat Capacity Temperature Limit (HCTL) curve is eventually reached. This would require emergency depressurization, thus rendering RCIC non-functional. The BWR Owners Group (BWROG) issued Revision 3 of the BWROG Emergency Procedure and Severe Accident Guidelines. The revised BWROG guidance allows operators to remain at mid-range pressures, such as directed in the RBS FLEX strategy, without performing emergency depressurization (Reference 3.18). Based on the BWROG new guidance, emergency depressurization is appropriate only if adequate core cooling will not be sacrificed as a result. Core cooling is thus prioritized over other Emergency Procedures Guidelines (EPG) objectives. This new guidance has been incorporated into the latest revision of EOP-0001 (Reference 3.12). As pool temperature increases, the containment / SP design temperature of 185 °F will be exceeded at t~5 hours, with RCIC taking suction from the suppression pool. While industry initiatives have relaxed this limit for FLEX scenarios for Mark III plants, it is desirable to limit the temperature increase as much as possible (Reference 3.18). A key assumption in the RBS FLEX strategy presented herein is that exceeding 185 °F is allowed.

Based on the discussion above, it is necessary to provide a cooler suction source for RCIC as well as to inject into the vessel cooler water than that being provided by the suppression pool at elevated temperature. The CST is assumed unavailable due to not meeting FLEX requirements for seismic and wind/missile protection. The only other reasonably available path using installed equipment is from the Upper Containment Pool (UCP). A modification has been implemented to install a permanent cross-tie line from the Fuel Pool Cooling and Cleanup (SFC) system lines from the UCP to the RCIC/HPCS suction line from the CST. This cross-tie line from the UCP is made via the existing 8" dia. SFC piping line SFC-008-076-3 to the existing 6" dia. RCIC pump suction line ICS-006-015-2 in the "D" Tunnel. The cross-connect is a 6" line with a 6" isolation valve. This is adequate to accommodate the 6" RCIC suction line. Connection into the SFC line is made by installing a tee in this line, with flanged connection for the valve and appropriate pipe routing down to the supply line. An existing check valve (E22-VF002) isolates the supply line back to the CST since that path is assumed to be open to atmosphere due to the BDBEE. Further, valve E51-MOVF031 must be closed and valve E51-MOVF010 opened to establish this path.

In addition to the modification described above, siphon breakers in the UCP must be left closed during normal operation. Defeating the siphon breakers would slightly increase the chance of inadvertently draining the UCP (note that no fuel may be stored in the UCP during normal operation). However, there are additional valves that are normally closed in the drain path. Manual valve SFC-V126 will also be closed. Revised siphon breaker operating instructions and new precautions have been added to appropriate procedures.

Prior to the SP reaching 185°F (t~5 hours), the operators will line up the UCP suction path to RCIC. This will provide water at ~90-100°F to RCIC suction for injection into the vessel.

It is important that injection of cool water from the UCP to the RPV via RCIC be able to continue as SP level increases to slow the rapid heat up of the SP. This requires relaxation of the Safety Relief Valve (SRV) Tail Pipe Level Limit (SRVTPLL) and the Pressure Suppression Pressure (PSP) level limit. The revised BWROG guidelines include overrides for various steps which provide directions to terminate RPV depressurization if it is anticipated that the depressurization will result in loss of injection required for core cooling. The EOPs have been revised based on the Revision 3 EPGs (References 3.18 and 3.19). Therefore, RCIC will continue to inject relatively cool water into the vessel from the UCP until the volume is depleted and Phase 2 measures can begin.

The only air operated valves which are required to be cycled using air during the FLEX event are the SRVs. The main steam and safety relief system (SVV) compressors provide the normal air supply to the SRVs and are backed-up by the penetration valve leakage control system (LSV) air compressors or instrument air. All of these systems will be lost due to the FLEX event. The SRVs have back-up air accumulators adequate for a four hour SBO. Automatic depressurization system (ADS) SRV air accumulators are sized to provide 4 to 5 actuations per valve at atmospheric pressure in the drywell. A total of 28-35 ADS SRV actuations are available. The non-ADS SRV accumulators can provide a minimum of 37 valve cycles. This is enough for a 4-hour SBO, which is predicted to require 22 SRV operations. However, this capacity may not be enough for all of FLEX Phase 1 which is desired to last for ~8 hours to allow time for personnel resource arrival and Phase 2 equipment staging. It is therefore necessary to provide another means for continuing to use SRVs well into Phase 1.

The FLEX backup air supply to the SRVs is air bottles which can be connected in the auxiliary building, 141ft elevation. All equipment for backup air bottles is staged at that location, and secured for seismic protection during normal operations. A location near the connection point for one of the divisions, SVV-V48 or V51, is utilized. In addition, the SP level indication that will be used (CMS-LT23A) has a bubbler type instrument which requires air. The same connection used to provide backup air to the SRVs also supplies this level instrument. RBS-FSG-003 provides instructions to open SVV-MOV1A or B to establish a continuous air supply to the bubbler (See Section 2.3.4.2 and Reference 3.61).

The Phase 1 coping strategy relies upon the station safety related 125VDC batteries (ENB-BAT01A – Division I and ENB-BAT01B – Division II) to provide power to critical instrumentation, SRVs, the RCIC system, and other DC loads. Entergy established that the goal for the duration of Phase 1 is at least 8 hours. In order to extend battery availability to meet the required 8-hour time duration, non-essential DC loads beyond those shed by the SBO Abnormal Operating Procedure (AOP), are shed beginning at 1 hour into the event. In addition to load shedding, the Division II battery (ENB-BAT01B) is eventually cross-tied to the Division I bus (ENB-SWG01A) to continue powering Division I DC loads. (Figure 3) The cross-tie occurs when the Division I battery is depleted to a capacity where it can no longer sustain the required loads. (See Section 2.3.10)

2.3.2 Phase 2 Strategy

Primary Strategy Core Cooling

Reactor core cooling will be maintained using RCIC from the UCP with the operators adjusting the RCIC flow controller until RCIC flow is reduced to the minimum allowed by procedures (~300 gpm). At this point (t=8 hrs), it is crucial to begin cooling the suppression pool to remove decay heat being deposited into the containment and prevent SP boiling. This will allow progress toward ultimately stabilizing SP temperature and containment pressure as vessel cool down continues. To do this, the SPC system is placed into service. One of the SPC pumps (SPC-P1A/B) will be aligned take suction from the low pressure coolant injection (LPCI) "C" suppression pool suction line and discharge through the SPC heat exchanger (SPC-E1) to the SP through the LPCI "C" test return line.

The SPC pumps will be powered directly from a FLEX portable diesel generator (PDG) (Figure 5) positioned at grade outside the auxiliary building on the west side ("west canyon"). Should this preferred connection be inaccessible, an alternate connection will be established by routing cables through doors on the east side of the auxiliary building. The SPC pump motors require 227 amps at 100% load and 1195.2 amps locked rotor (LR) (Reference 3.17). These conditions were assumed in determining the FLEX DG size of 500 kW.

One of two 2500-gpm FLEX pumps (one electric motor-driven, and one diesel motor-driven) provide primary and alternate connection points for cooling water to the SPC heat exchanger. The electric motor driven pump, FLEX Pump 1 (FLX-P1), is powered by a single 480VAC, 500 kW FLEX DG (Figure 6).

FLX-P1 is permanently staged (but not connected) in the tunnel from the SSW basin to the auxiliary building ("G" Tunnel, 70ft elevation near the west end tunnel termination hatchway). The pump is connected to the SSW system through use of a combination of piping and hoses: a new suction tie-in and isolation valve SWP-V3110 on line SWP-030-219-3 for pump suction, and a new line on existing valve SWP-V3099 which connects to the SSW "B" supply line (SWP-030-026-3) for the discharge flow. Two parallel 6 inch hoses are used to connect between the pump and different pipe sections. See Figure 1 for additional detail.

Staging and connecting the FLX-P1 pump in the "G" Tunnel to supply SSW water requires consideration of potential flooding of the tunnel. Also, access is needed to the adjoining "E" Tunnel for valve manipulations. While these tunnels themselves are not subject to site flooding and are protected from extreme precipitation, winds, seismic events, etc., there are several lines in the tunnels which are non-safety related, class 4 piping. The largest of these lines is 12", with most being smaller. These lines are part of several systems which may at any time contain water and/or connection to water supplies.

In the unlikely event that a pipe break occurs in any of these lines, it potentially could render the tunnels temporarily inaccessible until the flooding has been controlled. Since these lines are in close proximity to safety-related piping in the tunnel, they are typically designed as seismic category II/I so that any failure cannot damage the category I equipment. The results from an evaluation of tunnel flooding identified 15 lines that have at least some sections that are not seismically robust. The water source of all of these lines is either the CST or demineralized water tank. Investigation showed that the closure of four valves in the yard following a seismic FLEX event will effectively isolate these water supplies. These valves are CNS-V13, CNS-V1, MWS-V71, and MWS-V76. AOP-0065, Extended Loss of AC Power (ELAP), (Reference 3.14) provides direction to the operators to determine if tunnel flooding is occurring and to isolate the above valves if it is.

With the arrangement above, reactor decay heat will be rejected to the SCT. Since the fans are not powered due to ELAP, heat removal by the tower will be significantly reduced and will only be provided by evaporation. However, the large volume and mass of water in the SCT provides sufficient water at acceptable temperatures through 72 hours after the event.

When the UCP is depleted, at approximately 34 hours (Reference 3.15), a new injection source will be required to continue core cooling. To accomplish this, the vessel will be completely depressurized by opening one SRV per EOP-1 and the SPC system will be realigned to a configuration which provides both containment and core cooling. Two additional SRVs will be opened before RPV water level reaches 90 inches, so that 3 SRVs remain open to ensure the RPV remains depressurized. The SP temperature rapidly increases to about 176 °F when depressurization is completed, after which the temperature reduction in the SP will recommence due to cooling of the SP water by the SPC heat exchanger prior to vessel injection. In this configuration, the SPC pump, powered by a portable diesel generator, takes suction from the SP (via RHR "C" suction line), discharges through the SPC heat exchanger, and then injects to the reactor pressure vessel (via RHR "C" injection line) to provide core cooling. Heated water from the core is returned to the SP through open SRVs. The vessel injection lineup must be performed in advance of depressurizing so that level control may continue uninterrupted once RCIC is no longer available. The overall alignment is similar to the licensed RHR alternate shutdown cooling mode, except a SPC pump is used instead of a RHR pump. The containment heat removal function is also maintained because the flow from the SP is pumped through the SPC heat exchanger where heat is transferred to the UHS via a FLEX cooling loop. The heat removal capacity of this configuration is capable of handling core decay heat as well as removing stored energy from the containment. The FLEX cooling loop was initially established for containment heat removal and incorporates a FLEX pump (powered by a PDG) taking suction from the UHS basin and portions of the SSW train "B" piping to provide a path to the SPC heat exchanger and back to the UHS.

The diesel-driven FLEX Pump 2 (FLX-P2), can be deployed at grade, southeast of the SSW basin near the "west" (Div. II) SCT pipe chase wall if the FLX-P1 pump is not available. Alternate SSW connections are provided to allow connection of this pump from outside the pipe chase. A new pipe line (10") and valve (SWP-V3111) was added from line SWP-030-219-3 near the point where it is capped off at the west end of the "G" tunnel to the west pipe chase and up to grade level. At this point, a penetration through the west chase outside wall was made to allow connection to the FLX-P2 pump suction. Another 10" line was added from grade level, through a penetration in the west pipe chase wall, down the chase to the "G" tunnel. The FLX-P2 pump discharge can be connected to this line from outside the pipe chase. This line is then connected by 6" hoses to the new line which connects to valve SWP-V3099 and the SSW supply line. See Figure 1 for additional detail.

Alternate Strategy Core Cooling

The alternate core cooling strategy will be used should the SPC core cooling path be unavailable. As in the primary strategy, the alternate strategy will be placed into service following depletion of the UCP water source for RCIC and the subsequent depressurization of the RPV. This is expected to occur approximately 34 hours following the ELAP/LUHS. With a core cooling flow of 200 gpm, the water level in the RPV will slowly increase to the level of the main steam lines and will begin to flow to the suppression pool. Operators can also maintain RPV level within a level band by controlling the discharge manifold valve on the FLEX pump. An inline flowmeter is installed at the pump to facilitate injection and level control. The alternate strategy provides a core cooling method that is diverse and completely independent of the primary SPC strategy. The FLEX Pump 3 (FLX-P3 or FPW-P4) pumps water through fire hose to a low pressure core spray (LPCS) flushing line connection, through valves E21-VF025 and E21-MOVF005 and on to the RPV for core cooling. The flushing connection is located on a platform (133ft elevation) in the northwest crescent of the auxiliary building. Since the connection is located in the seismic category I building, it is protected from all hazards. Use of a portable Flex Pump 3 for reactor makeup and cooling meets the guidance of NEI 12-06, Section 3.2.2 (13).

The FLX-P3 pump's primary function is to provide makeup water from the SCT basin to the SFP. The pump design includes a discharge manifold with four outlets (each with a shutoff valve) which can accommodate individual hose connections to support both the SFP cooling and core cooling functions at the same time. The required flow for both functions is 35 gpm to the SFP (normal operation) or 60 gpm (refueling) and 200 gpm for core cooling for a total of ~235 to 260 gpm. These flow rates are well within the capability of the FLEX 3 pump. An inline flowmeter will be utilized on the core cooling hose to monitor the flow to the RPV. See Section 2.3.9.3 for additional information.

Primary Strategy to Power Battery Charger

Adequate battery power in Phases 1 and 2 is required for success of the strategies. The 125 VDC batteries are available through Phase 1 with load shedding and cross-tie (Section 2.3.10) for a period of 8 hours 55 minutes after the event. It is therefore essential that battery charging begin as soon as possible into the event. Within 8 hours, a portable 200kW, 480V FLEX diesel generator (DG) will be connected to charge battery ENB-BAT01A via 480V bus EJS-SWG1A through battery charger ENB-CHGR1A (Figure 2). The DG will be positioned in the "east canyon" and cables can be run to an area near exterior door

CB098-14 where a standard 480V receptacle is installed (Section 2.3.4.11).

Once the PDG is connected and energized, the cross-tie to ENB-SWG01B must be disconnected. (ENB-BAT01B must not be allowed to charge since at this time there is no battery room exhaust fan available) and battery ENB-BAT01A must be reconnected to the Div. I DC bus to begin charging as the charger carries the load. Other loads on EJS-SWG1A must be shed with the exception of EHS-MCC14A, which powers the Div. I battery room exhaust fans (required during battery charging) and backup lighting to the control room All equipment planned for this strategy is safety related or will be protected in storage.

Alternate Strategy to Power Backup Battery Charger

An alternate approach, if the primary connection is not available, is to connect a FLEX DG to station Backup Battery Charger BYS-CHGR1D located in the control building, elevation 116'. Previously this could be done via a connection located on the exterior of the normal switchgear building. However, this building is non-seismic and the connection is unprotected. A new connection line was installed which runs to BYS-CHGR1D through the control building (Figure 4). This modification included installation of a control building interior diesel generator electrical connection cabinet, an interior disconnect switch, an interior transfer switch, and cabling/raceway to allow a FLEX diesel generator to power Backup Battery Charger BYS-CHGR1D (Section 2.3.4.12). Portable fans will be used for hydrogen removal from the battery rooms if this alternate strategy is used.

Primary Strategy to Power the SPC Pumps

The SPC pumps will be powered by a portable 500kW FLEX DG that is positioned in the "west canyon" outside the auxiliary building. This area may require debris removal if the BDBEE involves high winds. In case of Local Intense Precipitation (LIP) BDBEE the area will have up to 4 inches of standing water which is expected to dissipate within 6-hours. A description of modifications installed to facilitate re-powering either SPC Pump 1A or SPC Pump 1B to a FLEX PDG in the west canyon is provided in Section 2.3.4.9 and depicted in Figure 5. These modifications include permanent connections that allow the FLEX PDG to be connected to either one of the SPC pumps.

Alternate Strategy to Power the SPC Pumps

A flexible power cord long enough to be routed from the SPC transfer switch in the pipe tunnel west of the reactor building into the auxiliary building stairwell, through the auxiliary Building and out the access door to the east canyon. This portable cable is sized such that the Phase 2 FLEX PDG output circuit breaker provides adequate overcurrent protection for it. An evaluation was performed (Reference 3.20) to determine the requirements for these Phase 2 alternate connections. Motor protection from overload and short-circuit, as well as operational control, is provided from the FLEX PDG output circuit breaker.

Primary Strategy to Power the FLX-P1 Pump

The SSW FLEX1 pump will be pre-staged in the "G" tunnel on the 70ft, elevation, south of the SSW basin. This 2500 gpm pump will be powered by a separate, portable FLEX PDG (500kW) located at grade with cables routed through permanently installed conduit from inside the fuel building, into "G" tunnel and to the pump motor (Figure 6). The installation of a receptacle, cabling and conduit, motor protector and disconnect switch has been completed. The receptacle is located in the fuel building and the FLEX PDG will be deployed to the northwest corner of the Fuel Building.

Alternate Strategy to Power the FLX-P1 Pump

A flexible power cord long enough to be routed from the FLX1-P1 pump staged in the "G" tunnel to the alternate location for the FLEX PDG. This portable cable is sized such that the Phase 2 FLEX PDG output circuit breaker provides adequate overcurrent protection for it. An evaluation was performed (Reference 3.20) to determine the requirements for these Phase 2 alternate connections. Motor protection from overload and short-circuit, as well as operational control, is provided from the FLEX PDG output circuit breaker.

FLEX Portable Diesel Generators Deployment Strategy

Transition from Phase 1 (reliance on station batteries) to Phase 2 (repowering station battery chargers) will be made using one (1) FLEX 480 VAC 3-PH 200 kW PDG (Figure 2). The FLEX PDG will be connected to EJS-SWG1A which powers battery charger ENB-CHGR1A which provides 125VDC to ENB-SWG01A that charges the

Division I batteries (this action does not become time critical until after 8 hours). It is anticipated that the decision to deploy the FLEX PDGs will be made during the initial response phase; however battery durations are calculated to last at least 8 hours. Two (2) of the required FLEX PDGs will be maintained in on-site FLEX storage buildings.

Transition from Phase 1 to Phase 2 (repowering SPC pumps and FLX-P1 pump) will be made using two (2) FLEX 480 VAC 3-PH 500 kW PDGs. The connection of one FLEX PDG to the staged FLX-P1 in the "G" tunnel (Figure 6) and the connection of the second FLEX PDG to SPC-P1A or SPC-P1B (Figure 5) is anticipated to be completed by 8 hours after the event. The only actions required are to deploy the FLEX PDGs, plug into receptacles, and start the PDGs. The required FLEX PDGs to power this equipment will be maintained in on-site FLEX storage buildings.

2.3.3 Phase 3 Strategy

Primary Strategy

The intent is to extend Phase 2 strategies long term with no immediate reliance on equipment from the National SAFER Response Centers (NSRC).

Continued operation of the Phase 2 strategy using SPC equipment is acceptable based on References 3.15 and 3.22. These analyses evaluated that a SPC pump along with the SPC heat exchanger and a FLEX 1 (FLX-P1) or FLEX 2 (FLX-P2) cooling water pump can sustain core cooling past 72 hours. The Modular Accident Analysis Program (MAAP) (Reference 3.15) and calculation G13.18.12.3 (Reference 3.75) confirm that use of a FLEX 3 pump for alternate Phase 2 core cooling along with the SPC equipment and FLEX 1 or 2 pumps for containment cooling will also maintain core cooing for at least 72 hours. Phase 3 is considered to begin when the SSW cooling tower fans are repowered from a 480V NSRC PDG connected to EHS-MCC16B (Figure 7).

Alternate Strategy

The alternate strategy is to utilize additional FLEX equipment from the NSRC. The reactor core cooling strategy is to use the RHR B train in the alternate method of Decay Heat Removal (DHR) or in the normal shutdown cooling (SDC) mode (Reference 3.77). One of the two 2500 gpm FLEX pumps (i.e., the FLEX pump being used in the Phase 2 strategy) will provide flow from the basin to the SSW piping. This flow will be routed to the RHR B heat exchangers to allow cooling through that path. The RHR heat exchangers are designed to remove ~126 MBTU/hr under design conditions for suppression pool cooling with 5800 gpm SSW flow. Since the flow of the FLEX pump is 2500 gpm, it is estimated that the heat removal will be limited to about 60-80 MBTU/hr for SDC. At 72 hours, the decay heat removal requirement is ~48 MBTU/hr (Reference 3.16). Thus, SDC will be able to handle the necessary heat removal to keep vessel temperature <200°F, even with reduced SSW flow to the heat exchangers (Reference 3.23).

2.3.4 Systems, Structures, Components

2.3.4.1 Reactor Core Isolation Cooling (RCIC)

The RCIC system (209) contains the piping from the suction sources in the suppression pool and condensate storage tank to the reactor vessel sparger through RHR and feedwater line "A". The piping includes the RCIC pump, the line fill pump, min-flow bypass line to the SP, test line to the CST, and associated system valves and instrumentation.

The RCIC system is designed to assure that sufficient reactor water inventory is maintained in the reactor vessel to permit adequate core cooling to take place.

At the initiation of the BDBEE, the reactor scrams, main steam isolation valves (MSIVs) automatically close, feedwater is lost, and safety relief valves (SRVs) automatically cycle to control pressure, causing reactor water level to drop. When reactor water level reaches -43 inches (Level 2), RCIC automatically starts. Since the CST is assumed to be unavailable, RCIC suction will immediately swap to the SP due to sensed low CST level by E51-LTN035A (E), located on safety related piping. The instrument loop and the suction valves are DC powered and the valves will change position as designed to align to the SP. Injection recovers the vessel water level to the normal band.

2.3.4.2 Safety Relief Valves (SRVs)

The only air operated valves which are required to be cycled using air during the FLEX event are the SRVs. All of the systems which can provide air to the SRVs (SVV, PVLCS, and instrument air) will be lost due to the FLEX event. The SRVs have back-up air accumulators adequate for a four hour SBO (Reference 3.24, Section 15C.2.5.3). Automatic depressurization system (ADS) SRV air accumulators are sized to provide 4 to 5 actuations per valve at atmospheric pressure in the drywell. A total of 28-35 ADS SRV actuations are available. The non-ADS SRV accumulators can provide a minimum of 37 valve cycles. This is enough for a 4 hour SBO, which is predicted to require 22 SRV operations (Reference 3.24, Section 15C.2.5.3). However, this capacity may not be enough for all of FLEX Phase 1 which is desired to last for ~8 hours to allow time for personnel resource arrival and Phase 2 equipment staging. It is therefore necessary to provide another means for continuing to use SRVs well into Phase 1.

The FLEX air supply is 16 air bottles which are stored in racks located on the 141ft elevation of the auxiliary building. The bottles will be connected to valves SVV-V48 and SVV-V51 (Reference 3.28) via air hoses and regulators after a BDBEE. In addition, the SP level indication that will be used (CMS-LT23A) has a bubbler type instrument which requires air. The same connection used to provide backup air to the SRVs also supplies this level instrument. Plant FSGs include directions to open SVV-MOV1A or B continuously for air supply to the bubbler (Reference 3.61).

Calculation G13.18.2.6-192 (Reference 3.26) determines the number of air bottles required to ensure that the SRVs and SP level instrumentation are available during the ELAP. The results of this calculation are that 12 air bottles provide sufficient air reserve to operate 5 SRVs and the SP level instrumentation for 72 hours during an ELAP with approximately 12.61% margin.

The air bottles were originally used in the SBO procedure (Reference 3.28) and are now also dedicated to both SBO and FLEX strategies. Therefore, new FLEX system mark numbers (FLX-TK1 through FLX-TK16) have been issued to the bottles (Reference 3.29).

All equipment associated with connecting the backup air bottles (hoses, regulators, etc.) is located in a storage box on the auxiliary building, 141ft elevation. An existing storage enclosure was renumbered as FLX-AIR-HOSE and relocated to the auxiliary building as shown on drawing EM-034B (Reference 3.27). FLX-AIR-HOSE will be floor mounted, as shown on drawing EC-076AA (Reference 3.30), and is evaluated for seismic loads in calculation G13.18.1.4-112 (Reference 3.31) per the requirements of Specification 200.010, Structural Design Criteria (Reference 3.32).

2.3.4.3 Batteries

The safety related batteries and associated DC distribution systems are located within safety related structures designed to meet applicable design basis external hazards and will be used to initially power required key instrumentation and applicable DC components. Load shedding of non-essential equipment provides an estimated total service time of approximately 8 hours of operations.

2.3.4.4 Suppression Pool

The suppression pool (SP) is the heat sink for reactor vessel SRV discharges and RCIC turbine steam exhaust following a BDBEE. It is also the suction source for the RCIC pump for providing core cooling during the first 4 to 5 hours after shutdown caused by the BDBEE.

The design basis for the SP, is to initially serve as the heat sink for any postulated transient or accident condition in which the normal heat sink, main condenser, or SDC is unavailable. Energy is transferred to the SP by either the discharge piping from the SRVs or the drywell LOCA vents. The SRV discharge line piping is used as the energy transfer path for any condition which requires the operation of the relief valves. The drywell LOCA vents are the energy transfer path for all energy releases to the drywell.

The SP receives this flow, condenses the steam portion of this flow, and releases the non-condensable gases and any fission products to the pressure suppression chamber air space. The condensed steam and any water carryover cause an increase in pool volume and temperature. Energy can be removed from the SP when RHR is operating in the suppression pool cooling mode. During a BDBEE energy is removed from the SP by use of portions of the SPC system and SSW system (see Section 2.3.2).

The SP is the primary source of water for the core spray and LPCI systems, and the secondary source of water for the RCIC and high pressure core spray (HPCS) systems. The water level and temperature of the SP are continuously monitored in the main control room (MCR).

The SP fills the bottom 20 ft of the annular volume between the drywell and the containment wall. A cylindrical weir wall inside the drywell forms the inner boundary of the suppression pool. A system of submerged horizontal vent openings in the lower portion of the drywell wall are incorporated to direct steam to the SP where condensation (vapor suppression) occurs if a pipe ruptures within the drywell. The SP contains 1,055,019 gallons of water at a level of 20 ft.

The suppression pool water level is maintained between ≥ 19 ft 6 inches and ≤ 20 ft 0 inches per LCO 3.6.2.2 of the Technical Specifications.

2.3.4.5 Suppression Pool Cleanup & Alternate Decay Heat Removal (SPC)

The SPC is designed as a non-safety related system to maintain SP water clarity and chemistry, and provide an alternate method of decay heat removal when the reactor is shutdown. Portions of the system that are used in FLEX include pumps SPC-P1A and SPC-P1B, heat exchanger SPC-E1 and piping.

The SPC system components credited for use in FLEX are contained in seismic category I structures which provide protection from beyond design basis external events. The pumps and heat exchanger are located in a seismic category I piping tunnel which also provides protection for BDBEEs. Engineering Report RBS-CS-13-00007 (Reference 3.33) demonstrates SPC component functionality following a seismic event by utilizing a combination of existing seismic design and evaluation documentation review and seismic margin assessment methods. Specific components requiring additional evaluation included pumps SPC-P1A and SPC-P1B, heat exchanger SPC-E1, unit cooler HVY-UC1, valves, and small-bore piping. Based on this evaluation, the as-built configuration of SPC system components credited for implementation of RBS FLEX strategies are justified as having high confidence of component functionality following a seismic event, and can therefore be credited for use during a post-earthquake FLEX event.

2.3.4.6 Ultimate Heat Sink

The SCT and water storage basin forms a part of the SSW system which functions as the UHS". While the SSW pumps are not available because of the BDBEE and ELAP, the SSW basin is available for use in the FLEX strategy. The SCT and storage basin is designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, and floods. The nominal volume of water in the UHS basin is 6,400,000 gallons.

2.3.4.7 Service Water Piping

Portions of the SSW "B" supply and return to SCT are utilized to provide cooling water the SCP heat exchanger for SP cooling. The piping is safety-related and designed to seismic category I criteria. The piping is protected from other external hazards by its location in seismic category I structures which provide protection for high winds, missiles and external flooding.

2.3.4.8 Core Cooling Connections

Primary Core Cooling Connection

Phase 2 primary core cooling is provided by one of two installed SPC pumps located in the "E" tunnel. When used for core cooling, one pump takes suction from the RHR "C" pump suction line from the SP and discharge water into the RPV through the RHR "C" injection line. Either of the parallel pumps can provide core cooling using the same suction and discharge path. This alignment makes use of existing piping and valves. Phase 2 core cooling is initiated after RCIC operation has depleted the water in the UCP (approximately 34 hours after the ELAP). To accomplish this, the vessel will be completely depressurized by opening five SRVs and the SPC system will be aligned to inject water into the vessel. This establishes the complete flow path by allowing the injected water to return to the SP. Cooling of the SP is discussed in Section 2.5.2.

Alternate Core Cooling Connection

Phase 2 alternate core cooling is provided by the FLEX 3 pump (FLX-P3 or FPW-P4). This pump takes suction from the SCT basin and discharges water into the RPV through the LPCS injection line. Phase 2 core cooling is initiated after RCIC operation has depleted the water in the UPC (approximately 34 hours after the ELAP). A 2½ inch hose is connected to one of four discharge nozzles on the FLEX-3 pump and routed to the LPCS flushing connection (valve E21-VF025) in the auxiliary building. The flushing connection is located on a platform (133ft elevation) in the northwest crescent of the auxiliary building. Since the connection is located in the seismic category I building, it is protected from all hazards

2.3.4.9 Primary Electrical Connection for SPC pumps

The SPC pumps will be powered directly from a FLEX PDG positioned at grade outside the auxiliary building in the "west canyon". Modifications to the plant were implemented to facilitate the connection of the PDG to the SPC pumps. This includes installation of a PDG connection cabinet (SPC-RCPT1, located adjacent to door AB098-08), a circuit breaker/disconnect switch (SPC-SW1) above the PDG connection cabinet, motor protection (SPC-MST1, 70ft elevation in the auxiliary building west stairwell) and separate transfer switches (SPC-TRS1 and SPC-TRS2) for each SPC pump. Permanent conduit was installed for the wiring between the connection cabinet, circuit breaker and motor protector. The transfer switches (SPC-TRS1 and SPC-TRS2) are located in the SPC equipment room (elevation 70 ft). Flexible cables for connecting the motor protection cabinet to one of the SPC pump transfer switches are staged in a cable storage box in the SPC equipment room. (Reference 3.34)

2.3.4.10 Alternate Electrical Connection for SPC pumps

The alternate electrical connection for powering the SPC pumps is provided by routing cable for a PDG located in the east canyon into the auxiliary building stairwell (door AB098-03), through the auxiliary building, and then into the SPC equipment room for connection to one of the SPC pump transfer switches. (Reference 3.35)

2.3.4.11 Primary Electrical Connection for Battery Chargers

Phase 2 electrical power is provided by using a FLEX PDG to repower the Division I battery charger ENB-CHGR1A. Modifications to the plant were implemented to facilitate the connection of the PDG to the battery charger. The modifications include the following:

- Installation of PDG connection cabinet (EJS-RCPT1, located in the control building 98ft elevation, west corridor)
- Installation of a circuit breaker/disconnect switch (EJS-SW1, located adjacent to connection cabinet EJS-RCPT1)
- Installation and termination of new permanent cable and conduit between the connection cabinet and disconnect switch
- Revising the settings for spare breaker EJS-SWG1A-ACB011 and relabeling
- Installation and termination of new permanent cable, conduit between the new disconnect switch and switchgear breaker EJS-SWG1A-ACB011.

This configuration permits the powering of charger ENB-CHGR1A, MCR Appendix R backup lighting receptacle POP-LTGR02, and battery room exhaust fan motor HVC-FN3A (or –FN3D) from the existing spare breaker EJS-SWG1A-ACB011 which will be back-fed from a FLEX diesel generator as part of the FLEX implementation plan. (Reference 3.34).

2.3.4.12 <u>Alternate Electrical Connection for Battery Chargers</u>

Alternate Phase 2 electrical power is provided by using a FLEX PDG to repower the non-divisional backup swing battery charger BYS-CHGR1D. This capability has been implemented with the following modifications.

- Installation of PDG connection cabinet (BYS-RCPT7, located on 98ft elevation of the control building Cable Chase II)
- Installation of a permanent circuit breaker disconnect switch (BYS-SW7, located adjacent to BYS-RCPT7)
- Installation of a permanent transfer switch (BYS-TRS5)
- Installation and termination of new permanent cable and conduit between the connection cabinet and the breaker disconnect switch
- Installation and termination of new permanent cable and conduit between the breaker disconnect switch and the interior transfer switch
- Disconnecting the power feed cable at battery charger BYS-CHGR1D and rerouting it through new conduit to the new transfer switch
- Installation and termination of new permanent cable and conduit between the new transfer switch and backup battery charger BYS-CHGR1D.

This configuration allows battery charger BYS-CHGR1D to continue to receive power from transfer switch BYS-TRS4 during normal operation, and during a BDBEE, the battery charger will receive power from the FLEX PDG staged outside the control building (CB) east wall. Charger BYS-CHGR1D can provide power to any one of the three Class IE Division DC buses or any one of three non-safety related buses through existing switchgear. For FLEX it is connected to the Division 1 DC bus. (Reference 3.34). To ensure the new FLEX system that will be attached to switchgear BYS-SWG01D and battery charger BYS-CHGR1D can remain functional, a seismic qualification evaluation (SQE) was performed to verify the following seismic/structural parameters:

- The seismic qualification level of panel BYS-SWG01D including modifications that altered and/or replaced components and sub-components in the panel.
- The seismic qualification level of battery charger BYS-CHGR1D including modifications that altered and/or replaced components and sub-components in the battery charger.
- The installation details of the non-safety related commodities and components installed adjacent to BYS-SWG01D and BYS-CHGR1D on 116ft elevation of the CB with the objective is to ensure that during a seismic event no adverse interaction occurs between these units and the non-safety related commodities installed close by.

This evaluation confirmed that panel BYS-SWG01D and battery charger BYS-CHGR1D are seismically qualified to RBS requirements and have been maintained as safety related seismic equipment. This evaluation confirmed that structural adequacy of panel BYS-SWG01D, battery charger BYS-CHGR1D and the components installed in them will be maintained before, during and after a seismic event.

There is no concern for seismic interaction between these two safety related seismic equipment provided for standby distribution system and standby battery charger (BYS-SWG01D and BYS-CHGR1D) and the non-safety related commodities installed close by.

2.3.5 Key Reactor Parameters

Instrumentation providing the following key parameters is credited for all phases of the reactor core cooling and decay heat removal strategy:

RPV wide range water level indication is available in the MCR on panels H13-PNLP629 (B21-ESN091A) and H13-PNLP601 (B21-LIR610E).

RPV pressure indication is available in the MCR on panel H13-PNLP601 (B21-LR/PRR623A).

The above instrumentation is available prior to and after load stripping of the DC and AC buses during Phase 1. Availability during Phases 2 and 3 will be maintained by repowering the class 1E battery charger for the Division 1 station batteries using a FLEX PDG.

Portable FLEX equipment is supplied with the local instrumentation needed to operate the equipment. The use of these instruments is detailed in the associated FSGs for use of the equipment. These procedures are based on inputs from the equipment suppliers, operation experience, and expected equipment function in an ELAP.

In the unlikely event that 120 VDC and 120 VAC Vital Bus infrastructure is damaged, alternate FLEX strategy guidelines for obtaining the critical parameters locally is provided in RBS- FSG-007 in accordance with the guidelines of NEI 12-06 Section 5.3.3.1 (as clarified by FAQ 14-001).

2.3.6 Thermal Hydraulic Analyses

The RBS FLEX strategy timeline is supported by the results of a plant specific MAAP analysis and various other calculations.

Case 1 of the MAAP4 analysis (Reference 3.36) represents the optimal method for controlling reactor water level which represents the scenario as described in RBS FLEX Strategy. The RBS FLEX strategy is based on operators commencing a cooldown of the RPV at 1 hour by initiating a controlled blowdown through one SRV to a pressure of 200 psig at less than 100°F per hour. After this point the reactor pressure is maintained between 200 and 400 psig to allow continued operation of RCIC. The RPV pressure will be maintained in the 200 – 400 psig range even if the SP temperature exceeds the HCTL in order to provide RPV injection with RCIC operation. This is acceptable based on new BWROG EPG guidelines that allow the reactor to remain at pressure if emergency depressurization will result in the loss of the only source of injection. At approximately four hours, RCIC suction is transferred from the SP to the UCP to ensure continued operation of RCIC with a cool source of water. The SPC heat exchangers are available to cool the SP at eight hours. When the UCP is depleted (approximately 34 hours), SPC pump discharge is aligned to inject into the RPV via the LPCI C injection line. The RPV is fully depressurized to establish a path for the injected water to return to the SP. This configuration maintains both RPV injection and SP cooling.

The results of the analysis is summarized as follows: The RPV water level remains above the top of active fuel (TAF). The peak containment and drywell air space pressures are all within their design bases. The peak suppression pool water temperature exceeds the 185°F design basis. This is considered acceptable for a BDBEE since the 185°F limit was established for Design Basis Events (DBE's) in which containment integrity is challenged by internal containment pressure. This analysis demonstrates that 1) the maximum allowable internal containment pressure of 15 psig is not challenged even when suppression pool temperatures exceed 185°F, 2) a general cooling trend is established at 8 hours when SP cooling via the SPC heat exchanger is established, and 3) the reactor can be totally depressurized to allow direct SPC injection without challenging containment integrity.

MAAP4 Code benchmarking for the program's use in support of post-Fukushima applications is discussed in detail in Section 5 of EPRI Report 3002001785 "Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications" (Reference 3.37), which includes MELCOR Code result comparisons as well as direct result comparisons to actual plant pressure and temperature data from Fukushima Dai-ichi Units 1, 2, and 3. The EPRI report concludes that the MAAP4 code is acceptable for use in support of the industry response to Order EA-12-049.

The RBS MAAP4 analysis was performed in accordance with Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013 position paper, EPRI Technical Report 3002001785.

Key modeling parameters cited in Tables 4-1 through 4-6 of the "MAAP4 Application Guidance, Desktop Reference for Using MAAP4 Software, Revision 2" (Electric Power Research Institute Report

1020236) are specifically addressed in the MAAP4 Analysis (Reference 3.36). The reactor vessel and containment nodalization followed standard schemes that are described. The MAAP4 Code is readily capable of analyzing the two-phase flow conditions from the RPV, and validations were performed for the key parameters that are checked for these two-phase level and flow conditions. Modeling of heat transfer and losses from the RPV, decay heat, and the plant-specific inputs are also described and followed standard practices.

2.3.7 Recirculation Pump Seal Leakage

The RBS MAAP4 analysis uses an initial leak rate of 66 gpm at normal RPV operating pressure to account for primary system leakage. The 66 gpm leakage is the same as that in Assumption 8 for BWR/6, Mark III analysis in Section 4.5.1.5 of NEDC-33771P (Reference 3.38). This assumption is applicable since RBS is a BWR/6 Mark III plant. The primary system leakage is the sum of the Technical Specification limit and recirculation pump seal leakage. According to Appendix 15C of the RBS USAR, the River Bend station blackout (SBO) licensing basis for RCS pump seal leakage is 18 gpm per pump. RCS operation leakage is limited to 30 gpm per Technical Specification 3.4.5. Therefore, the assumed leakage of 66 gpm in NEDC-33771P is appropriate.

The primary system leakage is assumed to start at time zero and vary with reactor pressure. The RPV leakage location is set at the reactor recirculation (RR) pump suction nozzle elevation (ZSRR) and it was iteratively determined that a leakage area (ALOCA) of 1.07E-03 ft^2 would provide the assumed initial leakage of 66 gpm at normal reactor pressure. The leakage is determined using an area in order to allow variations in the leakage value depending on primary side pressure conditions. The primary system leakage is initially 66 gpm but increases to a maximum of about 100 gpm during the first hour as RPV subcooling increases due to RCIC injection. The leakage then decreases when the RPV is depressurized at one hour and is maintained between about 20 and 40 gpm. Flow from the recirculation pump seal will be single-phase liquid due to the location of the leak which is low in the RPV with RPV level continued to be maintained above TAF. Upon exiting the RPV, the seal leakage will flash a portion of the flow to steam based on saturated conditions in the drywell, creating a steam source and a liquid water source to the drywell.

2.3.8 Shutdown Margin Analysis

Not applicable to BWRs for FLEX.

2.3.9 Flex Pumps and Water Supplies

2.3.9.1 FLEX 1 Pump

FLX-P1 pump is the primary pump for providing cooling water to the SPC heat exchangers for SP cooling. It takes suction on the SCT and pumps water through the existing SSW "B" supply header to the SPC heat exchangers. Water is returned to the SCT through the existing SSW return line. FLX-P1 is permanently staged (but not connected) in the "G" tunnel, 70ft elevation near the west end of the "G" tunnel near the point where line SWP-030-219-3 is capped. The pump is seismically secured and protected from all external hazards by its location in the seismic category I "G" Tunnel. For an ELAP/BDBEE, the pump suction will be connected to line SWP-030-219-3 near the point where it is capped off at the west end of the tunnel. This line extends into the bottom of the SSW basin and was originally intended as a connection to the Unit 2 basin. It will allow the pump to take suction from near the pool bottom via valve SWP-V353. A blind flange originally on the end of SWP-V353 has been removed to provide full access the SCT basin. A tie-in (SWP-010-930-3) for pump suction is provided with a new 10" safety-related isolation valve (SWP-V3110), with adapters for 6" hose connections on the end. New 10" piping (FLX-010-001-4) from a point near the discharge of pre-staged FLX-P1 to a point just west of the access platform located south of the SCT pipe chase was also installed. Each end of this piping will have adapters to allow for two 6" hose connections. This piping will be used to connect the pre-staged FLX-P1 discharge to the SSW "B" supply line (SWP-030-026-3) after a BDBEE by connecting hoses on both ends of the piping. The pump will only be connected at the time of the event or for testing. (Reference 3.39)

FLX-P1 is an electric motor driven pump sized to provide 2500 gpm at a minimum total dynamic head of 160 feet. Power for the pump is provided by a 500 kW PDG.

2.3.9.2 FLEX 2 Pump

FLX-P2 is the alternate pump for providing cooling water to the SPC heat exchanger for SP cooling. The FLX-P2 a portable diesel-driven pump that will be deployed from FLEX storage building 1 (Reference 3.43) to a location at grade adjacent to the SCT pipe chase. Suction for the pump is provided by a new 10" tie-in to SWP-030-219-3 in the SCT pipe chase with a 10" safety-related isolation valve (SWP-V3111). New 10" piping (SWP-010-931-3) is installed from the new tie-in to the deployment location of the portable FLX-P2 at grade southeast of the SCT basin. The 10" piping is reduced to 6" in diameter before being routed through a new 12" penetration in the SCT pipe chase wall, which protects the SSW piping from tornado missiles. The 6" piping terminates inside the penetration via a blind flange. The exterior of the penetration will be protected by a missile shield. Pump discharge is provided with new 6" piping (FLX-006-005-4) from a second penetration in the SCT pipe chase wall above grade down to an open area just outside of the SCT pipe chase in the "G" Tunnel. The piping expands to 10" in diameter once it exits the penetration in the SCT wall and enters the pipe chase. This piping can be used to connect the portable FLX-P2 discharge to the SSW "B" supply line (SWP-030-026-3) after a BDBEE. The downstream end of this new piping that terminates in the "G" Tunnel will have adapters to allow for two 6" hose connections for connection to the SSW "B" supply line (SWP-030-026-3). The grade end of this piping terminates inside the penetration with a blind flange. The exterior of the penetration is protected by a missile shield. Once the plates are removed, the blind flanges can be removed and the fittings needed to connect FLX-P2 to the piping via hoses can be installed.

FLX-P2 is a diesel-driven pump rated at a minimum total dynamic head of 160 feet at 2500 gpm.

2.3.9.3 FLEX 3 Pump

The FLEX 3 pump (FLX-P3 or FPW-P4) is the alternate pump for providing water to the reactor vessel for core cooling. The FLEX 3 pump pumps water through fire hose to a LPCS flushing line connection, through valves E21-VF025 and E21-MOVF005 and on to the RPV for core cooling. The flushing connection is located on a platform (133ft elevation) in the northwest crescent of the Auxiliary Building. The hydraulic calculation for the FLEX 3 pump (Reference 3.47) confirms that it is capable of providing 200 gpm to the reactor core via LPCS while providing the required flow to any one of the three SFP cooling makeup scenarios. The calculation is performed with the following assumptions:

- Suction flow of 450 gpm (accounts for SFP spray flow of 250 gpm and 200 gpm to the reactor) through 75 feet of 6" diameter hose.
- Discharge hose to LPCS flushing connection is assumed to be 550 feet of 2 ½ inch hose (20% greater than required length).
- Use of HPCS hydraulic parameters to represent the LPCS flushing line. This is conservative since the overall length for HPCS is greater than the LPCS length. The LPCS flushing line is 5 ft of 3" pipe and the pump discharge line is 109 ft of 10" pipe compared to HPCS flushing line length of 15 ft of 3" pipe and pump discharge line length of 144.3 ft of 10" pipe.
- Discharge pressure to the reactor vessel is based on reactor pressure following full depressurization (Reference 3.15). This is determined from the MAAP analysis which accounts for the linkage between the reactor and containment pressures through the SRVs and their discharge lines (Reference 3.15).

The hydraulic calculation determined that the required minimum total system head is 200 ft of water (86.6 psi). This is below the required total system head of 285 ft (123.4 psi) for spray flow to the SFP. The total flow for both functions is well within with the capability of the FLEX 3 pump.

Operating at 1800 gpm, the pump can provide 450 gpm at a pressure of 430 ft (186.2 psi).

While not required by the Order or NEI 12-06, the pump is also capable of providing core cooling even if there is no containment heat removal during the ELAP. Without heat removal, the containment pressure will gradually increase to the failure pressure of 53.7 psia (Reference 3.73) in approximately 16.5 hours (Reference 3.74). The containment fails due to local yielding and tearing at the equipment hatch and thus the peak containment pressure is 53.7 psia. Based on MAAP calculations the RPV pressure at the time of containment failure is assumed to be 20 psi above the failure pressure which results in a reactor pressure of 73.7 psia. Use of this reactor pressure in the hydraulic calculation for alternate core cooling results in a pump head requirement of 281 ft (122 psi). As indicated above the FLEX 3 pump is capable of providing sufficient flow at this pressure. The hose used for this alignment can be operated at pressures up to 270 psi (90 percent of annual service test pressure of 300 psi) and is therefore capable of supporting the core cooling function.

2.3.9.4 Water Supplies

Suppression Pool

Because the CST is not seismically qualified, it is considered unavailable for the BDBEE, and the RCIC suction will be auto switched to the SP at the initial onset of the event. The SP provides the initial source of water for cooling the RPV. The SP contains approximately 1,055,000 gallons of water. The SP water level is maintained between ≥ 19 ft 6 inches (~1,014,000 gallons) and ≤ 20 ft 0 inches (~1,055,000 gallons) per LCO 3.6.2.2 of the Technical Specifications (Reference 3.40).

The SP fills the bottom 20 ft of the annular volume between the drywell and the containment wall. A cylindrical weir wall inside the drywell forms the inner boundary of the SP. The containment is designed to withstand the maximum postulated seismic event as well as all postulated environmental events including tornadoes.

Upper Containment Pool

The UCP is located above, and supported by, the drywell. It is divided into four sections: the fuel transfer and storage area, the separator storage pool, the dryer storage pool, and the reactor cavity. This pool is used as a source of cool suction water for RCIC in Phase 1 of an ELAP/BDBEE scenario. Since the pool is located in the containment, it is designed to seismic category I requirements and is protected from external events. The pool is maintained full during normal operations. Calculation G13.18.12.4-045 (Reference 3.41) determined that the maximum useable volume of water available for RCIC was 438,839 gallons. However, 400,000 gallons was used in the FLEX supporting analyses.

This additional makeup water source was achieved by installing a permanent FLEX cross-tie from the UCP to the RCIC pump (E51-PC001) suction line. This cross-tie line from the UCP was made by connecting the existing 8" dia. SFC piping line SFC-008-076 to the existing 6" dia. RCIC pump suction line ICS-006-015-2 in the "D" Tunnel. The new cross-tie is isolated by a new locked closed manual gate valve, ICS-V3029, also located in the "D" Tunnel.

Standby Cooling Tower Basin

The SCT and its basin form the UHS for RBS. The SCT and basin is a seismic category I, safety related structure that also provides protection for the internal piping and components from other external event hazards (e.g., tornado missiles, high winds, flooding, etc.) While the FLEX strategy assumes that the SSW pumps and fans will not be available due to the ELAP, the water in the basin is available. The SCT basin contains a nominal 6,400,000 gallons (Reference 3.44).

The SCT basin is the water source for cooling that is used to cool the SP and containment. Calculation G13.18.12.4-047 performed a thermal performance evaluation of the SCT and basin for the FLEX strategy (Reference 3.42). Major assumptions in the calculation include: no credit for cooling from natural circulation or evaporation; SFP makeup flow of 200 gpm from the basin is initiated at 8 hours; basin water is not being used for core cooling; and evaporation losses of 330 gal/hr. At 72 hours it is assumed that makeup to the basin becomes available and one division of SCT fans are repowered. The calculation concluded that the SSW basin can satisfactorily cool the SP through 72 hours (maximum basin water temperature of ~150°F) without makeup water or repowering the SSW cooling tower fans. At 72 hours, repowering the SSW cooling tower fans and providing 20,000 gal/hr of makeup water to the basin will allow for indefinite core cooling. RBS has contracted with an off sight vendor to provide makeup at a minimum of 20,000 gallons per hour.

The SCT basin is also the water source for the alternate core cooling strategy using a FLEX 3 pump. This strategy requires 200 gpm for core cooling for the basin. Since the required flow to the SFP for boiloff makeup is ~60 gpm, the total flow from the basin is 260 gpm. There is sufficient volume in the basin to support this strategy for 72 hours without makeup to the basin (Reference 3.75).

The above two scenarios are representative of water loss from the SCT basin for the primary and secondary core cooling strategies. The first assumes the primary core cooling strategy, using SPC (Section 2.3.2), is functioning and that 200 gpm from the SCT basin is used for spray cooling the SFP. The use of spray cooling is conservative since the SFP is designed for all applicable external events and a breach of the pool is highly unlikely. The second assumes the alternate core cooling strategy is in use with 200 gpm from the SCT basin injecting to the RPV for core cooling along with 60 gpm (maximum required flow for pool boiloff) is being pumped to the SFP. However, RBS also has the capability to provide 250 gpm to the SFP for spray cooling if necessary. If this flow is required for use with either the primary or secondary core cooling strategy, makeup to the SCT basin may be required earlier than 72 hours depending on the specific timing and flow requirements associated with establishment of core cooling and SFP spray cooling. In such cases, the need for earlier makeup to the basin will be determined on an ad hoc basis and appropriate actions taken.

Standby Cooling Tower Fans

The SCT fans and tower internals are located inside the tower structure and are protected by the walls and roof, which are designed to withstand both horizontal and vertical tornado missiles. The fans are required to be repowered as part of the Phase 3 strategy in order to ensure continued cooling of the SP and RPV. The SSW cooling tower fans are repowered with an 1100kW – 480V NSRC turbine-driven generator connected to EHS-MCC16B which is located in the SCT. An alternate strategy makes use of two 1MW - 4160V NSRC generators to provide power to the SSW cooling tower fans through the Division 2 4160V bus.

2.3.10 Electrical Analysis

The Class 1E battery duty cycle of 8 hour 55 minutes (with crosstie of Division II to Division 1 bus) was calculated in accordance with the IEEE-485 methodology using manufacturer discharge test data applicable to the licensee's FLEX strategy as outlined in the NEI white paper on Extended Battery Duty Cycles. The time margin between the calculated battery duration for the FLEX strategy and the expected deployment time for FLEX equipment to supply the dc loads is approximately three (3) hours for RBS.

The strategy to re-power the station battery charger requires the use of a PDG. The PDGs (primary and alternate) for battery charging are 480 VAC, 200 kW trailer-mounted generators. Each PDG includes a 500 gal double-walled diesel fuel tank built into trailer.

Additional replacement 480 VAC generators and 4kV diesel powered generators are available from the NSRC for the Phase 3 strategy. The specifications and ratings for this equipment are listed in Table 5.

2.4 Spent Fuel Pool Cooling/Inventory

The basic FLEX strategy for maintaining SFP cooling is to monitor SFP level and provide makeup water to the SFP sufficient to maintain the SFP level at or above 107 ft-10 5/16 inches. This is 23 ft above the top of irradiated fuel (SR 3.7.6.1, Reference 3.40).

2.4.1 Phase 1 Strategy

Phase 1 strategy will be the use of plant design to maintain cooling for fuel in the SFP via the large inventory and heat capacity of water in the SFP. Water level in the SFP will be maintained at or above 107 ft-10 5/16 inches.

The SFP will slowly heat up following the loss of SFP cooling due to loss of AC power. Calculation G13.18.12.4-041, "Spent Fuel Pool and Upper Containment Pool Time to Boil and Uncover Fuel for Extended Loss of Offsite Power (FLEX)" determined the SFP time to boil is 9.51 hours and the time to boil off to the top of fuel is 137.62 hours from initiation of the event. The initial coping strategy for SFP cooling is to monitor SFP level using instrumentation installed as required by NRC Order EA-12-051.

2.4.2 Phase 2 Strategy

Makeup Strategy Method 1 (Hose)

The first method is with the FLEX 3 pump connected to the SSW basin and running hose to the SFP as described in Attachment 13, Section 3.2 of OSP-0066 (Reference 3.46). The FLEX 3 pump is placed near the SCT and non-collapsible hose is used to establish a suction path to the SCT basin. Hose is then routed from the pump discharge to the SFP where diffusers are attached to the end of the hose and placed into the pool.

Makeup Strategy Method 2 (SFP Cooling Piping)

This method provides the capability to supply makeup water to the SFP without accessing the refueling floor. With this method the discharge of the FLEX 3 pump is connected to the 2" drain line off of line SFC-010-36-3 downstream of isolation drain valve SFC-V66. During a BDBEE, the existing 2" NPT threaded pipe cap will be removed and a vent valve as well as a 2" NPTM x 2.5" adapter will be screwed onto the drain line. The adapter will allow for connection of a 2.5" hose with NH fittings to be connected to the 2" NPT threaded drain line. Required adapters and the 2.5" hose will be stored in the FLEX Storage Buildings.

Makeup Strategy Method 3 (Spray)

The case that requires spray cooling for the SFP greater than the makeup rate will utilize existing equipment that is intended to support the mitigating strategies requirements from previous NRC Order EA-02-026, Section B.5.b, and 10 CFR 50.54(hh)(2). The regulatory guidance contained in NRC Order EA-02-026, Section B.5.b, as noted in JLD-ISG-2012-01 continues to provide an acceptable means of meeting the requirement to develop, implement and maintain the necessary guidance and strategies for that subset of BDBEEs. (Reference 3.3, 3.4) The monitor spray nozzles and hoses needed to provide spray and/or makeup to the SFP are stored in the FLEX storage buildings.

Calculation G13.18.2.0-085 (Reference 3.47) was performed to determine the FLEX 3 pump requirements necessary for all of the three SFP makeup methods described above in conjunction with reactor core cooling via the LPCS flushing connection. The pump must be capable of providing 450 gpm of flow, with a total system head of 285 ft, and an $NPSH_R$ of no greater than 27 ft to meet the most demanding requirements of the guidance provided in NEI 12-06, which is the scenario of providing makeup to the SFP via portable spray monitors.

2.4.3 Phase 3 Strategy

Additional capabilities will be from the NSRC as a backup to the on-site FLEX high capacity pumps.

2.4.4 Structures, Systems, and Components

2.4.4.1 Primary Connection

Makeup Strategy Method 1 (Hose)

There are no connections associated with the Method 1 strategy; all equipment is portable and does not require any physical connections to permanent plant equipment.

Makeup Strategy Method 2 (SFP cooling piping)

There will be a capability to supply makeup water to the SFP without accessing the SFP floor. The connection is to the 2" drain line off of line SFC-010-36-3 downstream of isolation drain valve SFC-V66. During a BDBEE, the existing 2" NPT threaded pipe cap will be removed and a vent valve as well as a 2" NPTM x 2.5" Storz adapter will be screwed onto the drain line.

The piping used to provide makeup flow to the SFP from the hose connection point is contained within the fuel handling building (FB) and is protected from all applicable external hazards. FLEX equipment will be provided with a storage strategy based on the use of seismically rugged, diverse, spatially separated locations

Makeup Strategy Method 3 (Spray)

There are no connections associated with the Method 3 strategy; all equipment is portable and does not require any physical connections to permanent plant equipment.

2.4.4.2 Alternate Connection

There are no alternate connections for the three methods described in Section 2.4.2 for supplying makeup to the SFP.

2.4.4.3 Ventilation

Per NEI 12-06 (Reference 3.3) guidance, a baseline capability for spent fuel cooling is to provide a vent pathway for steam and condensate from the SFP. In order to establish a vent pathway for steam and condensate, the double doors on the 95' elevation (door FB95-1) to the new fuel receiving area will be opened. Door FB113-2 will be opened to the stairwell and door FB171-1 will be opened on the roof. Because cooler air will be allowed to enter the fuel building through the FB95-1 doors, a chimney effect will be established through the stairwell to the roof. This action is required to be performed prior to the onset of SFP boiling (as water temperature approaches 200°F).

2.4.5 Key Reactor Parameters

The key parameter for the SFP make-up strategy is the SFP water level. The SFP water level is monitored by the instrumentation that was installed in response to Order EA-12-051, *Reliable Spent Fuel Pool level Instrumentation*.

2.4.6 Thermal-Hydraulic Analyses

An analyses was performed that determined with the maximum expected SFP heat load immediately following a core offload, the SFP will reach a bulk boiling temperature of 212°F in approximately 9.5 hours and boil off to the top of fuel in 137.62 hours unless additional water is supplied to the SFP. The initial coping strategy for SFP cooling is to monitor SFP level using instrumentation installed as required by NRC Order EA-12-051. A flow of 60 gpm will replenish the water being boiled for the limiting case. Deployment of any of the SFP makeup strategies within 72 hours with a flow rate that exceeds boil-off rate (60 gpm for the limiting at power case) will provide for adequate makeup to restore the SFP level and maintain an acceptable level of water for shielding purposes. A hydraulic calculation was performed to demonstrate the feasibility of the flow paths and determine the required pump performance requirements (Reference 3.47). The FLEX 3 pumps (FLX-P3 and FPW-P4) credited for the SFP makeup strategy are capable of providing at least the required 450 gpm at 285 TDH.

2.4.7 Flex Pump and Water Supplies

2.4.7.1 FLEX 3 Pump

Either of the two FLEX 3 pumps (FLX-P3 or FPW-P4) is capable of providing the required flow for any of the three SFP makeup methods. The pumps can satisfy the most limiting method by providing at least 450 gpm at 285 TDH. The FLEX 3 pumps are trailer-mounted, diesel driven centrifugal pumps. One is stored in each FLEX storage building. The pump is deployed by towing the trailer to the designated location near the SCT basin. One FLEX 3 pump is required to implement the SFP strategy.

2.4.7.2 Standby Cooling Tower Basin (Refer to 2.3.9.3)

The SCT basin (UHS) is the source of water for direct supply of makeup water to the SFP for all three methods of makeup.

2.4.8 Electrical Analysis

The SFP will be monitored by instrumentation installed by Order EA-12-051. The power for this equipment has backup battery capacity for seven days. The capability to connect external DC sources of power is also included.

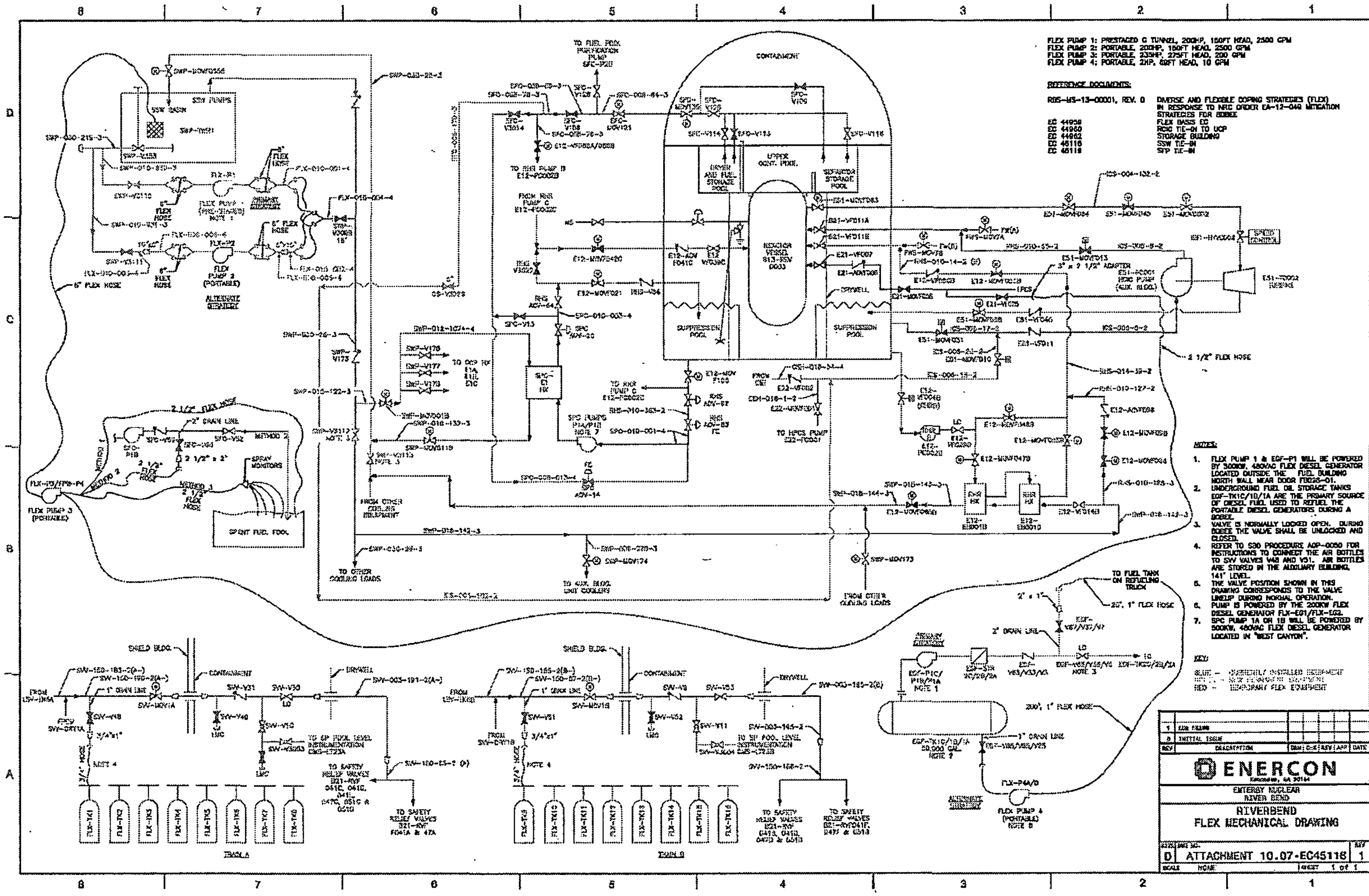

Figure 1 - FLEX Mechanical Drawing

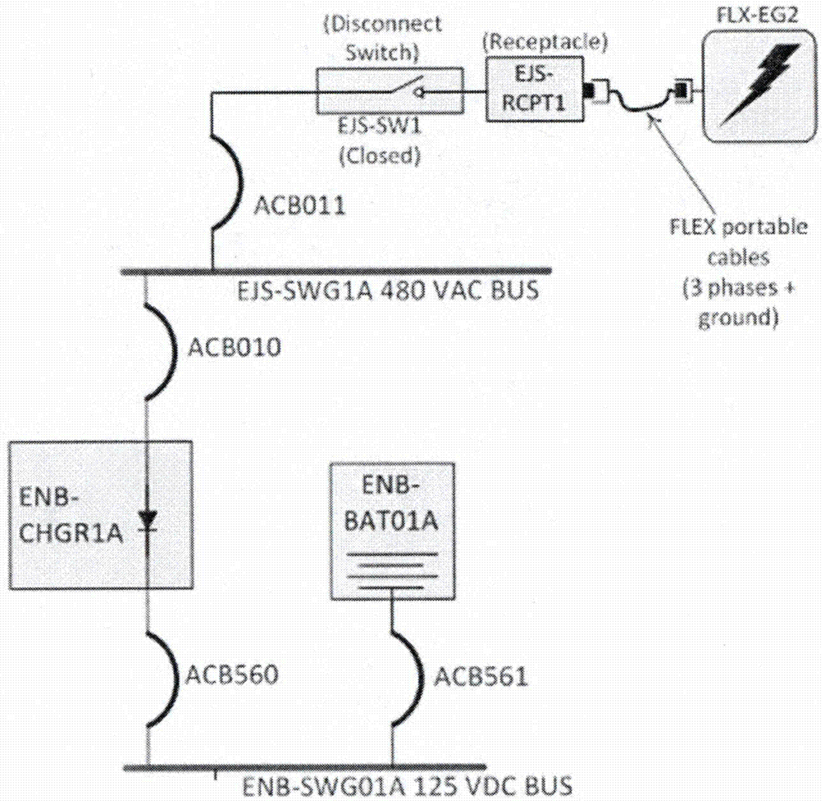

Figure 2 - Primary DC Charger Power

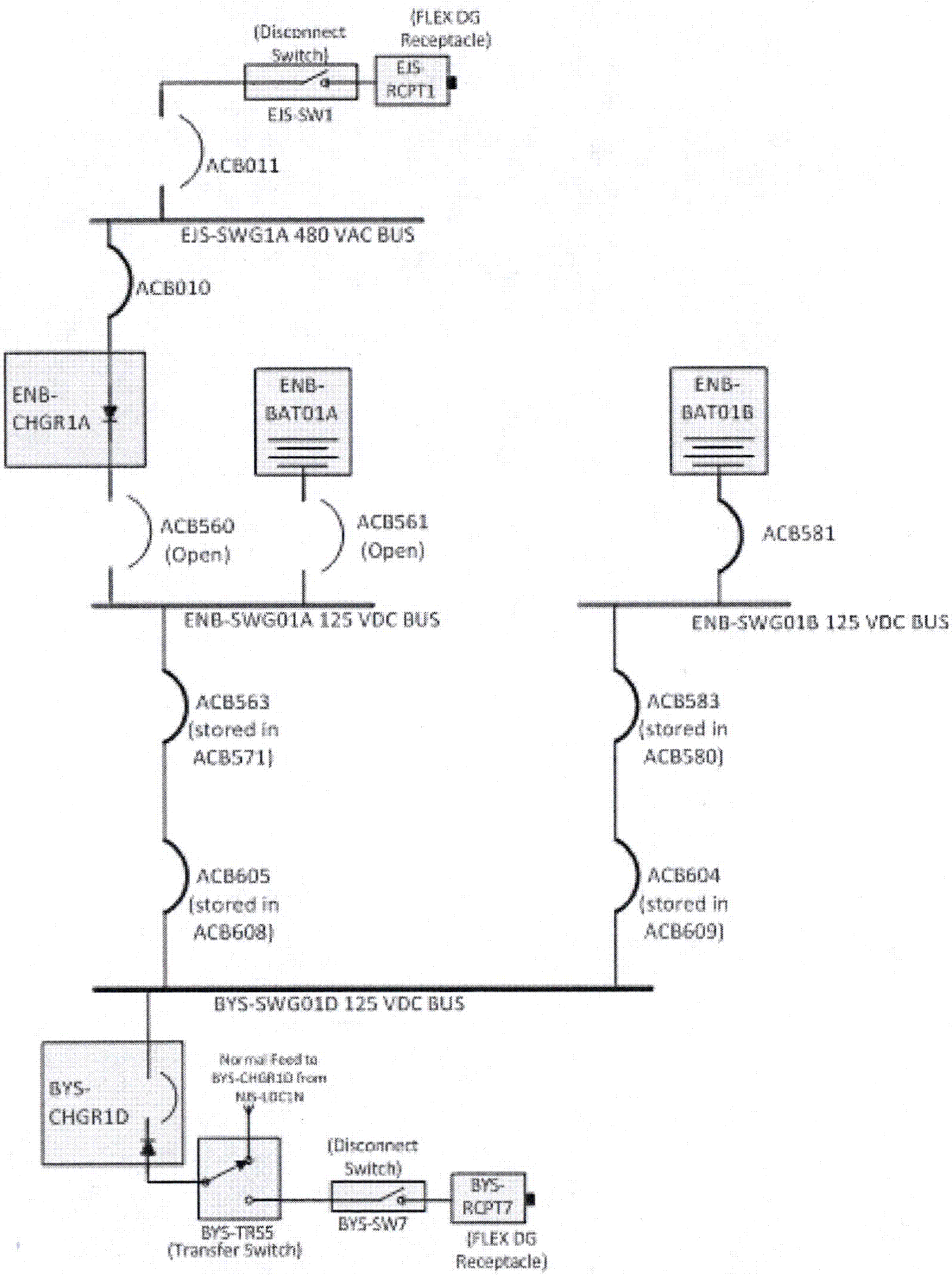

Figure 3 - Division II to Division I Battery Cross-tie

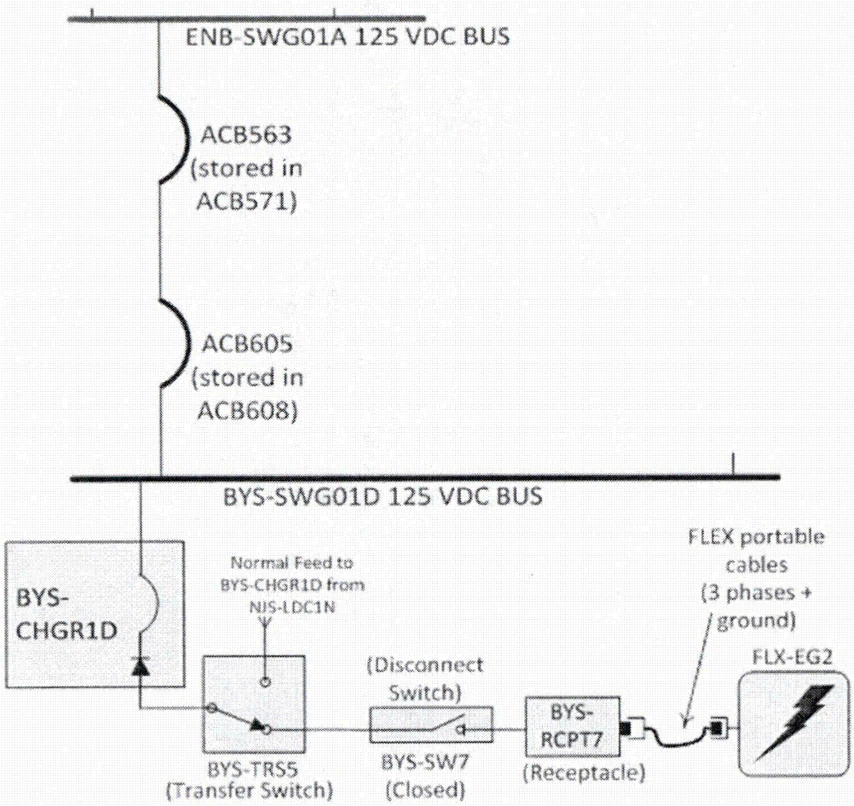

Figure 4 - Alternate DC Charger Power

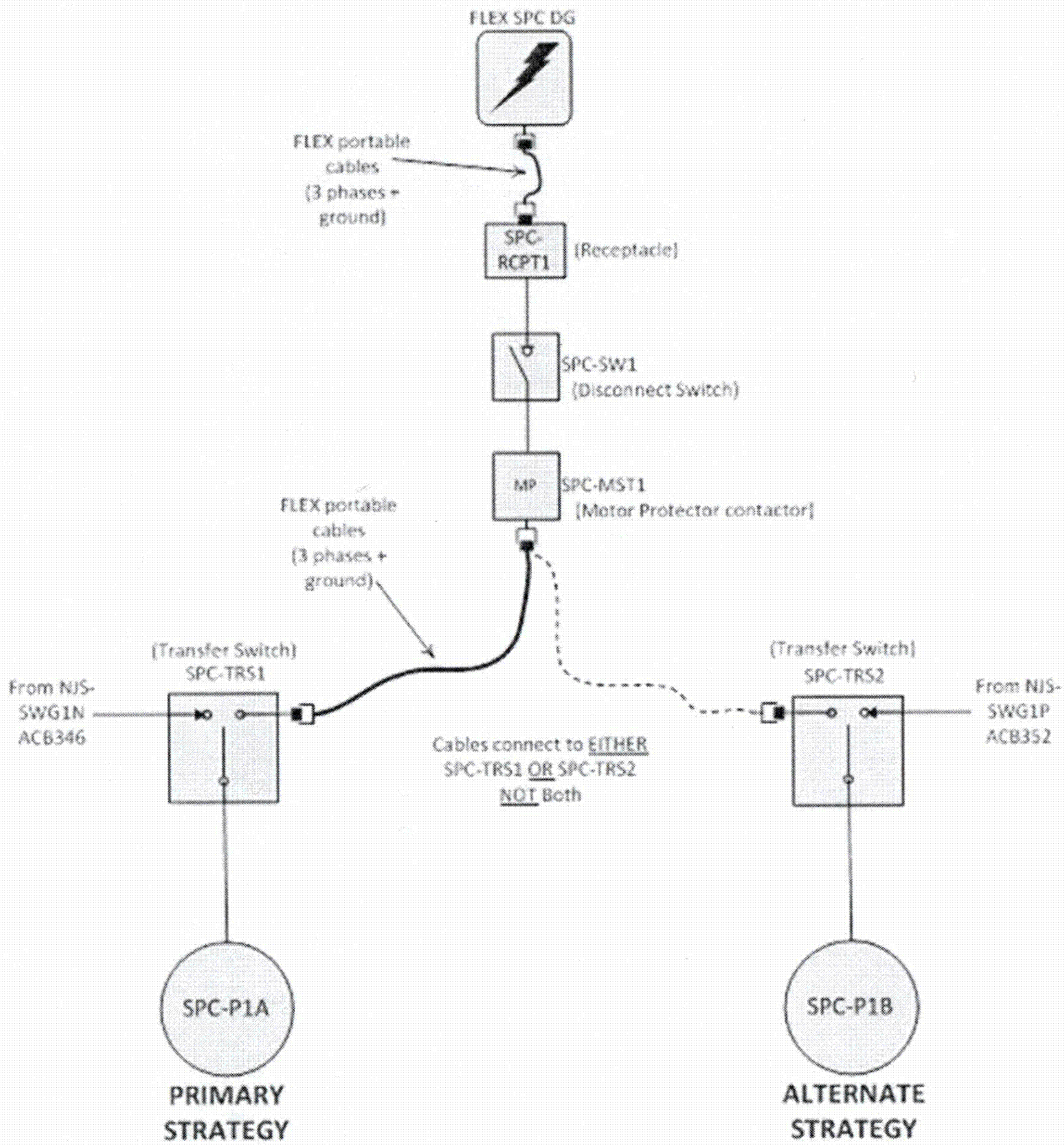

Figure 5 - SCP Pump Electrical Power

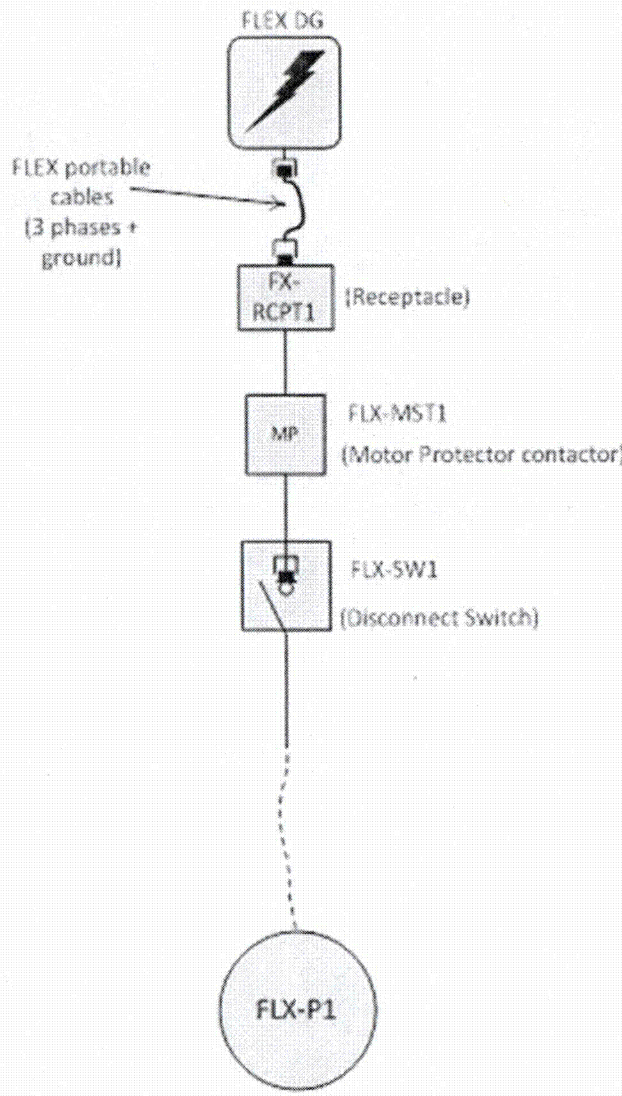

Figure 6 - Pump FLX-P1 Electrical Power

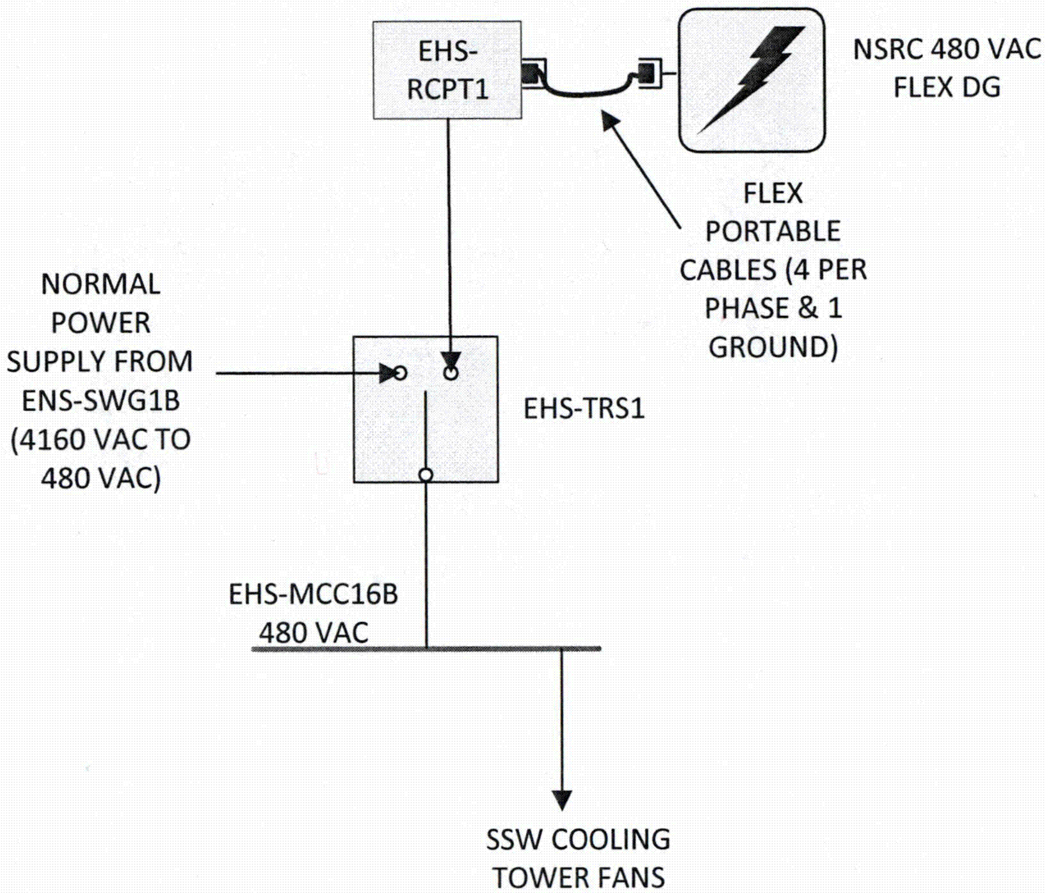

Figure 7 - Standby Cooling Tower Fans Electrical Power

2.5 Containment Integrity

During the BDBEE containment integrity is maintained by normal design features of the containment, such as the containment isolation valves and heat removal utilizing portions of the SPC system. As the SP heats up due to RCIC operation and relief valve operation, the containment will begin to heat up and pressurize. The FLEX strategy is based on using the SPC pumps and heat exchanger and cooling water from the SCT basin to cool the SP for containment heat removal. This is initiated as part of Phase 2 and occurs 8 hours after the ELAP/BDEEE event.

Plant-specific MAAP4 analyses have concluded that containment and drywell temperatures and pressures will remain below their design limits. The peak SP water temperature exceeds the 185°F design temperature for a short period of time (total of approximately 8 hours) but that is acceptable given that containment pressure remains at least 5 psi below its design limit of 15 psig. The analysis also demonstrates that a general cooling trend is established at 8 hours when SP cooling via the SPC pump and heat exchanger is established and the reactor can be totally depressurized to allow direct SPC injection without challenging containment integrity.

2.5.1 Phase I

During Phase 1, containment integrity is maintained by normal design features of the containment, such as the containment isolation valves, with the exception of those MOVs which will fail as-is. SBO procedure AOP-0050 [Reference 3.28] contains instructions for manual isolation of important containment isolation valves. Since, in accordance with NEI 12-06, no non-mechanical valve or pipe failures need be postulated, the containment is assumed to be isolated following the event. As the SP heats up, the containment atmosphere will begin to heat up and slightly pressurize. Eight hours after the ELAP, containment pressure will reach ~7 psig, which is well under the 15 psig design pressure.

The Phase 1 coping strategy for containment involves monitoring containment temperature and pressure and SP temperature and level using installed instrumentation. Monitored instruments include primary containment pressure (CMS-PT4A), primary containment temperature (CMS-RTD41A), suppression pool water level (CMS-LT23A), and suppression pool temperature (CMS-RTD40A).

Hydrogen Igniters

The NEI guidelines state that hydrogen igniters for Mark III containment units should have a "prioritization approach for deployment." That is, under the extreme conditions postulated in the guidance, a prioritization approach should be outlined to support on-site staff decision-making on whether resources should focus on deployment of FLEX capabilities for fuel damage prevention versus for containment protection following fuel damage. This is required even though the FLEX scenario does not postulate that the fuel becomes uncovered such that significant hydrogen production is expected. If the plant staff determines that the installed equipment is functioning well, repowering of hydrogen igniters may become a lower priority than deploying other coping equipment.

Hydrogen igniters are normally AC powered by EHS-MCC2A for Div. I and EHS-MCC2K for Div. II. This power will be lost in the FLEX event. FLEX procedures contain the steps needed to repower the igniters using a hydrogen igniter PDG. A hydrogen igniter PDG is stored in each FLEX storage building.

2.5.2 Phase 2

At t~8 hours, SP cooling is initiated using the SPC system as described in Section 2.3.2. This will result in a gradual reduction in SP temperature after peaking at approximately 208°F at about 8 hours. The temperature drops to approximately 170°F in 50 hours and then increases to ~185 °F when the RPV is depressurized for SPC core cooling. The SP temperature will then continue on a gradual trend downward. Containment pressure increases to approximately 9 psig prior to decreasing due to pool cooling. SP level will continue to rise until external sources of injection (i.e. UCP) are terminated. Water will reach a level of ~27' in the containment (and eventually in the drywell). There are no adverse consequences at this level and the expected containment pressure is well within the primary containment pressure limit (PCPL) in EOP-0001 (Reference 3.12).

2.5.3 Phase 3

Primary Strategy

The intent is to extend Phase 2 strategies long term with no immediate reliance on equipment from the National SAFER Response Centers (NSRC).

Continued operation of the Phase 2 strategy using SPC equipment is acceptable based on References (3.21 and 3.22). These analyses evaluated that a SPC pump along with the SPC heat exchanger and a FLEX1 or FLEX 2 cooling water pump can sustain core cooling past 72 hours. Phase 3 is considered to begin when the SSW cooling tower fans are repowered from a 480V NSRC PDG connected to EHS-MCC16B.

Alternate Strategy

The alternate strategy is to utilize additional FLEX equipment from the NSRC. The reactor core cooling strategy is to use the "B" loop of RHR in the alternate method of DHR or in the normal SDC mode (Reference 3.77). One of the two 2500 gpm FLEX pumps (i.e., the FLEX pump being used in the Phase 2 strategy) will provide flow from the basin to the SSW piping. This flow will be routed to the RHR B heat exchangers to allow cooling through that path. The RHR heat exchangers are designed to remove ~126 MBTU/hr under design conditions for suppression pool cooling with 5800 gpm SSW flow. Since the flow of the FLEX pump is 2500 gpm, it is estimated that the heat removal will be limited to about 60-80 MBTU/hr for SDC. At 72 hours, the decay heat removal requirement is ~48 MBTU/hr (Reference 3.16). Thus, SDC will be able to handle the necessary heat removal to keep vessel temperature <200°F, even with reduced SSW flow to the heat exchangers (Reference 3.23).

NSRC Equipment that will be utilized is listed in Table 5.

2.5.4 Structures, Systems, Components

2.5.4.1 Vent Strategy

The FLEX strategy does not include venting of the containment.

2.5.4.2 Suppression Pool Cleanup & Alternate Decay Heat Removal (SPC)

The SPC system is described in Section 2.3.4.5.

2.5.5 Key Containment Parameters

Instrumentation providing the following key parameters is credited for all phases of the Containment Integrity strategy:

- Primary containment pressure – device CMS-PT4A, indication is available in the MCR.
- Suppression pool water level – device CMS-LT23A, indication is available in the MCR.
- Suppression pool temperature – device CMS-RTD40A, indication is available in the MCR.
- Containment temperature – device CMS-RTD41A, indication is available in the MCR.

2.5.6 Thermal-Hydraulic Analyses

See Section 2.3.6.

2.5.7 Flex Pump and Water Supplies

See Section 2.3.9.

2.5.8 Electrical Analysis

See Section 2.3.10.

2.6 Characterization of External Hazards

2.6.1 Seismic

Per the RBS Updated Safety Analysis Report (USAR) (Reference 3.24, Section 2.5), the seismic criteria for RBS include two design basis earthquake spectra: Operating Basis Earthquake (OBE) and the Safe Shutdown Earthquake (SSE). The OBE and the SSE are 0.05g and 0.10g, respectively; these values constitute the design basis of RBS. Per NEI 12-06 Section 5.2 (Reference 3.3), all sites will consider the seismic hazard.

The RBS USAR was reviewed to perform a limited evaluation of the liquefaction potential outside the power block area for a design basis earthquake (SSE) event.

The potential for soil liquefaction for a design basis earthquake with maximum vibratory acceleration of 0.10g has been analyzed for the yard area and several structures (including the reactor building, the radwaste building, and the control building at RBS (Reference 3.24, Section 2.5.4.8). Results show a minimum factor of safety of 3 with respect to initial liquefaction for buried channel sands and gravels. Data clearly indicate a large margin of safety with respect to liquefaction of the foundation soil and compacted backfill supporting the seismic category I structures. Similar analyses for the soil supporting the turbine building under OBE loading indicate large margins of safety against liquefaction.

In accordance with the NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding the Seismic Aspects of Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident (Reference 3.48), a seismic hazard and screening evaluation was performed for RBS (Reference 3.49). A ground motion response spectrum (GMRS) was developed solely for purpose of screening for additional evaluations in accordance with the EPRI Seismic Evaluation Guidance - Screening, Prioritization and Implementation Details (SPID) (Reference 3.50). Based on the results of the screening evaluation, no further evaluation will be performed for RBS.

2.6.2 External Flooding

The design basis flood level (DBFL) is 96 ft mean sea level (MSL) which is limited by regional precipitation (Reference 3.24, Table 3.4-1). The grade level is a minimum of 90 ft MSL and the average plant grade is 94.5 ft MSL. Therefore, RBS screens in for an assessment of external flooding.

In accordance with the NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding the flooding aspects of Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident (Reference 3.48), a reevaluation of flooding hazards at RBS was performed (Reference 3.51). The reevaluation represents the most current flooding analysis. The reevaluation results were mostly bounded by the original USAR site flooding vulnerabilities and characteristics. However, reevaluation of flooding due to local intense precipitation (LIP) has resulted in a flooding height of 98.3 ft MSL versus the current licensing basis of 96 ft MSL. The reevaluated flood height is not expected to impact the FLEX strategy based on the following:

- Deployment paths: Flood depths are generally low (< 0.5 ft) in most deployment paths, but in some areas are significant (> 2 feet). Procedures and programs addressing moving FLEX equipment from storage areas account for the flood levels as well as any impact on deployment timing and FLEX equipment locations (RBS-FSG-005, Reference 3.76). This evaluation should consider the warning time and transient flood elevations that characterize the controlling flood mechanism (Local Intense Precipitation).

- Equipment Storage: Elevation of storage buildings is sufficient to preclude any impact from the LIP levels.

- Phase 2 FLEX Equipment Deployment and Connection: Flood levels in proposed locations of deployed FLEX Phase 2 equipment are expected to have largely receded prior to the time this equipment is connected and credited in the FLEX strategy. Even though the flood reanalysis shows that flood levels at doors to be opened to support the FLEX strategy will recede before the deployment strategy has them opened. RBS-FSG-005 (Reference 3.76) provides direction to utilize sand bagging or other suitable flood protection devices to prevent flood waters from entering open flood doors that may need to remain open for routing of portable electrical cables.

- Phase 3 Equipment: Deployment on-site of equipment from the Regional Response Center is not expected to be impacted due to recession of flood waters prior to Phase 3.

2.6.3 <u>Severe Storms with High Wind</u>

RBS is centered at 30°45'26" N latitude and 91°19'54" W longitude (Reference 3.24, Section 2.1.1.1). Per NEI 12-06 guidance, hurricane and tornado hazards are applicable to River Bend (Reference 3.3). NEI 12-06 Figures 7-1 and 7-2 were used for this assessment. Current plant design bases address the storm hazards of hurricanes, high winds and tornados.

All seismic category I structures are designed to withstand 100 mph fastest mile of sustained wind 30 ft above ground, based upon a 100-yr period of recurrence.

The design basis tornado parameters for the site are as follows:

- Maximum rotational wind velocity - 290 mph
- Maximum translational velocity - 70 mph
- Minimum translational velocity - 5 mph
- External pressure drop - 3.0 psi
- Rate of pressure drop - 2.0 psi/sec
- Radius at maximum rotational speed - 150 ft
- Tornado Missiles
    - 4 inch x 12 inch wood plank
    - 3-inch diameter steel pipe
    - 1-inch diameter steel rod
    - 6-inch diameter steel pipe
    - 12-inch diameter steel pipe
    - 13 ½ inch utility pole
    - Automobile

2.6.4 Ice, Snow and Extreme Cold

The guidelines provided in NEI 12-06 (Section 8.2.1) generally exclude the need to consider extreme snowfall at plant sites in the southeastern U.S. below the 35th parallel. The plant site is located at 30°45'26" N latitude and 91°19'54" W longitude (Reference 3.24, Section 2.1.1.1) and thus the capability to address extreme snowfall with snow removal equipment need not be provided.

The site is located within the region characterized by EPRI as ice severity level 3 (Reference 3.3, Figure 8-2). As such, the site is subject to the existence of considerable amounts of ice that could cause low to medium damage to electrical transmission lines.

Thus, RBS site screens in for an assessment for extreme cold for ice only.

2.6.5 High Temperatures

Per NEI 12-06 Section 9.2, all sites will address high temperatures. The climate of the site can be described as humid subtropical. Summer daily maximum temperatures average about 91°F, with rare periods of extremely hot temperatures over 100°F [Reference 3.24].

An extreme high temperature of 110°F was recorded in August 1909 at the old weather station located in the south end of the Baton Rouge business district. The FLEX equipment will be procured to function in high temperatures and consideration will be given to the impacts of these high temperatures on equipment storage and deployment; however, extreme high temperatures are not expected to impact the utilization of off-site resources or the ability of personnel to implement the required FLEX strategies.

2.7 Planned Protection of Flex Equipment

Equipment used to support Phase 2 of FLEX is stored in two pre-engineered metal storage buildings. Protection of FLEX equipment against high wind hazard events will be performed in accordance with Section 7.3.1.1.c of NEI 12-06, which states that the equipment should be stored in buildings that are separated by sufficient distance that minimizes the probability that a single event would damage all FLEX mitigation equipment. The buildings are located at a distance of over 3,000 ft. from each other perpendicular to the prominent tornado paths in order to provide adequate tornado separation (Reference 3.52). This separation assures that at least one of the storage buildings will be available following a BDBEE.

Due to this separation, the buildings are not tornado missile protected. The building design is required to bound ASCE 7-10, site wind speeds from RBS 200.010 (other than tornadoes) (Reference 3.54) and ASCE 7-05 to satisfy NEI 12-06 and the local building authority. The bounding 3-second gust, service level wind speed is 116 mph per Table 1 below. The storage buildings were conservatively designed to withstand a service level wind speed of 130 mph using the methodology from ASCE 7-05. This wind speed bounds the plant basic wind speed and the local building code wind speed.

Table 1 - RBS Wind Speeds

Reference	Basic Wind Speed and Datum	3-Second Gust	Service Level Wind Speed
RBS 200.010	100, fastest mile	116(1)	116
ASCE 7-05	100, 3-second gust	100	100
ASCE 7-10	120, 3-second gust	120	95(2)

Notes:
1) $V_{3\text{-second gust}} = (V_{\text{fastest mile}} \times 1.05) + 10.5$
2) $V_{\text{service level}} = V_{\text{factored design}} / 1.6^{1/2}$

Large portable FLEX equipment such as pumps and power supplies are positioned inside the FLEX storage building with enough separation space to protect them during a seismic event. Calculation G13.18.15.2-148 (Reference 3.55) provides the separation distance of the equipment within the building to ensure that they will not interact with each other during a seismic event. As long as the equipment is stored at a distance equal to or greater than the minimum distance of 15 inches it is not required to be tied down. Tie-down points are provided in the building slab so that equipment may be stored closer together if necessary. These tie downs are to be used to secure any equipment that is not considered stable or that is needed to be stored closer than the minimum separation distance of 15 inches.

Protection of FLEX equipment against external flooding events is performed in accordance with Section 6.2.3.1.1.a of NEI 12-06, which states that equipment is protected from floods if it is stored above the flood elevation from the most recent site flood analysis. Per RBS USAR Table 3.4-1 (Ref. 3.24), the design basis flood level at RBS is 96 ft MSL due to SSE condition combined with a 25 year flood. The northern storage building location is located at an elevation of 132 ft. and the southern storage building location is located at an elevation of 110 ft.

Protection of FLEX equipment from impacts due to extreme cold is performed in accordance with Section 9.3.1 of NEI 12-06, which states that equipment should be maintained at a temperature within a range to ensure its likely function when called upon. In accordance with Section 8.3.1.b of NEI 12-06 the storage of equipment shall be in a structure designed to or evaluated equivalent to ASCE 7-10 for the plant's design basis for the snow, ice and cold conditions. The plant's design basis low temperature is 2°F, per specification 215.200 (Reference 3.56). The indoor cold temperature limit bounds this ambient temperature to ensure the equipment function when called upon.

Central heating is not utilized. Electrical receptacles are available for local heating elements, which may be necessary depending on the equipment and fuel storage requirements. A procedure has been developed to provide guidance for protection of stored equipment against cold weather in the case of a loss of power to the storage buildings. Additionally the procedure provides guidance for determining when action will be required to implement protection of stored equipment against cold weather (i.e. powering block heaters, battery maintainers, etc.).

Protection of FLEX equipment from impacts due to extreme high temperatures is performed in accordance with Section 9.3.1 of NEI 12-06, which states that equipment should be maintained at a temperature within a range to ensure its likely function when called upon. The extreme high ambient temperature of 110°F is found in specification 215.200 (Reference 3.56). The indoor temperature limit of the buildings is a maximum of 120°F based on guidance from equipment vendors whom have provided acceptable storage temperatures for typical components within major FLEX equipment. Electrical equipment, installed in the storage buildings, is designed and sized to operate within the extreme temperature conditions of the storage buildings (Reference 3.79).

The building ventilation consists of natural circulation through louvers or the use of fans.

Automatic fire detection is installed in the building in lieu of fire suppression, per Section 3.2.21 of the NEIL Loss Control Manual. The design of the fire detection system is in accordance with NFPA 72. Additionally, hand-held fire extinguishers in accordance with NFPA 10 and emergency lighting of all exits in accordance with Section 7.10 of NFPA 101 are provided in the buildings (Reference 3.79).

A building security system with motion sensors is provided for detection of intruders. The storage buildings contain smart dialers to alert the MCR and site security in the event of fire or if building security is compromised.

Debris removal and towing equipment is also stored inside the FLEX Storage Buildings in order to be reasonably protected from the applicable external events such that the equipment is likely to remain functional and deployable to clear obstructions from the pathway between the FLEX equipment's storage location and its deployment location(s). This includes mobile equipment such as a front end loaders and tow vehicles (trucks) that are stored inside the FLEX storage buildings.

Deployment of the FLEX and debris removal equipment from the FLEX storage buildings is not dependent on off-site power. All required actions can be accomplished manually.

2.8 Planned Deployment of Flex Equipment

2.8.1 Haul Path and Accessibility

Pre-determined haul paths have been identified and documented in the FSGs. Figure 8 shows the haul paths from the FLEX storage buildings to the various deployment locations. These haul paths have been reviewed for potential soil liquefaction and have been determined to be stable following a seismic event. Additionally, the haul paths attempt to avoid areas with trees, power lines, narrow passages, etc. when practical. However, high winds can cause debris from distant sources to interfere with planned haul paths. Debris removal equipment is stored inside the FLEX storage buildings to be protected from the severe storm and high wind hazards such that one set of equipment remains functional and deployable to clear obstructions from the pathway between the FLEX storage buildings and its deployment location(s).

The potential impairments to required access are: 1) doors and gates, and 2) site debris blocking personnel or equipment access. The coping strategy to maintain site accessibility through doors and gates is applicable to all phases of the FLEX coping strategies, but is immediately required as part of the immediate activities required during Phase 1.

Doors and gates serve a variety of barrier functions on the site. One primary function is security and is discussed below. However, other barrier functions include fire, flood, radiation, ventilation, tornado, and HELB. As barriers, these doors and gates are typically administratively controlled to maintain their function as barriers during normal operations. Following an a BDBEE and subsequent ELAP event, FLEX coping strategies require the routing of hoses and cables through various barriers in order to connect FLEX equipment to station fluid and electric systems. For this reason, certain barriers (gates and doors) will be opened and remain open. This violation of normal administrative controls is acknowledged and is acceptable during the implementation of FLEX coping strategies.

The ability to open doors for ingress and egress, ventilation, or routing of temporary cables/hoses is necessary to implement the FLEX coping strategies. Security doors and gates that rely on electric power to operate opening and/or locking mechanisms are barriers of concern. The security force will implement an access contingency upon loss of the security diesel and all AC/DC power as part of the security plan. Access to the owner controlled area, site protected area, and areas within the plant structures will be controlled under this access contingency as implemented by security personnel.

The deployment of onsite FLEX equipment to implement coping strategies beyond the initial plant capabilities (Phase 1) requires that pathways between the FLEX storage building(s) and various deployment locations be clear of debris resulting from BDB seismic, high wind (tornado), or flooding events.

The stored FLEX equipment includes two heavy duty pickup trucks equipped for towing of FLEX equipment and trailers and two front end loaders for debris removal and towing. One truck and one front end loader is stored in each FLEX storage building.

Vehicle access to the protected area is via the double gated sally-port at the security building. As part of the security access contingency, the sally-port gates will be manually controlled to allow delivery of FLEX equipment (e.g., generators, pumps) and other vehicles such as debris removal equipment into the protected area.

Phase 3 of the FLEX strategies involves the receipt of equipment from offsite sources including the NSRC and various commodities such as fuel and supplies. Transportation of these deliveries can be through airlift or via ground transportation. Debris removal for the pathway between the site and the NSRC receiving location and from the various plant access routes may be required. The same debris removal equipment used for on-site pathways will be used to support debris removal to facilitate road access to the site. RBS also has an agreement with a vendor to assist with debris removal on the offsite haul path.

2.9 Deployment of strategies

2.9.1 Core Cooling Strategy

Section 2.3.2 provides additional detail for the core cooling strategy. Prior to transition to Phase 2, the PDGs for the SPC pump and the FLX1-P1 pump are deployed beginning at 6 hours and setup for operation by 8 hours after the BDBEE. The primary deployment location for the SPC PDG is in the west canyon. The connection from the PDG is made to receptacle SPC-RCPT1 located in the west AB stairwell on the 98ft elevation. The cabling is routed through exterior security gate AB098-G2 and west stairwell exterior door AB098-06.

The FLEX PDG (stored in south FLEX storage building) for the SSW FLX-P1 pump is deployed to the north side of the FB near security gate FB098-G2. The power cables are routed through this gate to receptacle FLX-RCPT1 located on the north interior wall of the FHB near door FB098-01. The FLX-P1 pump is permanently staged in the "G" tunnel. Six inch flexible hoses stored in the tunnel are used to establish the pump suction to the SCT basin and the pump discharge connection to the SSW "B" piping.

The diesel-driven SSW FLX-P2 pump (stored in north FLEX storage building) is deployed to the southeast side of the SCT. This pump is an alternate to the permanently staged SSW FLEX-P1 pump. Six inch flexible hoses are connected to piping connections at grade level to establish the pump suction to the SCT basin and the pump discharge connection to the SSW "B" piping. Six inch flexible hoses stored in the tunnel are used to establish the required connections.

2.9.2 Alternate Core Cooling Strategy

Section 2.3.2 provides additional detail for the alternate core cooling strategy. FLEX 3 pump (FLX-P3 or FPW-P4), which is used for SFP makeup, is also the alternate core cooling pump. One of these diesel driven pumps is deployed to the southeast side of the SCT and takes suction from the SCT basin through six inch flexible hose. Two and one-half inch fire hose is routed from FLX-P3/FPW-P4 discharge to the West side of the AB, through AB security gate AB098-G2, west stairwell exterior door AB098-06, up the AB west stairwell, through AB door AB141-02, and then to LPCS discharge line flush connection at valve E21-VF025.

2.9.3 Containment Strategy

Section 2.5.2 provides additional detail for the containment strategy. The containment heat removal strategy uses the FLX-P1 pump, the SPC pump, their associated PDGs and the SPC heat exchanger or the FLX-P2 pump, the SPC pump and its associated PDG, and the SPC heat exchanger. These components are first used for containment heat removal until the UCP water source is depleted and RCIC is no longer viable. At that time the SPC discharge is realigned to establish core cooling and continue containment heat removal. The components are deployed as described in Section 2.9.1.

The FLEX DG for the hydrogen igniters is deployed to the west side of the AB near exterior security gate AB098-G2 and west stairwell exterior door AB098-06. Cabling is routed from the PDG to panels HCS-PNL01A1 and HCS-PNL01A2 on elevation 141'-0".

2.9.4 Electrical Strategy

Section 2.3.2 provides additional detail for the electrical strategy. The FLEX PDG for battery charging is deployed to the west side of the CB as near as feasible to CB west side outside access door CB098-17. The power cables are routed through outside access door CB-098-17, southeast stairwell door CB098-15 and keycard door CB098-14 to receptacle EJS-RCPT1 in the 98ft west corridor.

2.9.5 Fueling of Equipment

The FLEX strategies for maintenance and/or support of safety functions involve several elements including the supply of fuel to necessary diesel powered generators, pumps, hauling vehicles, etc. The general coping strategy for supplying fuel oil to diesel driven portable equipment, i.e., pumps and generators, being utilized to cope with an ELAP / LUHS, is to draw fuel oil out of any available existing diesel fuel oil tanks on the RBS site.

The primary source of fuel oil for portable equipment is the three EDG fuel oil storage tanks. Each tank contains a minimum volume of 38,996 gallons (Reference 3.63). These tanks are contained in the diesel building and therefore are protected from all hazards.

The quality of fuel oil in EDG fuel oil storage tanks is maintained in accordance with the diesel fuel oil testing program (reference RBS Technical Specifications 5.5.9). Fuel oil in the fuel tanks of portable diesel engine driven FLEX equipment will be maintained in the preventative maintenance program in accordance with the manufacturer's guidance and existing site maintenance practices.

Fuel oil will be transported to FLEX equipment in 500 gallon fuel tanks mounted on a portable trailer. This trailer will be deployed to the east side of the Division 2 EDG room. The primary strategy involves repowering existing fuel transfer pump EGF-P1B to fill the trailer mounted fuel tank. The alternate strategy utilizes an electric-driven portable pump and hose to fill the portable fuel tank. The portable trailer will be towed by a super duty pickup truck to the refueling staging area. Fuel will be pumped from the trailer mounted fuel tank to the diesel engine driven FLEX equipment by an electric fuel pump on the trailer.

Based on a fuel consumption study (Reference 3.53), the total diesel fuel consumption for all FLEX equipment during the initial 72 hours is 10,146 gallons. The fuel truck has sufficient capacity to support continuous operation of the major FLEX equipment expected to be deployed and placed into service following a BDBEE. At this conservative fuel consumption, the three underground fuel oil storage tanks, which are protected from BDB external hazards, have adequate capacity to provide the on-site FLEX equipment with diesel fuel for >30 days.

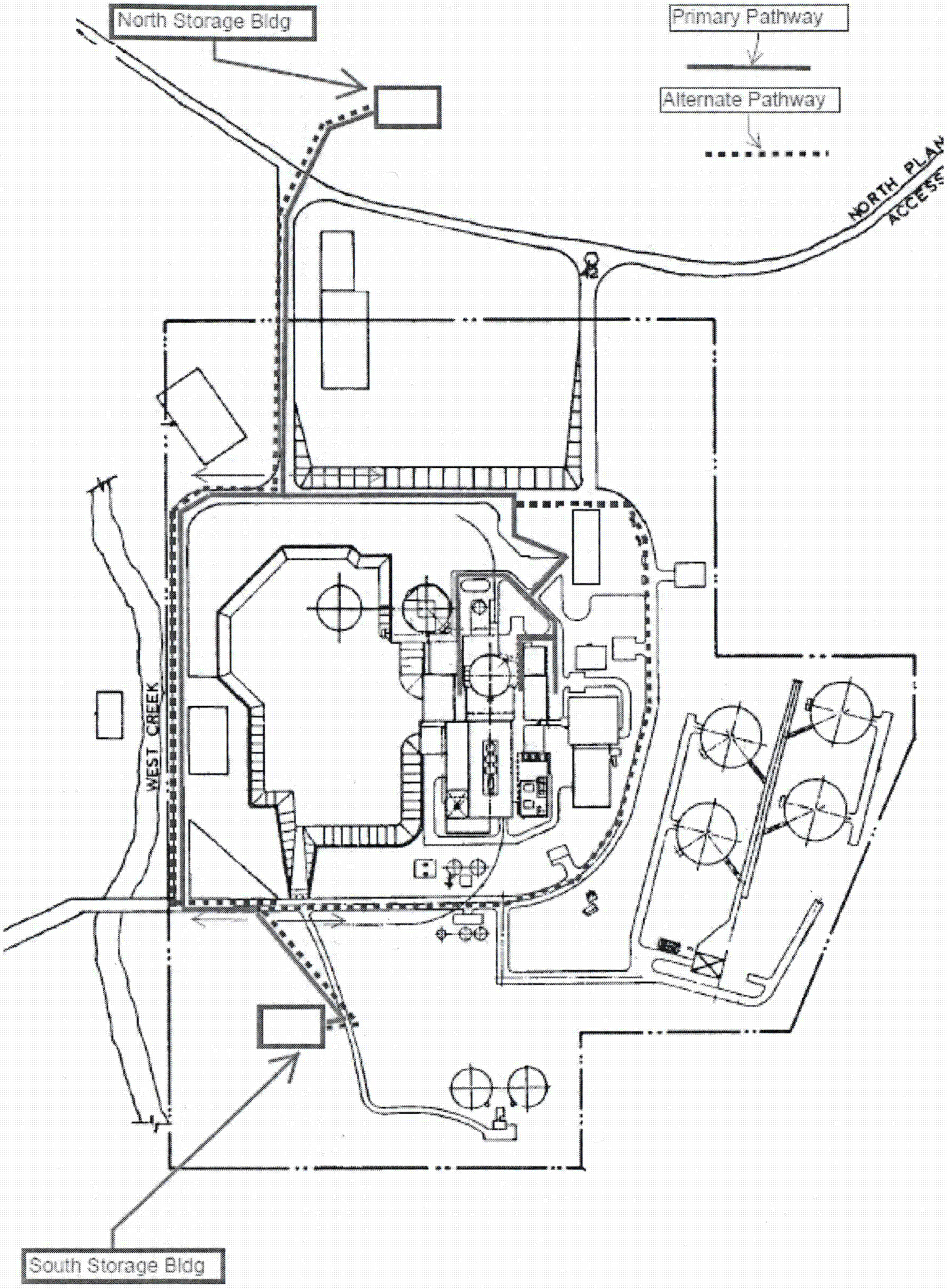

Figure 8 Deployment Paths

2.10 Offsite Resources

2.10.1 National SAFER Response Center

The industry has established two National SAFER Response Centers (NSRCs) to support utilities during BDBEEs. Entergy has established contracts with the Pooled Equipment Inventory Company (PEICo) to participate in the process for support of the NSRCs as required. Each NSRC will hold five sets of equipment, four of which will be able to be fully deployed when requested, the fifth set is assumed to be in a maintenance cycle. In addition, on-site FLEX equipment hose and cable end fittings are standardized with the equipment supplied from the NSRC or utilize adapters stored in the FLEX storage buildings. In the event of a BDBEE and subsequent ELAP/LUHS condition, equipment will be moved from an NSRC to a local assembly area established by the Strategic Alliance for FLEX Emergency Response (SAFER) team. For RBS, the local assembly area is the Livingston Parish Fair Grounds. The alternate assembly area is the Crosby Municipal Airport in Crosby, Mississippi. From these sites, equipment can be taken to the RBS site and staged south of the north FLEX storage building by helicopter if ground transportation is unavailable. Communications will be established between the site and the SAFER team via satellite phones and required equipment moved to the site as needed. First arriving equipment will be delivered to the site within 24 hours from the initial request. The order at which equipment is delivered is identified in the RBS's "SAFER Response Plan."

2.10.2 Equipment List

The equipment stored and maintained at the NSRC for transportation to the local assembly area to support the response to a BDBEE at RBS is listed in Table 5. Table 5 identifies the equipment that is specifically credited in the FLEX strategies for RBS but also lists the equipment that will be available for backup/replacement should on-site equipment break down. Since all the equipment will be located at the local assembly area, the time needed for the replacement of a failed component will be minimal.

2.11 Habitability and Operations

2.11.1 Equipment Operating Conditions

Following a BDBEE and subsequent ELAP event at RBS, ventilation providing cooling to occupied areas and areas containing FLEX strategy equipment will be lost. Per the guidance given in NEI 12-06, FLEX strategies must be capable of execution under the adverse conditions (unavailability of installed plant lighting, ventilation, etc.) expected following a BDBEE resulting in an ELAP/LUHS. The primary concern with regard to ventilation is the heat buildup which occurs with the loss of forced ventilation in areas that continue to have heat loads. A loss of ventilation analyses was performed to quantify the maximum steady state temperatures expected in specific areas related to FLEX implementation to ensure the environmental conditions remain acceptable for personnel habitability or accessibility and within equipment limits.

The key areas identified for all phases of execution of the FLEX strategy activities are the MCR, RCIC room, switchgear rooms and battery rooms.

2.11.1.1 Main Control Room

GOTHIC analysis (Reference 3.64) of the MCR over a period of 72 hours following an extended loss of AC power considered several mitigating actions beyond removal of ceiling tiles as directed in the SBO AOP to maintain the MCR at an acceptable maximum temperature of 110°F, the limit for human performance as specified in NUMARC 87-00 (Reference 3.8). The GOTHIC analysis determined that a 2000 cfm fan must be used to exhaust control room air through the control room door and into the adjacent stairwell. Doors CB157-01, CB157-02, CB136-09, CB136-05, and CB126-G1 will need to be propped open to establish a flow path to dissipate heat through the building roof. This action may be delayed up to 30 hours following an ELAP.

2.11.1.2 RCIC Room

It is not anticipated that the RCIC room will require occupation by personnel during the event. The only case where personnel would be required to enter the RCIC room will be during Phase 1 if remote operation fails. Gothic analyses (Reference 3.65) determines the RCIC room transient temperature response for 72 hours following an ELAP. If mitigating actions are not performed (i.e., room doors remain closed), the maximum RCIC room temperature is 174 °F throughout the event, which is below the maximum allowable room temperature criteria of 200°F. The calculation concludes that operation of the RCIC system at bthis temperature is acceptable for a prolonged station blackout of at least 72 hours duration.

As shown on drawings EB-003AB and EB-003BB, the RCIC room (Fire Area AB-4, Zone 2) has a preaction sprinkler fire suppression system (PS-1). Fire detection for these areas is provided by smoke detector (SD-96) rather than thermal detectors. As shown on P&ID PID-15-01C and panel drawing 244.800-319-024, the smoke detectors system (SD-96) sends a signal to RDAC-12 which allows the deluge valve, FPW-V286 to open. For conservatism, it is assumed that smoke detector SD-96 will fault in the expected steamy environment that will exist in the room during this event. This is due to the gland seal compressor being removed from service for deep load shedding of the station batteries. This will result in the deluge piping being provided with water pressure from the fire protection system. Specification 214.400 (Reference 3.66) shows that the PS-1 sprinkler system is equipped with 165°F upright sprinklers. Because calculation the Gothic analysis (Reference 3.65) determines a maximum room temperature of 174°F it must be assumed that the nozzles will open and water spray would occur. In order to preclude negative impact to the operation of the RCIC pump due to water spray or room flooding, it is required that operator action be taken to isolate this system before this occurs. Manual isolation of the RCIC room sprinkler system can be achieved by closing valve FPW-V252, which is located on the 95' elevation of the auxiliary building. This valve isolates just the RCIC room such that no other area sprinkler systems would be impaired. From Figure 1 of the room heat-up analysis, this action would need to be taken within approximately 9.5 hours from the startup of the RCIC pump before the room temperature approaches 165°F.

Directions to close the valve before this time have been included in the FSGs.

2.11.1.3 Standby Battery Rooms

A Gothic analysis (Reference 3.67) for the battery rooms determines the temperature in the Division 1, 2, and 3 battery rooms for 72 hours following a BDBEE resulting in an ELAP. From NEI 12-06 (Reference 3.3), the effects of loss of HVAC in an extended loss of AC power event can be addressed consistent with NUMARC 87-00 (Reference 3.8). Based on Appendix F of NUMARC 87-00, most equipment outside of containment is expected to operate in temperatures not to exceed 150°F. The maximum temperature reached in any one battery room is approximately 130°F at 72 hours. This assumes that operators will open doors to the battery rooms within 30 minutes following the ELAP, which is consistent with AOP-0060, Loss of Control Building Ventilation (Reference 3.25). Equipment from the regional response center will be onsite at 72 hours which will be able to provide sufficient room cooling, therefore equipment contained in those rooms will remain capable of performing design functions. The standby battery rooms are not provided with a sprinkler fire protection system so there is no concern with inadvertent actuation.

An additional ventilation concern applicable to Phase 2 is the potential buildup of hydrogen in the battery rooms. Off-gassing of hydrogen from batteries is only a concern when the batteries are charging. Once a 480 VAC power supply is restored in Phase 2 and the Division 1 batteries begin re-charging, the ventilation fan for the Division 1 battery room is also re-powered and will prevent any significant hydrogen accumulation. However, the alternate battery charging strategy does not repower the bus that provides power to the fan. In that case a portable fan and flexible duct is required for ventilation of the room (Reference 3.68).

2.11.1.4 Standby Switchgear Rooms

A Gothic analysis (Reference 3.69) determines the transient temperature response in the Division 1, 2 and 3 standby switchgear rooms for the 72 hours following BDBEE/ELAP.

From NEI 12-06 (Reference 3.3), the effects of loss of HVAC in an extended loss of AC power event can be addressed consistent with NUMARC 87-00 (Reference 3.8). Based on Appendix F of NUMARC 87-00, most equipment outside of containment is expected to operate in temperatures not to exceed 150 °F. Two cases are modeled in this calculation based on timing of operator actions; doors to switchgear rooms opened 30 minutes after ELAP and doors to switchgear rooms opened 1 hour and 30 minutes after ELAP. There is little variation in the long term results between the two cases. The maximum temperature achieved in any on switchgear room is approximately 130°F. This assumes that operators will open doors to the standby switchgear rooms following the ELAP, which is consistent with AOP-0060 (Reference 3.25). However, Case 2 demonstrates that if the provisions in AOP-0060 are not met, the operator could open the doors at 1 hour and 30 minutes and achieve the same room temperatures as the 30 minutes case. Equipment from the regional response center will be onsite at 72 hours which will be able to provide sufficient room cooling should additional buses in the rooms be repowered.

The standby switchgears rooms are not provided with a sprinkler fire protection system so there is no concern with inadvertent actuation.

2.11.1.5 DC Equipment Room A

Gothic room heatup analysis (Reference 3.70) determines the transient temperature response of the Division 1 DC equipment room for 72 hours following an ELAP and mitigating action(s) required to maintain the maximum temperature at or below the maximum allowable temperature of 130°F. Equipment located in the Division 2 and 3 DC equipment rooms is not credited in the FLEX strategy and were not evaluated. Ventilation is required to maintain the room temperature below 130°F. A 2500 CFM fan will maintain a final temperature of 128°F while a 5000 cfm fan will maintain the temperature at 125 °F. The fan is required to be in place once battery charging begins 8 hours after the BDBEE/ELAP.

The Division 1 DC equipment room is not provided with a sprinkler fire protection system so there is no concern with inadvertent actuation.

2.11.2 Heat Tracing

The FLEX Strategy does not have dependency on heat tracing for any required equipment after the initiation of the event. The FLEX equipment is protected from low temperatures and freezing during normal plant operation using electric heaters.

2.12 Personnel Habitability

Personnel habitability was evaluated for the MCR in Section 2.11.1.1 above and determined to be acceptable.

Entergy industrial safety procedures currently address activities with a potential for heat stress to prevent adverse impacts on personnel (Reference 3.71).

2.13 Lighting

Following the BDBEE, emergency lighting is retained for the MCR via Appendix R lighting. Battery-powered Appendix R lighting will be available during Phase 1 as required by 10CFR50 Appendix R. Once the PDG is connected and supplying power to EJS-SWG1A, MCR lighting will be restored via power from EHS-MCC14A, which powers the Div. I battery room exhaust fans and backup lighting in the MCR. Portable lighting will be available for operators in order to perform the functions required during Phase 1 and subsequent phases of operation in areas where there is not Appendix R lighting.

Emergency portable LED lights with stands are available for use during an ELAP event and are available in the technical support center (TSC) and operations support center (OSC). Additional lighting stands are stored in the storage buildings. The preferred deployed locations of the portable diesel driven light towers are the east and west sides of the control building, west side of the auxiliary building, and south east corner of the SCT. The portable FLEX pumps have LED lights mounted on them for area lighting. The large PDGs have tripod LED lights stored on them which will be also used for area lighting.

In addition to installed Appendix "R" lighting, the portable LED lights and portable light towers, the FLEX storage building will also include a stock of flashlights and head lights to further assist the staff responding to a BDBEE during low light conditions. Flashlights and heal lights are also stored in the OSC/TSC lockers.

2.14 Communications

RBS has communication capabilities with off-site response organizations, the NRC, between emergency response facilities, with field and off-site monitoring teams, and with in-plant and off-site emergency response organization staff. An assessment of communications assuming a large-scale natural event, which would lead to an extended loss of all AC power was performed and described in Reference 3.72. As part of this assessment, RBS identified enhancements/changes to maintain communications capabilities for responding to emergency events.

Changes resulting from design evolution occurred such that some of the original strategies communicated to the NRC in RBG-47335 were revised. The implemented design ensures the required power and physical protection from flooding, wind, and seismic events are provided for the essential equipment per NEI 12-01. The BDBEE communications strategy inside the plant power block buildings relies on radio consoles (also called audio consoles) in the MCR and hand-held portable radios elsewhere in the plant. Communications outside of the plant rely on deployable or hand-held satellite phones. Additionally, one permanently mounted satellite phone, installed in the services building, provides satellite phone service to the MCR via existing copper phone wires to handsets on the Control Room Supervisor's (CRS) desk and to the Emergency Plant Manager's (EPM) position located in the TSC.

Overall, a total of twelve deployable and eleven handheld satellite phones and thirty handheld radios are provided as part of the communications enhancement. These phones and radios are staged at their appropriate locations.

A combination of batteries and uninterruptible power supplies (UPSs) to power site communications equipment is available. Each satellite phone is provided a 24 hour power supply capability through batteries, including two fully charged spare batteries stored with the phones. Radios are provided a 24 hour power supply capability through batteries including two fully charged spare batteries stored with the phones. Four UPS units will provide 24 hours of back-up power for radio consoles, battery chargers, radio repeaters, amplifiers and other critical communications equipment. Three PDGs are required to assure EP communications equipment availability after the initial

24 hours following a BDBEE. During normal plant operation these PDGs are stored on individual trailers in FLEX storage facilities.

2.15 Water sources

Table 2 provides a list of potential water sources that may be used to provide cooling water to the RPV or the SFP, their capacities, and an assessment of availability following the applicable hazards identified in Section 2.6. Descriptions of the preferred water usage sources identified in Table 2 are provided below and are in sequence in which they would be utilized, based on their availability after an ELAP/LUHS event. As noted in Table 2, at least three water sources would survive all applicable hazards for RBS and are credited for use in FLEX strategies.

Even though RCIC is normally aligned to the CST, the CST is not credited for FLEX because the tank is not seismically designed or protected from missiles. However, the CST could be utilized as the initial source of RPV makeup if the ELAP/LUHS initiating event is not due to a seismic or missile generating event. The SP is the initial source of water for RCIC for ELAP/LUHS events which result in the loss of the CST. At approximately 4 hours, RCIC suction is transferred to the UCP because of increasing SP temperature. The available volume in the UCP is depleted at approximately 34 hours. At approximately 8 hours SP cooling is initiated using a SPC pump and the SPC heat exchanger with cooling water provided by the FLEX 1 or FLEX 2 pump from the SCT basin. The primary strategy for core cooling after the UCP depletes is realignment of the SPC heat exchanger discharge line from the SP to the RPV. This alignment satisfies both the core cooling function and the containment heat removal function. An alternate path for core cooling if the SPC RPV injection path is not available is injection of SCT basin water through the LPCS injection line to the RPV using the FLEX 3 pump.

Makeup water to the SFP is provided from the SCT basin by the FLEX 3 pump. The required makeup due to boiloff is < 60 gpm starting at approximately 8 hours. NEI 12-06 also requires plants to have the capability of spray cooling at 200 gpm (or 250 gpm if overspray is an issue) to the SFP. RBS has this capability.

Because of the water loss from the SCT basin due to evaporation, makeup to the SFP and, if required alternate makeup to the RPV, makeup water to the basin must be established at 72 hours following the ELAP/LUHS. RBS has contracted with a vendor to provide resources for water makeup to the SCT basin. During the FLEX response, RBS operators will coordinate with the vendor for makeup to the SCT basin. Potential water sources onsite will be prioritized as the source of water based on the conditions following the event. The following onsite sources will be considered.

- two fire protection storage tanks
- circulating water system flume and cooling towers
- two clarifiers (4,850,000 gals each)

If these sources are not available the contractor is capable of providing 20,000 gallons of makeup water per hour by vacuum trucks beginning 72 hours following the ELAP/BDBEE. The trucks will take their suction from the old ferry landing in St. Francisville or from nearby, alternate river access points if necessary. There are also multiple routes available for delivering water and equipment. For long term makeup, the vendor will locate a portable pump near the Mississippi River and run 8 inch high pressure lay-flat hose from the river to the SCT basin.

Table 2 – Water Sources

Makeup Water Source	Min. Normal Volume (gals.)	Water Chemistry[2]	Seismic Qualification	Protection Against Flood[1]	Protection Against High Wind[1]	Protection Against Missile[1]
Condensate Storage Tank[3]	Hi Alarm 585,000 Lo Alarm 198,000	Clean	Non Seismic	No	No	No
Suppression Pool[3]	1,055,019	Clean	Category I	Yes	Yes	Yes
Demineralized Water Storage Tank[3]	2 tanks Hi Alarm 321,000 Lo Alarm 59,500	Clean	Non-seismic	No	No	No
Condenser Hotwell[3]	Hi Alarm 132,000 Lo Alarm 101,000	Clean	Category II	No	No	No
Fire Protection System[3]	2 tanks M/U Off 280,000 Lo Alarm 144,000.	Unclean	Non-seismic	No	No	No
UHS (SSW Basin)[3]	6,400,000	Unclean	Category I	Yes	Yes	Yes
Circulating Water Flume and Towers[3]	6,700,000	Unclean	Non-seismic	No	No	No
Upper Containment Pool[4]	~400,000	Clean	Category I	Yes	Yes	Yes
Normal Service Water System Basin[3]	625,000	Unclean	Non-Seismic	No	No	No
Clarifiers[3]	2 @ 4,850,000	Unclean	Non-Seismic	No	No	No
Well Water Storage Tank[3]	M/U Off 84,000 Lo Alarm 38,000	Unclean	Non-Seismic	No	No	No
Mississippi River	N/A	Unclean	N/A	N/A	N/A	N/A

1) All Seismic Category I structures and components are designed for protection from wind/tornado loadings, flooding, and missiles according to USAR sections 3.3, 3.4, and 3.5, respectively.
2) Clean water sources include those that are chemically treated for injection to the reactor
3) Reference 3.44
4) Reference 3.41

2.16 Shutdown and Refueling Analysis

RBS will abide by the Nuclear Energy Institute position paper entitled "Shutdown/Refueling Modes" (Reference 3.59) addressing mitigating strategies in shutdown and refueling modes. This paper has been endorsed by the NRC Staff (Reference 3.60). Therefore, Entergy will incorporate the supplemental guidance provided in the NEI position paper to enhance the shutdown risk process and procedures. The approach for incorporation of the supplemental guidance is provided below.

In order to further reduce shutdown risk, the shutdown risk process and procedures will be enhanced through incorporation of the FLEX equipment. Consideration will be given in the shutdown risk assessment process to:

- Maintaining FLEX equipment necessary to support shutdown risk processes and procedures readily available, and
- How FLEX equipment could be deployed or pre-deployed/pre-staged to support maintaining or restoring the key safety functions in the event of a loss of shutdown cooling.

In cases where FLEX equipment would need to be deployed in locations that would quickly become inaccessible as a result of a loss of decay heat removal from an ELAP event, pre-staging of that equipment is required.

FLEX mitigating strategies available during shutdown and refueling modes are summarized below.

Hot shutdown (Mode 3) and cold shutdown (Mode 4) conditions (other than refueling modes) are bounded by the FLEX strategy for power operation. The FLEX strategy response times for an event that occurs while already in hot or cold shutdown are longer than for the power operation condition because the RPV is initially repressurized to allow use of the steam-driven RCIC system for core cooling. The subsequent Phase 1, 2, and 3 actions are the same as for power operation, but occur later as the decay heat is lower and heatup times longer, dependent on the elapsed time since shutdown.

There are many variables during Mode 5 which impact the ability to cool the core. To accommodate the activities of vessel disassembly and refueling, water levels in the reactor vessel and the reactor cavity are often changed. The most limiting condition is the case in which the reactor head is removed or de-tensioned and water level in the vessel is at or below the reactor vessel flange.

If an ELAP/LUHS occurs during this condition then (depending on the time after shutdown) boiling in the core occurs quite rapidly. RBS-FSG-003 (Reference 3.61) provides the guidance for cooling the UCP, which would provide cooling for reactor if the reactor head is removed as well as direct cooling of the reactor vessel if that is necessary. There may be short periods of time during Mode 5 where plant configuration may preclude use of this strategy. For example, as indicated in procedure OSP-0037 (Reference 3.78) if the event occurs at 1 day after shutdown, boiling will occur in less than 1 hour with fuel uncovering in less than 7 hours.

In Mode 5, using the design basis heat load, the SFP could begin to boil at approximately t= 3.8 hours and fuel could be uncovered at approximately t=80.2 hours. Also, if fuel were being stored in the UCP (i.e., Mode 5), the UCP could begin to boil at approximately t= 5.1 hours and fuel could be uncovered at approximately t=106.7 hours. A total makeup flow rate of 59.5 gpm is sufficient to maintain the water level in both the UCP and the SFP (Reference 3.45). SFP makeup strategy method 2 can be used to provide makeup to both the UCP and SFP at the same time by also establishing a flow path in the SFP system to the UCP (Reference 3.62). Makeup to the UCP and RPV can also be provided the primary Phase 2 core cooling strategy using the SPC pump powered by a portable diesel generator (Section 2.3.2).

For spent fuel pool cooling considerations, refer to Section 2.4.

2.17 Sequence of Events

Table 3 below presents a sequence of events (SOE) timeline for an ELAP/LUHS event at RBS. Validation of each of the FLEX time constraint actions has been completed in accordance the FLEX validation process document issued by NEI and includes consideration for staffing. A debris removal assessment based on site reviews and the location of the FLEX storage areas has been performed to determine a reasonable time needed to clear debris to allow FLEX equipment deployment to support the Phase 2 and beyond strategies. Debris removal equipment is stored in the FLEX Storage Building.

Additional technical basis details regarding the identified time critical actions follow the table and are indexed by the table "Action Item" number.

Table 3 - Sequence of Events Timeline

Action item	Elapsed Time	Action	Time Constraint Y/N	Remarks / Applicability
	0	**Event Starts**	NA	Plant @100% power
1	60 sec	RCIC starts	N	Reactor operator initiates or verifies initiation of reactor water level restoration with steam driven RCIC
2	~60 sec	RCIC Suction swaps from CST to SP based on low water in CST	N	Automatic
3	10-60 min	Operators attempt to restart EDGs	N	
4	1 hr	Operators enter ELAP/FLEX Procedure	Y	Time critical at a time greater than 1 hour. Entry into ELAP provides guidance to operators to perform ELAP actions.
5	1 hr	Using manual control of SRVs initiate depressurization of the RPV IAW EOPs to a pressure band between 200 - 400 psig)	Y	Reducing RPV pressure reduces challenges to the containment
6	1 hr	DC Deep Load shed begins	Y	Required to maximize battery life. DC buses are readily available for operator access
7	1 hr	Remove ceiling tiles in MCR	Y	Maintains MCR habitability. 10 tiles are removed in first hour. Thereafter, 10 tiles are removed every 10 minutes until all 80 are removed within 130 minutes.
8	3 hr	Deploy hydrogen igniter	N	Maintain containment integrity. This action only becomes critical if core cooling is lost and fuel is damaged. Deploying the generator is a contingency action that addresses containment integrity.
9	4 hr	Start valve re-alignment to swap RCIC suction from SP to UCP to preserve RCIC availability	Y	Alignment required to be in place in 5 hours. Preserves RCIC suction
10	4 hr	Maintain RPV within a pressure range of 200 to 400 psi	N	Controlling RPV pressure in this range allows continued operation of RCIC.

Action item	Elapsed Time	Action	Time Constraint Y/N	Remarks / Applicability
11	~ 6 hr	Initiate cross-tie of Division II batteries to Division I bus	Y	Extends battery life
12	6 hr	Start alignment of SSW FLEX Pump and SPC Pump and initiate operation by 8 hours	Y	Time critical at 8 hours. Provides containment heat removal by cooling suppression pool
13	6 hr	Initiate deployment of FLEX 3 pump for SFP makeup	N	Pool begins to boil approximately 9 hrs. Makeup required before Level 2 in SFP
14	8 hr	Portable DG for battery charging operational	Y	Supplies power to divisional batteries
15	8 hr	Start containment heat removal with SPC system and SSW FLEX pump	Y	Provides containment heat removal by cooling suppression pool
16	8 hr	Connect compressed air cylinders	Y	Maintains operation of SRVs and SP level indicator
17	8 hr	FLEX 3 Pump available for makeup to SFP. Vent the SFP area to minimize condensation during pool boiling by opening doors.	N	Boil-off rate is slow with a large volume of water in the SFP. Makeup should be initiated before level drops to SFP Level 2 (approximately 30 hours after boiling begins).
18	8 hr	Isolate valve FPW-V252 to prevent sprinkler actuation in RCIC room.	N	This action would need to be taken within approximately 9.5 hours from the start up of the RCIC pump before the room temperature approaches 165 deg F.
19	10 hr	If SPC pumps not available, initiate deployment of hose and valve alignment for alternate core cooling method.	N	This alternate core cooling strategy. FLEX 3 pump used as water source. Injection thru flushing connection on LPCS injection line.

Action item	Elapsed Time	Action	Time Constraint Y/N	Remarks / Applicability
20	15 hr	Alternate path using FLEX 3 pump available for use.	N	Complete hose runs, connections to FLEX 3 pump and LPCS flushing connection, and valve alignments except valve(s) in flushing connection. **Alternate path** now available for use. Only need to open the flush connection valve(s). Motor operated valves required to be open or closed to support the flow path must be confirmed to be in the required configuration with motor circuit breakers open.
21	~34 hr	Depressurize RPV and align SPC system to provide core cooling. SPC pump suction is from the SP and return water from the RPV is through the SRVs back to the SP.	Y	This will reduce pressure so SPC pumps can inject directly into vessel and continue core cooling
22	~34 hr	Depressurize vessel and initiate alternate core cooling into RPV from SCT basin using FLEX 3 pump.	N	Only necessary if SPC system is not available or capable of injecting into the RPV. Action to be taken when the UCP water volume depletes. Requires opening shutoff valve at FLEX 3 pump and flushing connection valve in the Auxiliary Building
23	72 hr	Align NSRC PDG to repower the SSW cooling tower fans. Initiate makeup to the SCT basin.	Y	With no active cooling or makeup the UHS temperature has been increasing and the volume decreasing. These actions enable the SPC to continue to perform both core and containment cooling until the appropriate recovery actions can be taken.

2.18 Programmatic Elements

2.18.1 Overall Program Document

The FLEX program document provides a description of the FLEX program for RBS. The key program elements provided in the Program Document include:

- Description of the FLEX strategies and basis
- Provisions for documentation of the historical record of previous strategies and the basis for changes
- The basis for the ongoing maintenance and testing programs chosen for the FLEX equipment
- Designation of the minimum set of parameters necessary to support strategy implementation

In addition, the program description includes a list of the engineering documents that provide the bases for the FLEX strategies.

Existing design control procedures have been revised to ensure that changes to the plant design, physical plant layout, roads, buildings, and miscellaneous structures will not adversely impact the approved FLEX strategies.

Future changes to the FLEX strategies may be made without prior NRC approval provided 1) the revised FLEX strategies meet the requirements of NEI 12-06, and 2) an engineering basis is documented that ensures that the change in FLEX strategies continues to ensure the key safety functions (core and SFP cooling, containment integrity) are met.

2.18.2 Procedural Guidance

The inability to predict actual plant conditions that require the use of FLEX equipment makes it impossible to provide specific procedural guidance. As such, the FSGs will provide guidance that can be employed for a variety of conditions. Clear criteria for entry into FSGs will ensure that FLEX strategies are used only as directed for BDBEE conditions, and are not used inappropriately in lieu of existing procedures. When FLEX equipment is needed to supplement EOPs or Abnormal Operating Procedures (AOPs) strategies, the EOP, AOP, Severe Accident Mitigation Guidelines (SAMGs), or Extreme Damage Mitigation Guidelines (EDGMs) will direct the entry into and exit from the appropriate FSG procedure.

FLEX Support Guidelines will provide available, pre-planned FLEX strategies for accomplishing specific tasks in the EOPs or AOPs. FSGs will be used to supplement (not replace) the existing procedure structure that establishes command and control for the event.

Procedural Interfaces have been incorporated into Procedure AOP-0050, Station Blackout, to the extent necessary to include appropriate reference to FSGs and provide command and control for the ELAP. Additionally, procedural interfaces have been incorporated into the following AOPs to include appropriate reference to FSGs:

- AOP-0028, "Seismic Event"
- AOP-0029, "Severe Weather"

FSG maintenance will be performed by Operations. In accordance with site administrative procedures, NEI 96-07, Revision 1, Guidelines for 10 CFR 50.59 Implementation, and NEI 97-04, Revision 1, Design Bases Program Guidelines, are to be used to evaluate changes to current procedures, including the FSGs, to determine the need for prior NRC approval. However, per the guidance and examples provided in NEI 96-07, Revision 1, changes to procedures (EOPs, AOPs, EDMGs, SAMGs, or FSGs) that perform actions in response events that exceed a site's design basis should screen out. Therefore, procedure steps which recognize the ELAP/LUHS has occurred and which direct actions to ensure core cooling, SFP cooling, or containment integrity should not require prior NRC approval.

FSGs will be reviewed and validated by the involved groups to the extent necessary to ensure the strategy is feasible. Validation may be accomplished via walk-throughs or drills of the guidelines.

2.18.3 Staffing

Using the methodology of (Nuclear Energy Institute) NEI 12-01, *Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities*, an assessment of the capability of the River Bend Station on-shift staff and augmented Emergency Response Organization (ERO) to respond to a Beyond Design Basis External Event (BDBEE) was performed. The results of the assessment were submitted to the NRC on October 9, 2014.

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

- an extended loss of ac power (ELAP)
- an extended loss of access to ultimate heat sink (UHS)

- impact on the unit (unit is operating at full power at the time of the event)
- impeded access to the unit 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.

A team of subject matter experts from Operations, Operations Training, Radiation Protection, Chemistry, Security, Emergency Planning and FLEX Project Team personnel performed a tabletop in July 2014. The participants reviewed the assumptions and applied existing procedural guidance, including applicable draft and approved FLEX Support Guidelines (FSGs) for coping with a BDBEE using minimum on-shift staff. 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 the estimated time to prepare for and perform the task.

The validated and verified Phase 2 Staffing Assessment concluded that the current minimum on-shift staffing as defined in the River Bend Station Emergency Plan is sufficient to support the implementation of the mitigating strategies (FLEX strategies) as well as the required Emergency Plan action, with no unacceptable collateral tasks assigned to the on-shift personnel during the first 6 hours. The assessment concluded that the on-shift staffing, with assistance from augmented staff, is capable of implementing the FLEX strategies necessary after the 6 hour period within the constraints. It was concluded that the Emergency response function would not be degraded or lost.

2.18.4 Training

Entergy's Nuclear Training Program has been revised to assure personnel proficiency in the mitigation of BDBEEs is adequate and maintained. These programs and controls were developed and have been implemented in accordance with the Systematic Approach to Training (SAT) Process.

Initial training has been provided and periodic training will be provided to site emergency response leaders on BDB 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.

Care has been taken to not give undue weight (in comparison with other training requirements) for Operator training for BDBEE accident mitigation. The testing/evaluation of Operator knowledge and skills in this area has been similarly weighted.

ANSI/ANS 3.5, Nuclear Power Plant Simulators for use in Operator Training, certification of simulator fidelity is considered to be sufficient for the initial stages of the BDBEE scenario until the current capability of the simulator model is exceeded. Full scope simulator models will not be upgraded to accommodate FLEX training or drills.

2.18.5 Equipment List

The equipment stored and maintained at the RBS FLEX Storage Building necessary for the implementation of the FLEX strategies in response to a BDBEE at RBS is listed in Table 4. Table 4 identifies the quantity, applicable strategy, and capacity/rating for the major FLEX equipment components only, as well as, various clarifying notes. Details regarding fittings, tools, hose lengths, consumable supplies, etc. are not in Table 4.

2.18.6 Equipment Maintenance and Testing

Maintenance and testing of FLEX equipment is governed by the Entergy Preventive Maintenance (PM) Program as described in EN-DC-324. The Entergy PM Program is consistent with INPO AP-913 and utilizes the EPRI Preventive Maintenance Basis Database as an input in development of fleet specific Entergy PM Basis Templates. Based on this, the Entergy fleet PM program for FLEX equipment follows the guidance NEI 12-06, Section 11.5.

PMs have been developed for both the "Standby" condition and the "Deployed" condition for the FLEX Portable and Support Equipment.

The Entergy PM Basis Templates include activities such as:

- Periodic Static Inspections
- Operational Inspections
- Fluid analysis
- Periodic functional verifications
- Periodic performance validation tests

The Entergy PM basis templates provide assurance that stored or pre-staged FLEX equipment is being properly maintained and tested. In those cases where EPRI templates were not available for the specific component types, PM actions were developed based on manufacturer provided information/ recommendations.

Additionally, the ERO performs periodic facility readiness checks for equipment that is outside the jurisdiction of the normal PM program and considered a functional aspect of the specific facility (EP communications equipment such as UPS, radios, batteries, battery chargers, satellite phones, etc.). These facility functional readiness checks provide assurance that the EP communications equipment outside the jurisdiction of the PM Program is being properly maintained and tested.

The unavailability of equipment and applicable connections that directly perform a FLEX mitigation strategy for core, containment, and SFP will be managed such that risk to mitigating strategy capability is minimized. Maintenance/risk guidance conforms to the guidance of NEI 12-06 as follows:

Portable FLEX equipment may be unavailable for 90 days provided that the site FLEX capability (N) is available.

If portable equipment becomes unavailable such that the site FLEX capability (N) is not maintained, initiate actions within 24 hours to restore the site FLEX capability (N) and implement compensatory measures (e.g., repair equipment, use of alternate suitable equipment or supplemental personnel) within 72 hours.

Work Management procedures will reflect AOT (Allowed Outage Times) as outlined above.

Table 4 – BWR Portable Equipment Stored On-Site						
Use and (Potential / Flexibility) Diverse Uses						**Performance Criteria**
List Portable Equipment	Core	Containment	SFP	Instrumentation	Accessibility	
Diesel Driven Hale FP2000DI-TC Portable Pump (FLEX 2)	X	X				2500 gpm @ 155.1 ft TDH
Two (2) 480V Diesel Generators (battery charging)	X	X		X		480 VAC 3-PH 200kW @0.8 PF
Three (3) 480V Diesel Generators (1 for FLEX 1 pump; 2 for SPC pump)	X	X				480 VAC 3-PH 500kW @0.8 PF
Two (2) 480V Diesel Generators with Lighting Stand (Hydrogen Igniter power)	X	X				480 VAC 3-PH 15kW
Two (2) Diesel Powered Pumps (1 - Hale IP1000DI-TC and 1 - Hale IP1000DJ-TC)	X		X			400 gpm @ 275 ft TDH combined flow for core cooling and SFP makeup
Two (2) Fuel Trailers	X	X	X		X	500 Gallon Tank 12 VDC 20 gpm Transfer Pump
Two (2) Electric Driven Blackmer XRLF1.25B Diesel Fuel Pumps	X	X	X		X	480VAC 3-PH 2HP motor, 10 gpm @ 70 ft TDH
Two (2) Electrical Trailers	X	X			X	8.5'W X 20'L X 7' H Enclosed Trailer,
Two (2) Mechanical Trailers	X	X	X		X	8.5'W X 21'L X 7.5'H Enclosed Trailer
Two (2) Front End Loaders					X	Case 821F Four Wheel Drive
Two (2) Tow Vehicles					X	1 Ton Pick-up Truck
Eight (8) Portable Lighting Towers					X	MagnaLight WAL-18LED-BP

Table 5 – BWR Portable Equipment From NSRC										
Use and (Potential / Flexibility) Diverse Uses								Performance Criteria		Notes
List Portable Equipment	**Quantity Req'd /Unit**	**Quantity Provided / Unit**	**Power**	**Core Cooling**	**Cont. Cooling/ Integrity**	**Access**	**Instrumentation**			
4160VAC Generators	2	2	Turbine	X	X		X	4.16 kV	1 MW	(1)
480VAC Generators	2	2	Turbine	X	X		X	480VAC	1100 KW	(2)
Low Pressure / Medium Flow Pump	1	1	Diesel					300 psi	2500 GPM	(3)
Mobile Water Treatment	0	2	Diesel	X					150 GPM	(5)
Portable Fuel Transfer Pump	0	1	Diesel		X	X		300#	2500 GPM	(3)
Diesel Fuel Transfer	0	AR	N/A	X	X	X	X		500 Gal	(3)
Lighting Towers	0	1	Diesel			X			40,000 Lu	(4)

Note 1 - NSRC 4kV generators supplied in support of Phase 3 for Core Cooling, Containment Cooling, and Instrumentation FLEX Strategies.

Note 2 - 1 NSRC 480V generator supplied in support of Phase 3 to restart SCT Fans for Core Cooling and Containment Cooling; 2nd generator for defense in depth

Note 3 - Not required for FLEX strategy--Provided for defense in depth

Note 4 - NSRC components provided for low light response plans.

Note 5 - Supplied for defense in depth.

3. References

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3.4 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 BDBEEs, Revision 0, dated August 29, 2012 (ADAMS Accession No. ML12229A174)

3.5 NRC Order Number, EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, dated March, 12, 2012 (ADAMS Accession No. ML12054A682)

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3.13 EOP-0005, Revision 317, Emergency Operating and Severe Accident Management Procedures Enclosures, July 30, 2015

3.14 AOP-0065, Revision 000, Extended Loss of AC Power (ELAP)

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3.16 Calculation G13.18.2.2-044, Revision 0, Reactor Core Isolation Cooling (RCIC) NPSH for Extended Loss of AC Power (FLEX)

3.17 Calculation G13.18.3.6-023, Revision 0, FLEX Strategy - Portable Diesel Generator System Sizing

3.18 BWR Owner's Group Emergency Procedure and Severe Accident Guidelines, Appendix B: Technical Basis, Volume 1, Revision 3, February 2013.

3.19 EPSTG*0001, River Bend Station Emergency Operating and Severe Accident Procedures Plant Specific Technical Guidelines (PSTG), Revision17

3.20 EC 44959, River Bend Station FLEX EC, Attachment 6.008 (FLEX Alternate Electrical Connections Evaluations)

3.21 Calculation G13.18.12.4-039, Revision 000, Containment Conditions for Extended Loss of AC Power (FLEX)

3.22 Calculation G13.18.12.4-047, Revision 000, Analysis of Standby Service Water (SSW) Cooling Tower Performance for Extended Loss of AC Power (FLEX)

3.23 Calculation G13.18.2.6-191, Revision 000, Residual Heat Removal (RHR) Heat Exchanger Heat Duty Sensitivity Study for FLEX Phase III Coping Strategy.

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