DUKE ENERGY

R. Michael Glover
H. B. Robinson Steam
Electric Plant Unit 2
Site Vice President

Duke Energy Progress
3581 West Entrance Road
Hartsville, SC 29550

O: 843 857 1704
F: 843 857 1319

Mike.Glover@duke-energy.com

10 CFR 50.4

Serial: RNP-RA/15-0053

August 19, 2015

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

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/RENEWED LICENSE NO. DPR-23

Subject: Compliance Letter and Final Integrated Plan in Response to the 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) For H. B. Robinson Steam Electric Plant, Unit No. 2

Ladies and Gentlemen,

On March 12, 2012 the NRC issued EA-12-049, "Order to Modify Licenses With Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" that directed Duke Energy to implement mitigation strategies for beyond-design-basis external events. Specific requirements were outlined in Attachment 2 of NRC Order EA-12-049.

This letter provides notification that Duke Energy has completed the requirements of EA-12-049 and is in full compliance with the Order for H. B. Robinson Steam Electric Plant, Unit No. 2 prior to commencement of plant start-up from (control rod withdrawal) from the second scheduled refueling outage after submittal of the overall integrated plan required by the Order. Enclosure 1 to this letter provides a summary of how the compliance requirements were met.

Enclosure 2 provides a summary of the answers to the Interim Staff Evaluation open and confirmatory items provided in the FLEX/Spent Fuel Pool Level Instrumentation Audit Report and significant issues that arose after the Audit Report was issued.

Enclosure 3 to this letter provides the Final Integrated Plan (FIP) for H. B. Robinson Steam Electric Plant, Unit No. 2.

This letter contains no new Regulatory Commitments and no revision to existing Regulatory Commitments.

Should you have any questions regarding this submittal, please contact Mr. Richard Hightower, Manager, Nuclear Regulatory Affairs at (843) 857-1329.

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

Executed on August 19, 2015.

Sincerely,

R. Michael Glover

R. Michael Glover
Site Vice President

RMG/shc

Enclosure: 1) Order EA-12-049 Compliance Requirements Summary
2) Technical Basis for Open Item Response
3) Final Integrated Plan

cc: Ms. M. C. Barillas, NRC Project Manager, NRR
Mr. K. M. Ellis, NRC Senior Resident Inspector
Mr. V. M. McCree, NRC Region II Administrator
Mr. J. C. Paige, Mitigating Strategies Project Manager, JDL-NRR

ENCLOSURE 1

Order EA-12-049 Compliance Requirements Summary

H. B. ROBINSON STEAM ELECTRIC PLANT UNIT NO. 2

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
ORDER EA-12-049 COMPLIANCE REQUIREMENTS SUMMARY

H. B. Robinson Steam Electric Plant, Unit No. 2 developed an Overall Integrated Plan (OIP) (Reference 1), documenting diverse and flexible strategies (FLEX) in response to Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," (Reference 2). The OIP for H. B. Robinson was submitted to the NRC on February 26, 2013 and was supplemented by Six-Month Status Reports (References 3, 4, 5 and 6), in accordance with Order EA-12-049.

Full compliance with the requirements of NRC Order EA-12-049 will be completed prior to the end of the second refueling outage after submittal of the OIP as required by Reference 2. The information provided herein documents full compliance with Reference 2 for H. B. Robinson Steam Electric Plant, Unit No. 2.

Completion of the elements identified below for H. B. Robinson, as well as References 1, 3, 4, 5, and 6 document full compliance with Order EA-12-049 for H. B. Robinson Steam Electric Plant, Unit 2.

NRC ISE AND AUDIT ITEMS - COMPLETE

During the ongoing audit process (Reference 7), Duke Energy provided responses for the following items for H. B. Robinson:

- Interim Staff Evaluation (ISE) Open Items
- ISE Confirmatory Items
- Audit Questions
- Safety Evaluation Review Items

NRC letter, "H.B. Robinson Steam Electric Plant, Unit No. 2 - Report for the Onsite Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Instrumentation Related to Orders EA-12-049 and EA-12-051" dated June 12, 2015, (Reference 8) delineated the items reviewed during the H. B. Robinson audit process.

MILESTONE SCHEDULE - ITEMS COMPLETE

Milestone	Completion Date	Activity Status
Complete Strategy Development	February 2013	Complete
Submit Integrated Plan	February 2013	Complete
Submit First 6-month Status Update	August 2013	Complete
Submit Second 6-month Status Update	February 2014	Complete
Submit Third 6-month Status Update	August 2014	Complete
Submit Fourth 6-month Status Update	February 2015	Complete
Complete Modification Identification	March 2013	Complete
Complete Modification Development	April 2015	Complete
Complete Equipment Procurement	May 2015	Complete
Complete Equipment PM Development	May 2015	Complete
Complete FSG Development	May 2015	Complete
Issue FSGs	June 2015	Complete
Complete Training Development	March 2015	Complete
Initiate Training Implementation	May 2014	Complete
Complete Training	June 2015	Complete
Complete Staffing Assessment	November 2014	Complete
Issue Regional Response Center Playbook for H. B. Robinson	March 2015	Complete
Complete Communications Integrated Plan	April 2014	Complete
Complete Online Modification Implementation	May 2015	Complete
Complete Outage Modification Implementation (R229)	June 2015	Complete
H. B. Robinson FLEX Implementation Complete	June 2015	Complete

STRATEGIES – COMPLETE

H. B. Robinson Steam Electric Plant, Unit No. 2 strategies are in compliance with the requirements of NRC Order EA-12-049. Strategy related items have been addressed as documented in References 3, 4, 5 and 6 or Enclosure 2 to this submittal.

MODIFICATIONS - COMPLETE

The modifications required to support the FLEX strategies for H. B. Robinson Steam Electric Plant, Unit No. 2 have been completed in accordance with the station design control process.

EQUIPMENT - PROCURED AND MAINTENANCE & TESTING - COMPLETE

The equipment required to implement the FLEX strategies for H. B. Robinson Steam Electric Plant, Unit No. 2 has been procured in accordance with NEI 12-06, Section 11.1 and 11.2, received at H. B. Robinson Plant, initially tested, the 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 H. B. Robinson Plant Preventative Maintenance program such that equipment reliability is maintained.

PROTECTED STORAGE - COMPLETE

The storage facility required to protect Beyond Design Basis (BDB) equipment has been completed for H. B. Robinson Steam Electric Plant, Unit No. 2. The BDB equipment is protected from the applicable site hazards and will remain deployable to assure implementation of the FLEX strategies for H. B. Robinson Steam Electric Plant, Unit No. 2.

PROCEDURES - COMPLETE

FLEX Support Guidelines (FSGs), for H. B. Robinson Steam Electric Plant, Unit No. 2, have been developed and integrated with existing procedures. The FSGs and affected existing procedures have been approved and are available for use in accordance with the site procedure control program.

TRAINING - COMPLETE

Training of personnel responsible for the mitigation of beyond-design-basis events at H. B. Robinson Steam Electric Plant, Unit No. 2 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 H. B. Robinson has been completed in accordance with "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," Enclosure 5 pertaining to Recommendation 9.3, dated March 12, 2012 (Reference 9), as documented in letter dated December 17, 2014, " H. B. Robinson Steam Electric Plant, Unit No. 2, Response to March 12, 2012, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendation of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, Enclosure 5, Recommendation 9.3, Emergency Preparedness - Staffing, Requested Information Items 1, 2 and 6 -Phase 2 Staffing Assessment," (Reference 10).

FSG strategies can be successfully implemented using the current minimum on-shift staffing.

NATIONAL SAFER RESPONSE CENTERS - COMPLETE

Duke 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 H. B. Robinson with Phase 3 equipment stored in the National SAFER Response Centers in accordance with the site specific SAFER Response Plan (Reference 11).

VALIDATION - COMPLETE

Duke has completed validation testing of the FLEX strategies for H. B. Robinson in accordance with industry developed guidance. The validations assure that 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. The FIP for H. B. Robinson Steam Electric Plant, Unit No. 2, is included as Enclosure 3 to this submittal.

FLEX PROGRAM DOCUMENT - ESTABLISHED

The Duke Energy FLEX Program Document (CSD-EG-RNP-8888) has been developed in accordance with the requirements of NEI 12-06 and is in effect for H. B. Robinson Steam Electric Plant, Unit No. 2.

REFERENCES

The following references support the H. B. Robinson Steam Electric Plant, Unit No. 2 FLEX Compliance Summary:

1. Duke Energy Letter, *Carolina Power and Light Company's Overall Integrated Plan in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049),* dated February 26, 2013 (ML13071A415).

2. Nuclear Regulatory Commission (NRC) Order Number EA-12-049, Order Modifying Licensees With Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, Revision 0, dated March 12, 2012, (ML12054A735).

3. Duke Energy Letter, *H. B. Robinson Steam Electric Plant, Unit No. 2, First Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA- 12-049),* dated August 28, 2013 (ML13252A243).

4. Duke Energy Letter, *H. B. Robinson Steam Electric Plant, Unit No. 2, Second Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying* Licenses *with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events(Order Number EA-12-049),* Dated February 24, 2014 (ML14063A283).

5. Duke Energy Letter, *H. B. Robinson Steam Electric Plant, Unit No. 2, Third Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying* Licenses *with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events(Order Number EA-12-049),* Dated August 26, 2014 (ML14251A013).

6. Duke Energy Letter, *H. B. Robinson Steam Electric Plant, Unit No. 2, Fourth Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying* Licenses *with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events(Order Number EA-12-049),* Dated February 23, 2015 (ML15065A041).

7. NRC letter to All Operating Reactor Licensees and Holders of Construction Permits, "Nuclear Regulatory Commission Audits of Licensee Responses to Mitigation Strategies Order EA-12-049," dated August 28, 2013 (ML13234A503).

8. NRC letter " H.B. Robinson Steam Electric Plant, Unit No. 2 - Report for the Onsite Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Instrumentation Related to Orders EA-12-049 and EA-12-05" dated June 12, 2015, (ML15154B098).

9. NRC letter from Eric J. Leeds, Director, Office of NRR, "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated March 12, 2012 (ML12073A348).

10. Duke Energy Letter, *H. B. Robinson Steam Electric Plant, Unit No. 2,* Response to March 12, 2012, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendation of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, Enclosure 5, Recommendation 9.3, Emergency Preparedness - Staffing, Requested Information Items 1, 2 and 6 -Phase 2 Staffing Assessment.

11. NRC letter from Jack Davis, JLD, Office of NRR, to Joseph E. Pollock, Vice President, Nuclear Operations, NEI, "Staff Assessment of National Safer Response Centers Established in Response to Order EA-12-049," September 26, 2014 (ML14265A107).

ENCLOSURE 2

Technical Basis for Open Items Response

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

RESPONSE TO NRC STAFF OPEN ITEM AQ-61
FOR
H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT 2
MITIGATION STRATEGIES INTEGRATED PLAN, REVISION 1

From the 3/02/15 to 3/06/15 NRC Mitigating Strategies Audit of H.B. Robinson Steam Electric Plant, Unit 2:

AUDIT QUESTION #61:

The primary source of AFW inventory is the condensate storage tank (CST) and its level instrumentation, which are seismically qualified, but are not protected from wind or missiles. Due to structures in the immediate vicinity of the existing CST, as well as potential obstructions and hazards above the CST, it is not recommended to attempt to harden the CST against high winds and tornado missiles. The CST is expected to survive a seismic event and is the installed source of Auxiliary Feedwater (AFW) to the Steam Driven Auxiliary Feedwater Pump (SDAFWP), however, its inventory is insufficient for indefinite coping (mission time is approximately 7 hours). The only other assured water source is the Ultimate Heat Sink (Lake Robinson), which, per the restrictions outlined in NEI 12-06, can only be accessed using portable equipment (assumes normal access to UHS is lost). Given these limitations, one Phase 2/3 seismic strategy to provide an indefinite supply of water to the CST/SDAFWP is to stage a portable diesel pumper at the lake with hoses routed to the CST FLEX connection at valve C-66, CST Drain Valve (EC90622) to provide an indefinite water supply to the CST.

As noted above, the CST is not protected against wind-generated missiles. EC94741 is initiated to modify the circulating water (CW) inlet bay at the main condenser to install a FLEX connection in the bay to access the UHS from within the turbine building which provides protection from wind-generated missiles. A portable low pressure diesel pumper will be staged in the turbine building protected by the turbine pedestal structure and easily deployable at the CW inlet bay. The Phase 2 wind/missile strategy for AFW supply will connect the pre-staged pumper to the CW inlet bay FLEX connection and discharge directly to the suction of the SDAFWP downstream of isolation valve AFW-4, or to the CST Drain FLEX connection at C-66. The CW bays will remain filled from the lake as long as lake level is above 217’ (normal level is 221’). This strategy can be accomplished in less than 1 hour. This strategy can also be used to supply makeup to the CST.

BACKGROUND

During the NRC Audit of March 2-6, 2015, regarding Audit Question 61, Steam Generator Dryout, The NRC Fukushima Flex Audit team questioned the Robinson strategy for providing water from the Circulating Water system after a high wind event. The NRC question centered on debris that might be deposited near the water source after a high wind event. Debris may limit accessibility to the new valve CW-125 and the associated hose assembly located in the condenser waterbox pit area. Limited accessibility may challenge the ability to respond to the event within the 61 minute time allotted for response.

The Robinson Fukushima Response Organization table top exercises for the strategy to supply Circulating Water to the Steam Driven Auxiliary Feedwater pump have been timed at approximately 30 minutes. This leaves approximately 30 minutes for debris removal in the condenser waterbox pit area to access valve CW-125. However, the table top did not allow time for debris removal.

SOLUTION OR CONCLUSION

An engineering evaluation (EC99828, Debris Removal At New Circ Water Valve For FLEX Pump (Reference 9)) was performed to characterize debris type and weight that may be located in the condenser waterbox pit area following a high wind event (See Table 1). Light weight loose debris may be deposited over valve CW-125 and the associated hose assembly. The debris may block access to the valve and hose. The evaluation also determined the equipment needed to remove debris to access valve CW-125 and hose assembly.

The recommend tool storage location is the same location as the Portable Low Press Flex Pumps. This location is inside the Turbine Building, Ground Floor.

BOUNDING TECHNICAL REQUIREMENTS

NRC order EA 12-049 (Reference 2) requires licensees to implement strategies to restore core cooling capabilities following a beyond-design-basis external event. NEI 12-06 (Reference 1) represents a guidance document to comply with this NRC order. NEI 12-06 Section 2 describes the process to determine site specific extreme external hazards and flexible coping strategies. To this end, EC 88926 was written to document the Robinson site specific coping strategies and their relationship to extreme external hazards. EC 88926 Table 3 describes the various coping strategies needed to meet core cooling requirements outlined in NEI 12-06. This table shows that Circulating Water supply to the Steam Driven Aux Feedwater Pump (SDAFWP) suction is a strategy used after a high wind event. Therefore, the Bounding Technical Requirements for this EC evaluation are derived from NEI 12-06 guidance with respect to high wind events.

NEI 12-06, Section 7.2.2

This NEI section states, in part, “The characterization of tornadoes is such that pre-staging of equipment in advance is not likely to be effective. However, the impact on the local infrastructure is much more limited than hurricanes and largely limited to debris dispersal.”

This means that tornadoes form and approach the site rapidly such that little time is available to move equipment from storage into position to respond to an extended loss of power event. The section also states that tornadoes spread debris over a small area as compared to a hurricane.

EC 88926, External Hazard Analysis, shows the controlling high wind event is a tornado due to higher wind speeds. NEI 12-06 (Reference 1) page 41 states that tornadoes generally travel from the west-southwesterly direction. This evaluation postulates debris at a specific location, the condenser waterbox pit. The bounding technical requirement based on EC 88926 and NEI 12-06 is a tornado moving from the west-southwest to northeast, on the south side of the Turbine Building, will maximize debris at the condenser waterbox pit.

NEI 12-06, Section 7.3.2

NEI 12-06 states "Deployment of FLEX following a hurricane or tornado may involve the need to remove debris. Consequently, the capability to remove debris caused by these extreme wind storms should be included."

Therefore, the bounding technical requirement is equipment suitable for clearing postulated debris shall be specified by the EC evaluation (EC99828) referenced above.

NEI 12-06, Section 11.3

This section states "If debris removal equipment is needed, it should be reasonably protected from the applicable external events such that it 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)."

Therefore, the bounding technical requirement is: A suitable storage location for debris removal equipment shall be specified by this EC evaluation.

This section also states "Deployment of the FLEX equipment or debris removal equipment from storage locations should not depend on off-site power or on-site emergency ac power (e.g., to operate roll up doors, lifts, elevators, etc.)."

The bounding technical requirement is: Deployment and use of debris removal equipment specified shall not require electrical power.

EVALUATION

Each NEI 12-06 (Reference 1) paragraph identified as a bounding technical requirement will be evaluated.

NEI 12-06 Section 7.2.2

This paragraph recognizes that tornadoes impact on local infrastructure is largely limited to debris dispersal. This means that potential loose debris deposited in the condenser waterbox pit area needs to be identified so a removal method can be established.

AP-053 (Reference 3), Severe Weather Response, and OMM-021(Reference 4), Operations During Adverse Weather Conditions, outlines activities to be performed when a tornado warning is received. Specific actions in OMM-021 include the removal or tie down of loose / unsecured item at the Turbine building ground level. Although the time between a tornado warning and actual event on site may be short, credit for removal of items such as trash cans, air hoses, drums and pails, etc. can be taken. While this will not be considered to eliminate all loose materials, it will limit debris from accumulating in the condenser waterbox pit area.

Site permanent structures near the condenser waterbox pit will effectively block debris entering the area from the north. The Turbine Building and Main Condensers are located immediately north of the pit area. The position of the condensers and concrete turbine pedestal will prevent high winds from the north blowing debris into the area. However, the south side of the Turbine Building mezzanine and operating floors are directly over the condenser waterbox pit. Process system piping is located on these floors. This piping has insulation and sheet metal jacketing over the pipe. This material can be expected to be "blown off" the pipe during a tornado event, and deposited in the condenser waterbox pit. Walkdown found other potential debris from heat trace cable, plastic sheeting, and scaffolding in the area. This debris will be included in Table 1.

Fire rated barriers, the Unit Auxiliary Transformer and the Start-Up Transformers are located approximately 30 feet east from the condenser waterbox pit. This equipment and structures do not form a continuous barrier to prevent debris from entering the area. Some debris may enter the pit from the east, due to the 15 foot space between the fire barriers and the Turbine Building. The main transformer Isophase Bus Duct is located on the east and south sides of the side of the condenser waterbox pit. The bus duct is constructed of thinner gage sheet metal and has a sizable cross section. The metal duct can be expected to be ripped loose during a tornado event, and may find its way into the condenser waterbox pit. This debris will be included in Table 1. The bus bars and bus supports have a much smaller cross section and consequently will not have substantial loads due to wind. While the bars and supports may be damaged, these components are not expected to relocate to the waterbox pit area.

The Main Transformers are located approximately 50 feet south of the condenser waterbox pit. The transformers do not form a continuous debris barrier, due to the spacing between the equipment. However, large debris such as cargo vans, uprooted trees, job boxes and vehicles will be blocked by the transformers.

Minimal debris would be generated from locations outside the Protected Area (PA) or offsite south of the condenser waterbox pit. Debris is limited by the travel distance from site borders to the condenser waterbox pit area. Debris entering the pit area from the south would travel through multiple barriers such as the PA fences, the site Vehicle Barrier System and the Main Transformers. PA fences have a very small cross section and hence small wind loading. The fencing will retain some amount of structural integrity to block light debris. Based on the travel distance and fixed barriers, materials and objects located south of the PA are not expected to travel to the condenser pit during a tornado event.

The Condensate Polishing Building is located on the southwest side of the condenser waterbox pit. This building is constructed of a sheet metal siding with a structural steel frame. This building is designed as a Class III structure and not specifically designed for tornado loads. Design Basis Document (DBD) GID/R87038/0007 (Reference 5) page 9, provides insight into tornado effects on a Class III structure. Metal siding is expected to be “blown off” by tornado winds. Once the siding is removed, internal pressure equalizes and the structural steel framing will withstand the tornado wind load. Based on the DBD, Condensate Polishing Building metal siding will contribute to debris loading in the condenser waterbox pit area.

Fire rated barriers are located between the main transformers, between the Turbine Building and start-up transformers and enclose the deluge valves for the transformer fire suppression systems. This location is on the south and east sides of the condenser waterbox pit. Calculation RNP-C/STRU-1261 (Reference 6) page 8 shows all barriers were designed to a wind load of 35 psf. This load is based on a 95 mile per hour wind. Tornado wind speeds are substantially higher. NEI 12-06 (Reference 1) page 42 finds Robinson tornado wind speed at 170 miles per hour. The higher winds may impact these barriers.

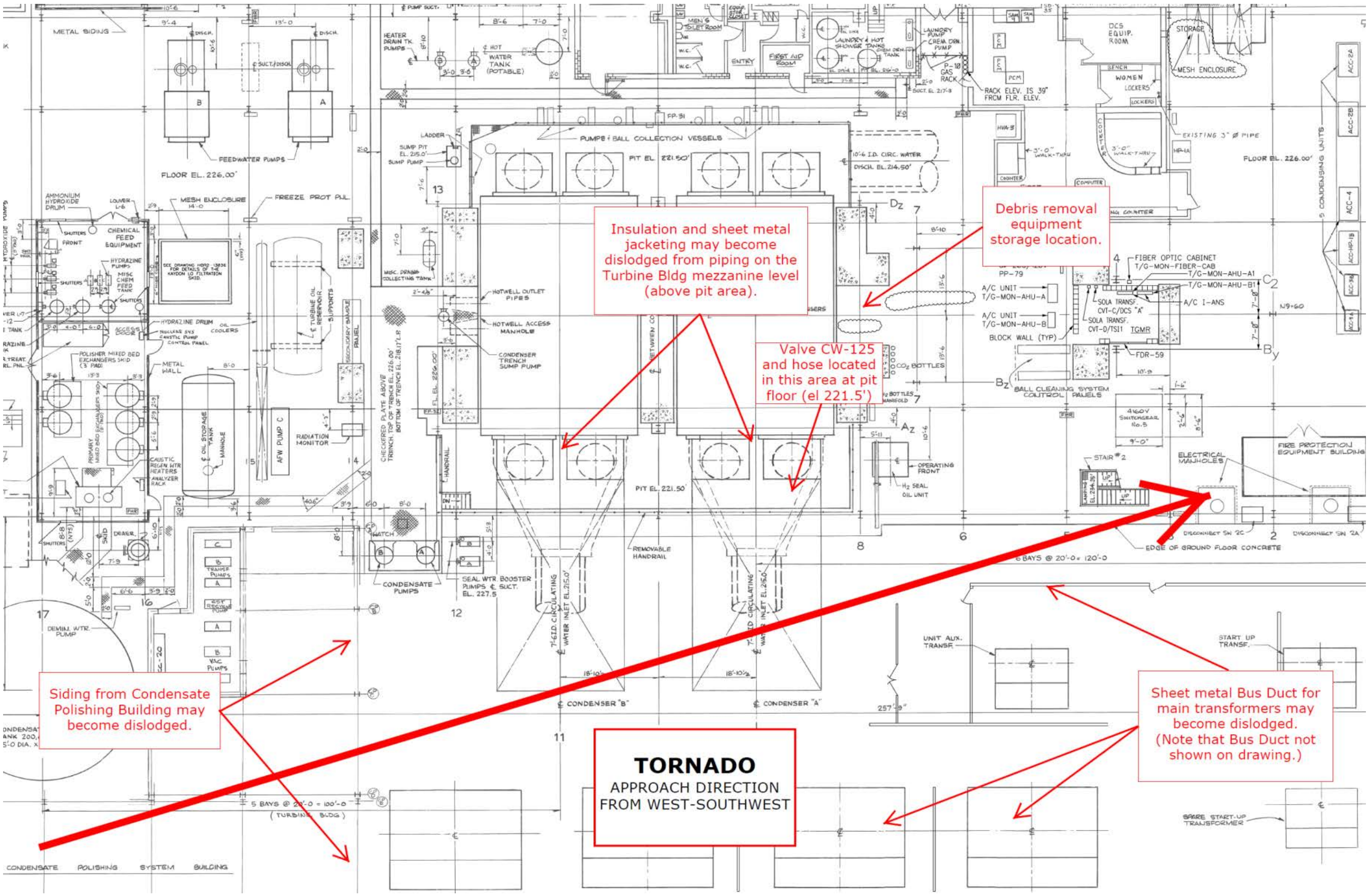
The fire barrier is constructed using a composite panel of fiber cement mechanically bounded to a punched steel sheet on both outer surfaces. The standard panel size is 39 inches by 118 inches and weighs 4.3 psf. (See Attachment 14 in Reference 6 for panel details.) The panels are attached to a structural steel frame using #12 self-tapping screws (Reference 7).

During a tornado event, the composite panels are expected to be “blown off” the supporting structural steel, since the weak link is the #12 screws. The supporting structure will remain intact as the Reference 6 calculation shows the steel is stressed to approximately 80% of the allowable stress. As some panels may be stripped from the support steel by high winds, the load on the supports will be reduced. The composite panels will remain relatively intact. The panels may bend, breaking the cement fiber, however, the sheet steel outer surfaces should remain in a single piece. The panels weigh approximately 137 lbs., based on the unit weight and dimensions. The cement fiber may crumble and break free from the panels as they are bent, lessening the assembly weight.

Deformed and bent fire barrier composite panels may be deposited in the condenser waterbox pit during a tornado. However, the panel size, shape and weight will allow removal using hand tools. The debris only needs to be relocated off the valve and hose by moving it a few feet. Pry bars will be made available to move this debris.

Debris entering the condenser waterbox pit will further be minimized by the handrail located on the pit's south side. Sheet metal siding, lumber, plywood can be caught by the handrail. Impact from the wind borne debris may deform the handrail steel (stress greater than allowable), however the handrail will still act as a barrier. Due to the small handrail pipe cross section, wind loads on the pipe will not dislodge the handrail from its concrete base.

Figure 1, Tornado Travel Path & Debris Locations, shows a plan view of the area around the condenser waterbox pit. The most probable tornado approach direction is from the west-southwest. Based on the attachment drawing, a walkdown was performed to identify any potential debris not mentioned in the above evaluation. The walkdown verified heavier items in Table 1 were located near the condenser waterbox pit. No new items were found. The walkdown determined miscellaneous construction materials may be in the area south and east of the condenser waterbox pit. These materials are listed as items 7 through 13 in Table 1.



Insulation and sheet metal jacketing may become dislodged from piping on the Turbine Bldg mezzanine level (above pit area).

Debris removal equipment storage location.

Valve CW-125 and hose located in this area at pit floor (el 221.5')

Siding from Condensate Polishing Building may become dislodged.

TORNADO
APPROACH DIRECTION FROM WEST-SOUTHWEST

Sheet metal Bus Duct for main transformers may become dislodged. (Note that Bus Duct not shown on drawing.)

Figure 1, Tornado Travel Path & Debris Locations

TABLE 1
Debris Characterization

	Debris	**Originating Location (relative to the pit area)**	**Weight Estimate (individual debris piece)**
1	Piping Insulation	North & Above	Very light
2	Sheet Metal Jacket for Piping Insulation	North & Above	Light
3	Scaffold poles, cross bracing and walkboards, and accessories.	East, South & Above	47 lbs. (walkboard 10' long)
4	Sheet Metal Condensate Polishing Building 4 ft. x 10 ft. panel	West	25 lbs.
5	Sheet Metal for Bus Duct 18 gage sheet metal 2ft. x 10ft. section	South & East	40 lbs.
6	Fire barrier composite panel	South & East	137 lbs.
7	Plastic sheeting	Various	Very light
8	Plywood 4x8 ft. sheet x ¾ inch	South& East	70 lbs.
9	Lumber / 2x12 / pine / 10 ft. long	South & East	75 lbs.
10	Tools staged in the area to support trades (drills, saws, conduit bender, work benches, etc.).	South & East	50 to 75 lbs.
11	Boxed materials staged for installation such as fittings, cables, fixtures, junction boxes, etc.	South & East	Less than 50 lbs.
12	Cardboard and packing materials	South & East	Very Light
13	Plastic containers and 5 gallon pails	South & East	Light

The debris characterization summarizes the weight of each piece of debris that may find its way into the condenser waterbox pit. This table is not meant to imply all debris will be present after a tornado event. Nor does this evaluation quantify the total number of each debris type that may be blown over the CW-125 valve and hose. The table is a basis for debris removal either by hand or using portable equipment after a high wind event.

Debris may pile over the valve and hose, however debris is expected to be distributed over a wider area. This means that all loose debris will not be deposited over the valve and hose.

Table 1 meets the bounding technical requirement implied by NEI 12-06, Section 7.2.2. That is the tornado wind generates localized debris that needs to be removed. Such debris has been characterized to determine removal equipment.

NEI 12-06, Section 7.3.2

Table 1 proves most debris weight will be less than 50 pounds for any single item. The heaviest debris will be the composite panels at 137 lbs. All debris can be removed by hand to clear the CV-125 valve and hose location. Debris blocking access to the flex connection simply needs to be moved to clear access. Immediately after the high wind event, flex equipment mobilization is the priority, not plant clean up. As such, any debris blocking the valve will only need to be moved a few feet.

Hand tools should be available to assist in debris removal. The hand tools listed in Table 2 are sized to handle objects by prying or pulling with mechanical advantage to make debris removal as easy as possible. The ratchet puller, cables and shackles are sized to drag or lift debris laying over the valve and hose. The 2000 lb. capacity is larger than the weight of any single piece of debris. The bar type tools are sized to break up and pry debris loose from the condenser waterbox pit. The tool length provides leverage to move debris. The steel shaft size ensures the tool will not bend when used as a lever to move debris in the 100 to 137 lb. range. Mechanical advantage provide by these bar tools will make debris removal faster.

TABLE 2
Recommended Debris Removal Tools

Tool	Description[1]	Quantity Required
Gooseneck Wrecking Bar	36 inches long, ¾ inch steel shaft	2
Digging Bar	72 inches long, 1 inch steel shaft, 4 inch wedge at base	2
Demolition Bar	30 inches long, 1 steel shaft with striking head	2
Ratchet Puller	2000 lbs. pull capacity, 1/16 inch cable, 6 ft. cable length	2
Shackles	Screw pin, 2000 lbs. capacity minimum, 3/8 inch body size	10
Cable	Wire rope, 2000 lbs. capacity minimum, ¼ diameter x 50 ft. long, closed hook at each end	2
Cable	Wire rope, 2000 lbs. capacity minimum, ¼ diameter x 25 ft. long, closed hook at each end	2

Note 1 General description provided to assist equipment purchase, not intended as an exact specification.

The bounding technical requirement in NEI 12-06, Section 7.3.2 is met. Suitable portable equipment for debris removal is specified by the evaluation.

NEI 12-06, Section 11.3

Debris removal equipment should be staged in the same location as FLEX-PMP-LP-A and –B (Portable Low Press Flex Pump). This location is inside the Turbine Building, Ground Floor. The storage location has been evaluated in EC 94741 (Reference 8) as providing suitable protection for flexible coping equipment for high wind hazards. The location is near the condenser waterbox pit and will be accessed during strategy implementation. No further evaluation is needed.

The portable equipment specified for debris removal in this evaluation is hand operated to provide mechanical advantage. No electric power is required to deploy or use this equipment.

The bounding technical requirements in NEI 12-06, Section 7.3.2 is met. Suitable protection from high winds events for debris removal is specified by the evaluation. No electric power is required to deploy or use this equipment.

QUALITY CLASS DETERMINATION

This engineering evaluation is Quality Class D. No change to the plant design basis, drawings or calculations is made. The evaluation documents the technical justification for debris removal to allow a specific flexible coping strategy to be implemented.

REFERENCES:

1. NEI 12-06 Rev. 0, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide
2. EA 12-049, NRC Letter, E.J. Leeds (NRC) to All Power Reactor Licensees and holders of Construction Permits in Active or Deferred Status, Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond Design Basis External Events, dated March 12, 2012
3. AP-053, Rev. 3, Severe Weather Response
4. OMM-021, Rev. 44, Operations During Adverse Weather Conditions
5. GID/R87038/0007, Rev. 6, DBD Hazard Analysis
6. RNP-C/STRU-1261, Rev. 0, Transformer Yard Fire Walls – Structural Calculation
7. HBR2-12518, Rev. 0, Fire Barrier Elevation View – Main Barriers
8. EC 94741 Rev. 3, Circulating Water Supply to Steam Driven Aux Feedwater Pump Section during ELAP and/or LUHS
9. EC 99828, Rev. 0, Debris Removal At New Circ Water Valve For FLEX Pump

ENCLOSURE 3

Final Integrated Plan

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

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 & 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 6.1.1) 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.

Based on NTTF Recommendation 4.2, the NRC issued Order EA-12-049 (Reference 6.1.2) on March 12, 2012 to implement mitigation strategies for Beyond-Design-Basis External Events (BDBEEs). The order provided the following requirements for strategies to mitigate BDBEEs:

a. Licensees shall develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and SFP cooling capabilities following a BDBEE.

b. These strategies must be capable of mitigating a simultaneous loss of all AC power and loss of normal access to the ultimate 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.

c. 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.

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

e. Full compliance shall include procedures, guidance, training, and acquisition, staging or installing of equipment needed for the strategies.

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

- Phase 1 - Initially cope relying on installed equipment and on-site resources.
- Phase 2 - Transition from installed plant equipment to on-site BDB equipment
- Phase3 - Obtain additional capability and redundancy from off-site equipment and resources until power, water, and coolant injection systems are restored or commissioned.

NRC Order EA-12-049 (Reference 1) required licensees of operating reactors to submit an overall integrated plan, 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 overall integrated plan or December 31, 2016, whichever comes first.

The Nuclear Energy Institute (NEI) developed NEI 12-06 (Reference 5), 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 2), dated August 29, 2012, which endorsed NEI 12-06 with clarifications on determining baseline coping capability and equipment quality.

1.1 Open Item

During the NRC Audit of March 2-6, 2015, regarding Audit Question 61, Steam Generator Dryout, the NRC staff expressed concern regarding the timeliness of the operator being able to complete the FLEX pump connection after addressing any possible debris and/or flooding concerns in the cooling water inlet bay. This is a time sensitive action that must be completed before SG dryout occurs. Therefore, the NRC staff requests that the licensee make available an engineering evaluation of potential debris in the area near the cooling water inlet bay and the time validation of performing the connection to the FLEX pump for SG makeup.

Robinson prepared an engineering evaluation to determine the type of debris that may affect the deployment of the alternate auxiliary feedwater strategy designed for a high wind event. Engineering Change (EC) 99828, Debris Removal At New Circ Water Valve For FLEX Pump, was submitted to the NRC via email on April 20, 2015.

Robinson also performed a time validation of the strategy deployment using the NEI Validation Process. The strategy was deployed in 18 minutes by three trained Operators, leaving a margin of 43 minutes for debris removal. A copy of the time validation is uploaded to the RNP e-Portal website.

1.2 References

1. NRC EA-12-049 Order to address Modifying Licenses With Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, March 12, 2012.
2. NRC JLD-ISG-2012-01 Interim Staff Guidance to address Compliance with Order EA-12-049 Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, August 29, 2012.
3. SECY 11-0124 Recommended Actions To Be Taken Without Delay From the Near-Term Task Force Report, September 9, 2011.
4. SECY 11-0137 Prioritization of Recommended Actions To Be Taken in Response to Fukushima Lessons Learned, October 3, 2011.
5. NEI 12-06 [Rev. 0] Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, August, 2012.
6. Robinson Nuclear Plant Unit 2 Updated Final Safety Analysis Report, Revision 25 dated December 17, 2013.
7. NEI 12-01, Revision 0, Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities.
8. WCAP-17601-P, Revision 1, Reactor Coolant System Response to Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs, August 2012.

9. PA-PSC-0965 Core Team Interim Position on ELAP Core Cooling (11-02-12 FINAL)
10. Specification WELC-5379-S8, Revision 2, Specification for Miscellaneous Tanks.
11. NUMARC 87-00, Revision. 1, Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors, August 1991.
12. Background Information For Westinghouse Owners Group Emergency Response Guideline, ECA-0.0, Loss Of All AC Power, LP-Rev. 2+ (ELAP) August 12, 2013
13. EOP-ECA-0.0, Loss of All AC Power, Rev. 0
14. PLP-007, Revision 80, Robinson Emergency Plan.
15. EC83803, Revision 0, RCP Safe Shutdown Seals
16. EC-EVAL91865: Rev. 0, Feasibility of Protecting the RWST and CST From Tornado and Associated Missiles
17. Shutdown / Refueling Modes NEI 12-06 Guidance
18. RNP-E-6.032, Fukushima Flex 4.2 Phase 1 – Load Profile Calculation for Battery A and B
19. Calculation RNP-M/MECH-1877, RNP Extended Loss of AC (ELAP) Power Containment Response
20. CA-2, Injection Rate For Long Term Decay Heat Removal
21. Calculation DAR-SEE-II-14-4, Evaluation Of Alternate Coolant Sources For Responding to a Postulated Extended Loss Of All AC Power at the H. B. Robinson Steam Electric Plant Unit No. 2
22. Calculation RNP-M/MECH-1712, Appendix R Mechanical Basis Calculation, section 3.27, Cooldown Using MSIV Bypass Lines
23. Calculation RNP-M/MECH-1590, Time-to-Boil Curves for the Fuel Pool and Refueling Cavity
24. Calculation NAI-1809-001, RNP-2 Reactor Auxiliary Building Extended Loss of AC Power FLEX Response
25. OP-925, Cold Weather Operation, Rev. 60
26. CN-SEE-II-13-27, H.B. Robinson Nuclear Plant FLEX Alternate Cooling Evaluation Input Auxiliary Feedwater Usage
27. WCAP 14027-P, Rev. 0, No. 1 Seal Flow Rate for Westinghouse Reactor Coolant Pumps Following Loss of All AC Power Task 3: Evaluation of Revised Seal Flow Rate on Time to Enter Reflux Cooling and Time at which the Core Uncovers
28. WCAP-17792, Rev. 0, Emergency Procedure Development Strategies for the Extended Loss of AC Power Event for all Domestic Pressurized Water Reactor Designs
29. NFPA-HAZ10, Hazardous Materials, 14th Edition
30. Calculation RNP-F-NFSA-0241, RNP Cycle 30 EC Supporting Calculations
31. EDMG-014, Alternate RCS Boration
32. EDMG-004, Steam Generators (S/G)
33. EDMG-005, Containment Vessel (CV)

34. SPP-038, Installation Operation And Removal Of Supplemental Cooling For HVH-1, 2, 3, & 4
35. GP-008, Draining the Reactor Coolant System
36. CSD-EG-RNP-8888, Flexible Response to Extended Loss of All AC Power (FLEX) NRC Order 12-049 – Mitigation Strategies (FLEX)

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

2.1 General Elements

2.1.1 Assumptions

The assumptions used for the evaluations of a H. B. Robinson Steam Electric Plant, Unit No. 2 Extended Loss of AC Power/Loss of Ultimate Heat Sink (ELAP/LUHS) event and the development of FLEX strategies are stated below. Boundary conditions consistent with NEI 12-06 Section 3.2.1, *General Criteria and Baseline Assumptions* are established to support development of FLEX strategies, as follows:

- The BDB external event occurs impacting the site.
- The reactor is initially operating at power, unless there are procedural requirements to shut down due to the impending event. The reactor has been operating at 100% power for the past 100 days.
- The reactor is successfully shut down when required (i.e., all rods inserted, no ATWS). Steam release to maintain decay heat removal upon shutdown functions normally, and reactor coolant system (RCS) overpressure protection valves respond normally, if required by plant conditions, and reseat.
- On-site staff is at site administrative minimum shift staffing levels.
- No independent, concurrent events, e.g., no active security threat.
- All personnel on-site are available to support site response.
- The reactor and supporting plant equipment are either operating within normal ranges for pressure, temperature and water level, or available to operate, at the time of the event consistent with the design and licensing basis.

The following plant initial conditions and assumptions are established for the purpose of defining FLEX strategies and are consistent with NEI 12-06 Section 3.2.1, *General Criteria and Baseline Assumptions*:

- No specific initiating event is used. The initial condition is assumed to be a loss of off-site power (LOOP) with installed sources of emergency on-site AC power and station blackout (SBO) alternate AC power sources unavailable with no prospect for recovery.

- Cooling and makeup water inventories contained in systems or structures with designs that are robust with respect to seismic events, floods, and high winds and associated missiles are available. Permanent plant equipment that is contained in structures with designs that are robust with respect to seismic events, floods, and high winds and associated missiles, are available. The portion of the fire protection system that is robust with respect to seismic events, floods, and high winds and associated missiles is available as a water source.

- Normal access to the ultimate heat sink is lost, but the water inventory in the ultimate heat sink (UHS) remains available and robust piping connecting the UHS to plant systems remains intact. The motive force for UHS flow, i.e., pumps, is assumed to be lost with no prospect for recovery.

- Fuel for BDB equipment stored in structures with designs that are robust with respect to seismic events, floods and high winds and associated missiles, remains available.

- Installed Class 1E electrical distribution systems, including inverters and battery chargers, remain available since they are protected.

- No additional accidents, events, or failures are assumed to occur immediately prior to or during the event, including security events.

- Reactor coolant inventory loss consists of unidentified leakage at the upper limit of Technical Specifications, reactor coolant letdown flow (until isolated), and reactor coolant pump seal leak-off at normal maximum rate.

- For the spent fuel pool, the heat load is assumed to be the maximum design basis heat load. In addition, inventory loss from sloshing during a seismic event does not preclude access to the pool area.

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

- Exceptions for the site security plan or other (license/site specific) requirements of 10CFR may be required.

- Deployment resources are assumed to begin arriving at hour 6 and fully staffed by 24 hours.

- This plan defines strategies capable of mitigating a simultaneous loss of all alternating current (AC) power and loss of normal access to the ultimate heat sink resulting from a BDB event by providing adequate capability to maintain or restore core cooling, containment function, and spent fuel pool (SFP) cooling capabilities at all units on a site. 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 pre-planned strategies developed to protect the public health and safety have been incorporated into the unit emergency operating procedures in accordance with established emergency operating procedure (EOP) 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 and direct the required actions to be taken when the limiting conditions are not met. The result of the BDB event 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).

2.1.2 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 spent fuel pool (SFP) using installed equipment, on-site portable equipment, and pre-staged off-site resources. This indefinite coping capability will address an extended loss of all AC power (ELAP) – loss of off-site power, emergency diesel generators and any alternate AC source, but not the loss of AC power to buses fed by station batteries through inverters – with a simultaneous loss of access to the ultimate heat sink (LUHS). This condition could arise following external events that are within the existing design basis with additional failures and conditions that could arise from a Beyond-Design-Basis external event.

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.

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 BDB external event by providing adequate capability to maintain or restore core cooling, containment function, and SFP cooling capabilities at both units at H. B. Robinson. 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 H. B. Robinson emergency operating procedures in accordance with established EOP change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59.

2.2 Reactor Core Cooling and Heat Removal Strategies

Core Cooling, RCS Makeup and Inventory Control - Modes 1-4

The FLEX strategy for reactor core cooling and decay heat removal is to release steam from the Steam Generators (SG) using either the Power Operated Relief Valves (PORVs) or Main Steam Header vents, and the addition of a corresponding amount of feedwater to the steam generators (SGs) via the steam driven AFW (SDAFW) pump. The AFW system includes the Condensate Storage Tank (CST) as the initial water supply to the SDAFW pump (seismic strategy) and the Circulating Water inlet bay via a portable low pressure pump (high wind/missile strategy). Operator actions to verify, re-align, and throttle AFW flow are required following an ELAP/LUHS event to prevent SG dryout and/or overfill.

RCS cooldown will be initiated within the first 2 hours following a BDB external event that initiates an ELAP/LUHS event.

DC bus load shedding will ensure battery life is extended to approximately 3 hours. Pre-staged generators will repower instrumentation prior to battery depletion.

RCS makeup and boron addition will be initiated by 16 hours to ensure natural circulation, reactivity control, and boron mixing is maintained.

2.2.1 Phase 1 Strategy

Following the occurrence of an ELAP/LUHS event, the reactor will trip and the plant will initially stabilize at no-load reactor coolant system (RCS) temperature and pressure conditions, with reactor decay heat removal via steam release to the atmosphere through the steam generator safety valves and/or power-operated relief valves (SG PORVs). Natural circulation of the reactor coolant system will develop to provide core cooling and the steam driven auxiliary feedwater pump will provide flow from the condensate storage tank to the steam generators to make-up for steam release.

Operators will respond to the event in accordance with emergency operating procedures (EOPs) to confirm reactor coolant system, secondary system, and containment conditions. A transition to ECA-0.0, “Loss of All AC Power,” (Reference 13) will be made upon the diagnosis of the total loss of AC power. This procedure directs isolation of reactor coolant system letdown pathways, confirmation of natural circulation cooling, verification of containment isolation, reducing DC loads on the station Class 1E batteries, and establishment of electrical equipment alignment in preparation for eventual power restoration.

The operators re-align auxiliary feedwater flow to all steam generators, establish manual control of the SG PORVs or manually operate the main steam header vents, and initiate a rapid cooldown of the RCS to minimize inventory loss through the RCP seals. ECA-0.0 directs local manual control of auxiliary feedwater flow to the steam generators and manual control of the SG PORVs or main steam header vents to control steam release to control the RCS cooldown rate, as necessary.

The Phase 1 strategy for reactor core cooling and heat removal relies upon installed plant equipment and water sources for auxiliary feedwater (AFW) supply to the steam generators and steam release to the atmosphere. Auxiliary Feedwater (AFW) cooling is available to provide secondary makeup sufficient to maintain or restore Steam Generator level with installed equipment to the greatest extent possible.

The S/G Power Operated Relief Valves (PORVs) are normally operated using the Instrument Air system or with the backup Nitrogen system (aligned via Attachment 2 of EOP-ECA-0.0). However, neither the primary Instrument Air, nor the backup Nitrogen system are robust. Therefore, the primary Instrument Air and backup Nitrogen systems cannot be relied upon during a beyond design basis external event. The Main Steam Safety Valves are an alternate method to depressurize, but their use is not recommended per the PA-PSC-0965 PWROG Core Cooling Position Paper (Reference 9) and WCAP-17601-P (Reference 8) (remaining on the Main Steam Safety Valves for an extended period of time may lead to failure of the valve(s) resulting in excessive uncontrolled RCS cooldown). Strategies currently exist to align portable nitrogen tanks to the S/G PORV header using H. B. Robinson procedure EDMG-004, Steam Generators, Attachment 1, Connecting Emergency Pressure Source to Operative SG PORVs, or Attachment 2, SG Manual Depressurization (Reference 32).

In addition to the SG PORV capabilities recommended in PA-PSC-0965, H. B. Robinson also has a strategy to cooldown the RCS using the main steam line isolation valve bypass lines. The strategy is detailed in calculation RNP-M/MECH-1712, Appendix R Mechanical Basis Calculation, section 3.27, Cooldown Using MSIV Bypass Lines (Reference 22). This capability results in a cooldown rate of 83°/hr, which bounds the recommended Westinghouse cooldown rate of 75°/hr. EC90627 was completed to protect the Turbine Building Class 1 Bay against the high wind and missile hazard to support the local strategies.

The primary source of AFW inventory is the condensate storage tank (CST) and its level instrumentation, which are seismically qualified (Reference 6), but are not protected from wind or missiles. Due to structures in the immediate vicinity of the existing CST, as well as potential obstructions and hazards above the CST, it is not recommended to attempt to harden the CST against high winds and tornado missiles (Reference 16). The CST is expected to survive a seismic event and is the installed source of AFW to the SDAFWP, however, its inventory is insufficient for indefinite coping (mission time is approximately 9 hours). The only other assured water source is the Ultimate Heat Sink (Lake Robinson), which, per the restrictions outlined in NEI 12-06, can only be accessed using portable equipment (assumes normal access to UHS is lost). Given these limitations, one Phase 2/3 seismic strategy to provide an indefinite supply of water to the CST/SDAFWP is to stage a portable diesel pumper at the lake with hoses routed to the CST FLEX connection at valve C-66, CST Drain Valve (EC90622) to provide an indefinite water supply to the CST.

The RCS will be cooled down and depressurized until Steam Generator pressure reaches 290 psig. RCS isolation is verified to have occurred automatically or manually, and RCS leakage will be through the RCP low leakage seals. Natural circulation is maintained and shutdown margin will be restored using phase 2 portable equipment for RCS boration and makeup (see section 2.3.2).

Load shedding of all non-essential DC loads would begin within 44 minutes after the occurrence of an ELAP/LUHS and completed within the next 16 minutes. With deep load shedding, the useable station Class 1E battery life is calculated to be 3.75 hours for station battery A and 3.25 hours for station battery B. (See Section 2.2.6)

2.2.2 Phase 2 Strategies

Beyond the use of installed equipment, steam generators must be able to be depressurized in order to support makeup via portable pumps. Multiple and diverse connection points for the portable pumps must be provided and cooling water must be available indefinitely.

An additional portable backup for S/G makeup is required per NEI 12-06, Section 3.2.2(13).

Two intermediate pressure pumpers (300 gpm @ 1000 psig) are staged for all seismic events as described below. The two low pressure pumpers can also be used to access the lake to refill the pre-staged AFW tanks.

Two portable pumps have been procured, each capable of 300 gpm at 1000 psig; this combination eliminates the need to depressurize the SGs in the event the backup AFW feed capability is needed due to an AFW interruption early in the ELAP transient resulting from a seismic event. Either portable pump can take suction from six pre-staged 20,000 gallon tanks (120,000 gal. total) and can be tied directly into the auxiliary feedwater system. Engineering Change (EC) 95266 is completed and adds a FLEX tee connection (AFW-166) to the SDAFWP discharge at AFW-121. Access to this primary connection is through the seismically qualified (Reference 6, Section 3.2) Turbine Building Class 1 Bay. This pre-staged seismic strategy can provide SG feed within approximately 23 minutes, well within the 61 minute dry-out time, and is a portable backup to the SDAFWP.

EC 90623 adds an alternate mechanical FLEX connection (AFW-165) inside the MDAFWP room on line 4-AFW-23, upstream of AFW-54. The MDAFWP room is in the Reactor Auxiliary Building (RAB) and is protected against applicable H. B. Robinson hazards. The MDAFWP room can be accessed from the outside through the seismically protected RAB hallways. Access to the MDAFWP room may also be via pathways in the turbine building that are not safety related. Two diverse pathways are selected. The first is the normal west-to-east walkway through the center of the turbine building to the

MDAFWP room. The second is from the west or southwest area outside the turbine building around the south side of the turbine building to the open pathway that leads directly to the MDAFWP room through the turbine building.

As noted above, the CST is not protected against wind-generated missiles. EC94741 modified the circulating water (CW) inlet bay at the main condenser with a FLEX connection in the bay to access the UHS from within the turbine building which provides protection from wind-generated missiles. Two portable low pressure diesel pumpers are staged in the turbine building protected by the turbine pedestal structure and are easily deployable at the CW inlet bay. The Phase 2 wind/missile strategy for AFW supply connects a pre-staged pumper to the CW inlet bay FLEX connection and discharges directly to the suction of the SDAFWP downstream of isolation valve AFW-4. The CW bays will remain filled from the lake as long as lake level is above 217' (normal level is 221'). This strategy can be accomplished in less than 1 hour with margin for debris removal. The inlet bay FLEX connection and low pressure pumpers can also be used to refill the AFW tanks described above.

One concern with the use of Lake Robinson as an AFW source is the issue of SG fouling or blockage leading to reduced heat transfer capacity and potential loss of core cooling. H. B. Robinson has evaluated lake water and deepwell chemistry to determine the coping times prior to diminished heat transfer or SG fouling. Calculation DAR-SEE-II-14-4, Evaluation Of Alternate Coolant Sources For Responding to a Postulated Extended Loss Of All AC Power at the H. B. Robinson Steam Electric Plant Unit No. 2 (Reference 21), demonstrates a coping time using the 'D' deepwell of over 700 hours (29.1 days), and lake or discharge canal water of approximately 283 hours (11.8 days). This assumes conservative lake Total Suspended Solids levels approximately 20X higher than normal levels. The coping time with lake water allows for deployment of National SAFER Response Center water treatment equipment that will be used to clean lake water for indefinite core cooling capability.

NEI 12-06 requires low leak seals and/or borated high pressure makeup. RCS inventory control and long term subcriticality are accomplished using phase 2 portable equipment that is stored in the Permanent FLEX Storage Building (PFSB). EC83803 (Reference 15) modified the RCP seals with Westinghouse SHIELD® passive thermal shutdown seals. Using the bounding analysis in the WCAP, H. B. Robinson has determined that Phase 2 boration capability is required for the planned plant cooldown, but makeup for inventory control is not required until Phase 3 as discussed below.

There are no installed means to provide borated makeup following an ELAP. The primary method of boration and inventory control is to use a portable high pressure, low volume pump connected directly to the charging lines or safety injection headers from the RWST or a portable tanker containing borated water. The makeup capacity of the portable pump is 60 gpm at 2000 psig which is adequate for the bounding analysis discussed in WCAP-17601-P (Ref 12) for Phase 2 boration. Phase 3 inventory control will be accomplished using the same portable diesel pumper which is also adequate for the bounding analysis discussed in WCAP-17601-P.

H. B. Robinson Steam Electric Plant, Unit No. 2 has an existing portable boration strategy with a capacity of 60 gpm @ 2000 psig through the charging header drain valves CVC-121A and CVC-121B (EC95216). Alternate RCS connections are available in the safety injection system (SI) through valves SI-888P and SI-888S. Currently, the RWST is seismically qualified (Reference 6, Section 3.2), but is not protected from wind or missiles (Reference 16). Portable high pressure pumping and portable tanker capability will be stored in the Permanent FLEX Storage Building to support this function. EC90622 added a FLEX connection to the exposed end downstream of normally locked closed drain valve (SI-837) located at the base of the RWST (See Figure 2) to access this borated water if it is available.

Core Cooling, RCS Makeup and Inventory Control - Modes 5-6

Reactor Core Cooling and Heat Removal with the Steam Generators unavailable during Modes 5 and 6 and the RCS vented is accomplished through RCS makeup. When the RCS is depressurized and drained to reduced inventory, the SGs are no longer coupled to the core and core cooling is accomplished through evaporative cooling. Injection flow to remove decay heat is less than 150 gpm (Reference 20). In Modes 5 and 6 RCS makeup for core cooling and inventory control in an ELAP event will be accomplished with a portable diesel pumper rated at 300 gpm at 1000 psig. The portable pumper can take suction from the RWST via a FLEX connection at SI-837, RWST Drain, or SFP via an Emergency Cooling Connection (ECC) in the SFP Cooling System and deliver through pre-staged connections in the safety injection lines at SI-879A and SI-879B. The SFP can also be accessed by using portable hoses and a pumper directly from the SFP operating floor. If the SFP is used as a source of borated water, the SFP can be replenished using existing SFP makeup strategies and manual addition of boric acid to the SFP. Calculations in EC95216 can be extrapolated to show that the addition of approximately 100 lbs. of boric acid per 1000 gallons of SFP makeup is sufficient to maintain shutdown margin in the SFP and the RCS. Installation of the FLEX connections will be controlled using the shutdown risk management process as described in the Shutdown Modes Position Paper endorsed by the NRC (Reference 17). See GP-008, Draining the Reactor Coolant System (Reference 35).

2.2.3 Phase 3 Strategy

The Phase 3 Strategy for core cooling and decay heat removal is a continuation of the Phase 2 strategies. Additional pumps are available from the National SAFER Response Center (NSRC) to provide backup to the BDB pumps. Additionally, a Reverse Osmosis/Ion Exchanger system will be provided from the NSRC to provide a method to remove impurities from alternate fresh water supplies to the SDAFW pump or the BDB pumps.

One 1 MW, 480VAC portable diesel generator (DG) will be provided from the NSRC in order to supply power to either of the two Class 1E 480VAC buses (emergency busses E1 or E2). Temporary power cables will be deployed from the Permanent FLEX Storage Building to be staged at the location of the 480VAC DG for connection to the Class 1E 480VAC bus through switchgear located in the Emergency Switchgear Room. The switchgear will be connected using a DB50 Bus Feed Adapter developed specifically for this purpose, or by using a pre-fabricated connections that replace the EDG output current transformer disconnects.

2.2.4 Systems, Structures, Components

2.2.4.1 Steam Driven Auxiliary Feedwater Pump

AFW is required to be in operation within 61 minutes of event initiation (Ref 12). With AC power lost, at least one steam supply valve (MS-V1-8A, MS-V1-8B, MS-V1-8C) to Steam Driven Auxiliary Feedwater Pump (SDAFWP) and AFW valves (AFW-V2-14A, AFW-V2-14B, AFW-V2-14C) to the steam generators must be manually operated. This is an existing Robinson strategy.

The SDAFWP and valves listed above are located in the Turbine Building Class 1 Bay (seismically protected area) and are protected from high wind and tornado missile hazards.

2.2.4.2 Steam Generator Power Operated Relief Valves (PORVs)

The S/G Power Operated Relief Valves (PORVs) are normally operated using the Instrument Air system or with the backup Nitrogen system (aligned via Attachment 2 of EOP-ECA-0.0). However, neither the primary Instrument Air, nor the backup Nitrogen system are robust.

In addition to the SG PORV capabilities recommended in PA-PSC-0965, H. B. Robinson also has a strategy to cooldown the RCS using the main steam line isolation valve bypass lines. The strategy is detailed in calculation RNP-M/MECH-1712, Appendix R Mechanical Basis Calculation, section 3.27, Cooldown Using MSIV Bypass Lines (Reference 22). This capability results in a cooldown rate of 83°/hr, which bounds the recommended Westinghouse cooldown rate of 75°/hr. EC90627 protects the Turbine Building Class 1 Bay against the high wind and missile hazard to support the local strategies.

2.2.4.3 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 within the first hour of an ELAP event provides an estimated total service time of approximately 3.25 to 3.75 hours of operations. Hydrogen generation in the vital battery room and adjacent rooms during the ELAP while using the pre-staged diesel generators to charge batteries and power the DC busses was evaluated in Calculation NAI-1809-001, RNP-2 Reactor Auxiliary Building Extended Loss of AC Power FLEX Response (Reference 24). Results of the calculation indicate that after battery charging begins and fire doors FDR12 and FDR28 are propped open for access to the battery room “…the hydrogen concentration in the battery room remains below 1% for the duration of the 7-day transient. The plateau trend shown in the figure is largely due to the natural circulation pattern in the room, and leakage through the open doorways." Battery room ventilation is not required for at least 7 days. Battery room ventilation will be supplied in Phase 3 when portable FLEX NSRC diesel generators are deployed to power E1 or 2 as described Section 2.3.3 above.

2.2.4.4 Condensate Storage Tank

The condensate storage tank (CST) provides an AFW water source at the onset of the event, but is not protected from wind or missiles. The CST is expected to survive a seismic event and is the installed source of AFW to the SDAFWP, however, its inventory is insufficient for indefinite coping (mission time is approximately 9 hours). The only other assured water source is the Ultimate Heat Sink (Lake Robinson), which, per the restrictions outlined in NEI 12-06, can only be accessed using portable equipment (assumes normal access to UHS is lost). Given these limitations, one Phase 2/3 seismic strategy to provide an indefinite supply of water to the CST/SDAFWP is to stage a portable diesel pumper at the lake with hoses routed to the CST FLEX connection at valve C-66, CST Drain Valve (EC90622) to provide an indefinite water supply to the CST.

2.2.4.5 Lake Robinson (UHS)

The ultimate source of core cooling water (and the only one capable of providing indefinite functionality) is Lake Robinson. The lake contains an average of 31,000 ac-ft (1.3×10^9 ft^3) of water and is considered an indefinite supply of water.

One concern with the use of Lake Robinson as an AFW source is the issue of SG tube fouling or blockage leading to reduced heat transfer capacity and potential loss of core cooling. H. B. Robinson has evaluated lake water and deepwell chemistry to determine the coping times prior to diminished heat transfer or SG fouling. Calculation DAR-SEE-II-14-4, Evaluation Of Alternate Coolant Sources For Responding to a Postulated Extended Loss Of All AC Power at the H. B. Robinson Steam Electric Plant Unit No. 2 (Reference 21), demonstrates a coping time using lake or discharge canal water of approximately 283 hours (11.8 days). This assumes conservative Total Suspended Solids levels approximately 20X higher than normal levels. The coping time with lake water allows for deployment of National SAFER Response Center water treatment equipment that will be used to clean lake water for indefinite core cooling capability.

2.2.5 FLEX Connections

2.2.5.1 Primary AFW Pump Discharge Connection

The primary AFW FLEX tee connection (AFW-166) is at the SDAFWP discharge at AFW-121. Access to this primary connection is through the seismically qualified (Reference 6, Section 3.2) Turbine Building Class 1 Bay. This pre-staged seismic strategy can provide SG feed within approximately 23 minutes, well within the 61 minute dry-out time, and is a portable backup to the SDAFWP.

2.2.5.2 Alternate AFW Pump Discharge Connection

EC 90623 adds an alternate mechanical FLEX connection (AFW-165) inside the MDAFWP room on line 4-AFW-23, upstream of AFW-54. The MDAFWP room is in the Reactor Auxiliary Building (RAB) and is protected against applicable H. B. Robinson hazards. The MDAFWP room can be accessed from the outside through the seismically protected RAB hallways. Access to the MDAFWP room may also be via pathways in the turbine building that are not safety related. Two diverse pathways are selected. The first is the normal west-to-east walkway through the center of the turbine building to the MDAFWP room. The second is from the west or southwest area outside the turbine building around the south side of the turbine building to the open pathway that leads directly to the MDAFWP room through the turbine building.

2.2.5.3 CST Connection

A suction and/or refill connection to the CST is installed at C-66, CST Drain Valve to facilitate refill of the CST or provide a suction source to portable equipment. The connection is seismically designed and located at the base of the CST. The connection includes a hose coupling suitable for easy connection of a pump and fire hose supplying water from the CW Inlet Bay or one of the other sources of water to refill the CST.

2.2.5.4 Primary RCS Connections

2.2.5.5 The primary RCS connections for boration and makeup (modes 1-4) are two charging header drain valves, CVC-121A and CVC-121B. High pressure couplings are stored with the high pressure hoses required with the portable boration equipment. The connections are made at the time of boration or makeup.

The primary RCS connection for boration and makeup (modes 5-6, RCS vented) is SI-879A, a SI header check valve that is re-configured using a pre-fabricated bonnet when needed. This time sensitive strategy is staged and implemented as described in procedure OMP-003, Shutdown Safety Function Guidelines, when the plant enters Mode 5.

2.2.5.6 Alternate RCS Connection

2.2.5.7 The alternate RCS connections for boration and makeup (modes 1-4) are two safety injection header drain valves, SI-888P and SI-888S. High pressure couplings are stored with the high pressure hoses required with the portable boration equipment. The connections are made at the time of boration or makeup.

The alternate RCS connection for boration and makeup (modes 5-6, RCS vented) is SI-879B, a SI header check valve that is re-configured using a pre-fabricated bonnet when needed. This time sensitive strategy is staged and implemented as described in procedure OMP-003, Shutdown Safety Function Guidelines, when the plant enters Mode 5.

2.2.5.8 RWST Suction Connection

There is a RWST Drain FLEX Connection installed at SI-837, RWST Drain, that can be used as source of borated water for RCS makeup if the RWST survives the event.

2.2.5.9 SFP Connections

There is a connection in the SFP Cooling System at valve SFPC-749 that would allow for SFP makeup using a portable pump and hoses without the need to access the SFP operating deck.
There is also a connection in the SFP Cooling System at the suction of the B SFPC Pump. This connection is an alternate borated water source for RCS makeup if the RWST is not available. This connection would also allow for SFP makeup using a portable pump and hoses without the need to access the SFP operating deck.

2.2.6 Key Reactor Parameters

The ability to maintain or re-power key reactor parameters as required by NEI 12-06 Section 3.2.1.10 and PWROG recommendations (Reference 12) is described below. The instrumentation recommended to monitor these key reactor parameters are as follows:

- RCS Hot Leg Temperature (Thot)
    - *Powered by both safety batteries (Loops 2 and 3 only).*
- RCS Cold Leg Temperature (Tcold)
    - *RCS Cold Leg Temperature is not powered by 125VDC Safety Batteries A and B. Tcold is not required if SG pressure indication is available as Tsat of SG pressure can be used as a substitute.*
- RCS Wide Range Pressure
    - *Powered by both safety batteries.*
- SG Narrow Range Level
    - *Powered by both safety batteries.*

- SG Wide Range Level
  - *Powered by both safety batteries (Local indication only for 'B' and 'C' SG's).*
- Core Exit Thermocouple Temperature
  - *Powered by both safety batteries.*
- RCS Passive Injection (Accumulator) Level
  - *RCS Passive Injection (Accumulator) Levels are powered by Instrument Busses 7 and 9, therefore only Battery A and 480V MCC 6 supply power (Narrow range only; 1 channel level and pressure per accumulator available).*
- Pressurizer Level
  - *Powered by both safety batteries.*
- Reactor Vessel Level Indicating System
  - *Powered by both safety batteries.*
- AFW Pump Flow
  - *Powered by both safety batteries (SDAFWP flow indication for A and B SG's only; MDAFWPs, flow indication only for A and C SG's).*
- SG Pressure
  - *Powered by both safety batteries.*
- CST Level
  - *CST Level is powered by instrument bus 1 and 2 (therefore only MCC 5 and Battery A supply power)*
- Battery Capacity/DC Bus Voltage
  - *Local indication only (Only available on ERFIS for initial 30-40 minutes).*
- Neutron Flux
  - *Powered by both safety batteries (N36 IR NIS and N52 SR (CPS) only available).*

Instrumentation channels that are powered by Station Batteries will be lost upon battery depletion. FLEX strategies to improve battery coping must occur by extending Phase 1. Phase 1 can be extended by strategic load shedding followed by additional deep load shedding in the first hour of the event to extend battery coping times to 3.25-3.75 hours (Reference 18).

Phase 2 and 3 battery coping will require FLEX diesel generators to power the battery chargers. EC90617 was completed to provide FLEX pre-staged diesel generator power to the Vital Battery Chargers. Two FLEX diesel generators will be stored in their deployed positions in the Reactor Auxiliary Building near the battery chargers. Each generator will be sized to power two Vital Battery Chargers. Electrical cables and pre-installed connectors will be routed from the FLEX diesel generators to an area in the battery room that allows for quick connection of the cables to each of the battery chargers. The primary strategy is to power the A (or A1) and B (or B1) Vital Battery Chargers from one pre-staged FLEX generator. The supporting ventilation system configuration will only allow the start, run and loading of one diesel at a time. This is an alternate method to the portable strategies recommended in NEI 12-06 and discussed in more detail in Enclosures 1 and 2 of this Final Integration Plan.

Duke Energy Progress, Inc. confirms that the FLEX strategy station battery run-time 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 detailed licensee calculations, supporting vendor discharge test data, FLEX strategy battery load profile, and other inputs/initial conditions required by IEEE-485 is available on the licensee's web portal for documents and calculations. The time margin between the calculated station battery run-time for the flex strategy and the expected deployment time for flex equipment to supply the DC load is approximately 1.25 hours determined as follows:

- Limiting battery duty cycle is 3.25 hours for Battery B
- T-0 thru T-1 hr. is for load shedding
- T-1 hr. thru T-2hrs. is for deploying the cables and aligning the pre-staged diesel generators to the battery chargers

2.2.6.1 Primary and Alternate Electrical Connections

As described above, two FLEX diesel generators will be stored in their deployed positions in the Reactor Auxiliary Building Drumming Room. Each generator will be sized to power two Vital Battery Chargers. Electrical cables and pre-installed connectors will be routed from the FLEX diesel generators to either of two distribution panels located in the Drumming Room. Similar electric cables stored in the drumming Room will be routed from either distribution panel, out the propped open door and down the hall to the Boric Acid Batching Tank Room. Cables stored in the Batching Tank Room will be connected to the cables from the distribution panels and routed through another door into the Vital Battery Room, where they will be connected to either redundant battery charger for each battery (A or A1, and B or B1 battery charger).

In addition to the battery repowering strategies, it is necessary for instrument readings to be attainable utilizing portable equipment (NEI 12-06 Section 5.3.3.1). EC90734 was completed to provide for local instrument monitoring. Portable meters, tables, power supplies, and procedures for obtaining the readings at the instrument racks are developed for all of the instruments required for FLEX.

Several critical instruments recommended by the PWROG are physically located within the Turbine Building Class I Bay. This area is not protected from wind/missile hazards. EC90627 was completed to harden the Turbine Class I bay against wind/missile hazards.

Steam line pressure transmitters (SG Pressure) have electrical freeze protection powered from non-safety related power panels. These sensing lines may be subject to freezing in extreme cold conditions. H. B. Robinson initiates a freeze protection program prior to the winter months in accordance with OP-925, Cold Weather Operation (Reference 25). Freeze protection circuits and temporary enclosures heated by 480 VAC electric heaters are used in the procedure. The main steam line pressure transmitters are included in the cold weather operation procedure as Attachment 10.13. FLEX equipment includes two Baldor T130 480 VAC generators and two portable electric heaters stored in protected locations. One of these generators can be deployed to power the portable heaters as necessary in an ELAP event.

2.2.7 Thermal Hydraulic Analyses

2.2.7.1 Secondary Analysis

The model used for determination of secondary response was that used in the generic analysis in WCAP-17601, Sections 5.2 and 5.4. Duke performed a site specific applicability review of the analysis and confirmed applicability to Robinson. Parameters used in the model were compared to the Robinson plant and the overall results were confirmed to be bounded by the model and inputs used in the WCAP and associated analytical codes.

Decay heat removal analyses (AFW requirements/time) were based on the following methods:

- decay heat function, dhIST(t,σ), decay heat determined as a function of time, t (in seconds), and the applied standard deviation margin, 2σ
- ANS 5.1-1979 +2σ Decay Heat Model
- ANS 73 Decay Heat Model

2.2.7.2 RCS Analysis

The model used for determination of RCS response was that used in the generic analysis in WCAP-17601, Section 5.2.1, and updated for Westinghouse 3 Loop Plants in WCAP-17792. Duke performed a site specific applicability review of the analysis and confirmed applicability to Robinson. Parameters used in the model were compared to the Robinson plant and the overall results were confirmed to be bounded by the model and inputs used in the WCAP and associated analytical codes.

RCS inventory makeup will begin by 16 hours following the onset of the ELAP condition. Based on information from WCAP 17601 and 14027-P (Reference 27), reflux cooling is considered to be in progress when the one-hour centered moving average (CMA) flow quality in the steam generator U-bend region exceeds 0.1 in any one loop. PWROG-14027-P provides a method of adjusting the results from WCAP-17601 based on new information concerning RCP seal leakage. This short evaluation follows in that same methodology to provide insight as to how long the plant can cope during an ELAP. H. B. Robinson has replaced all the RCP seals with low leakage seals such that the leakage during a loss of seal cooling event is limited to 1gpm/pump + 1gpm of unidentified leakage.

- RCP Leakage = 1gpm = 0.118 lbm/s (at Temp = 415F and Pressure = 310 psia)
- Total Leakage = 1 gpm (unidentified) + 1 gpm/RCP * 3 = 4 gpm = 0.473 lbm/s
- RCS initial mass = 412,000 lbm (See Table 5-2 in PWROG-14027-P)
- RCS mass at reflux cooling = 272,000 lbm (See Table 5-2 in PWROG-14027-P)
- Estimated CLA Injection = 69,000 lbm
- Mass lost to reach reflux cooling = 412,000 + 69,000 – 272,000 = 209,000 lbm
- Time to reflux cooling = 209,000 lbm / 0.473 lbm/s = 441,860.47 s = 122.74 hours

H. B. Robinson boration strategy requires RCS makeup to begin approximately 16 hours after the ELAP/LUHS event. RCS inventory control via the FLEX portable RCS makeup pump will be operating well before reflux cooling or core uncovery becomes a concern.

2.2.8 Reactor Coolant Pump Seals

H. B. Robinson Steam Electric Plant, Unit No. 2 is a Westinghouse 3-Loop plant with Westinghouse SHIELD low leakage RCP seals. Upon activation the seals are designed to allow <1gpm seal leakoff/RCP.

2.2.9 Shutdown Margin Analysis

A Shutdown Margin Analysis was performed and determined the SDM of at least 1% (Keff <0.99) is achieved in Cycle 30 with the addition of 209 ppm boron (Calculation RNP-F/NFSA-0241 (Reference 30)). The existing H. B. Robinson strategy for ELAP boration calls for 480 ppm boron in procedure EDMG-014, Alternate RCS Boration (Reference 31). Since the RCS inventory makeup is initiated no later than 16 hours following an ELAP/LUHS event, the borated water injected into the RCS for inventory makeup bounds the boration requirements for maintaining core reactivity shutdown margin of 1% following an ELAP/LUHS. The required makeup volume can easily be accommodated by RCS volume shrink without venting the RCS.

The SDM calculation assumes a uniform boron mixing model. Boron mixing was identified as a generic concern by the NRC and was then addressed by the PWR Owner's Group (PWROG). The NRC endorsed the PWROG boron mixing position paper with the clarification that a one hour mixing time was adequate provided that the flow in all loops is greater than or equal to the corresponding single-phase natural circulation flow rate. H. B. Robinson RCP seal leakage is 1 gpm/pump with low leakage seals. Since RCS makeup will be initiated at 16 hours, and the pump capacity of 60 gpm is well in excess of the maximum RCS leakage at 16 hours, the NRC clarification regarding single-phase flow has been addressed (as discussed in 2.2.7.2 above) and a one hour mixing time is acceptable. Since additional boron is not required until 28 hours after the ELAP event, the SDM of at least 1% is maintained.

2.2.10 FLEX Pumps and Water Supplies

2.2.10.1 Portable RCS Injection Pumps

The PA-PSC-0965 PWROG Core Cooling Position Paper recommends that the RCS Injection pump required delivery pressure be established at the saturation pressure of the reactor vessel head + 100 psi driving head to allow RCS injection. Following the formula in the position paper, the required delivery pressure for the RCS Injection pump at H. B. Robinson is approximately 1886 psia. Accordingly, the portable RCS injection pump is capable of delivering a minimum flow of 60 gpm at a discharge pressure of up to 2000 psig. Hydraulic analysis of the portable RCS injection pump with the associated hoses and installed piping systems confirm that the RCS Injection pump minimum flow rate and head capabilities exceed the FLEX strategy requirements for maintaining RCS inventory. Two portable RCS Injection pumps are available for the Robinson unit.

2.2.10.2 Intermediate Pressure Pumps

H. B. Robinson has two portable intermediate pressure pumps, each capable of 300 gpm at 1000 psig; this combination eliminates the need to depressurize the SGs in the event the backup AFW feed capability is needed due to an AFW interruption early in the ELAP transient resulting from a seismic event.

2.2.10.3 Low Pressure Pumps

H. B. Robinson has two portable low pressure pumps, each capable of 600 gpm at 70 psig. The pumps are stored in the turbine building protected from high winds and tornado missiles. The pumps are easily deployable at the CW inlet bay. The Phase 2 wind/missile strategy for AFW supply will connect one pumper to the CW inlet bay FLEX connection and discharge directly to the suction of the SDAFWP downstream of isolation valve AFW-4.

H. B. Robinson also has two low pressure Hale Pumps. One pump is a 3000 gpm, 100 psig pump, the other is a 1500 gpm, 150 psig pump designated as the B.5.b (50.54(hh)(2)) pump.

Both Hale pumps are stored in the PFSB.

2.2.10.4 Condensate Storage Tank

The primary source of AFW inventory is the condensate storage tank (CST) and its level instrumentation, which are seismically qualified. The CST is the installed source of AFW to the SDAFWP; its normal inventory of approximately 170,000 gallons is sufficient for approximately 7.5 hours after a plant trip from power.

2.2.10.5 Lake Robinson

Lake Robinson is the H. B. Robinson ultimate heat sink. The UHS is accessed from the circulating water inlet bay at the main condensers and is used as the backup for the CST to supply the SDAFWP or as makeup to the CST or pre-staged tanks. The lake contains an average of 31,000 ac-ft (1.3 x 10^9 ft^3) of water and is considered an indefinite supply of water. See section 2.3.4.5. for a discussion of lake water quality and coping times.

2.2.10.6 Discharge Canal

2.2.10.7 The discharge canal is easily accessed from the east or west deployment routes. The south end of the discharge canal has a convenient staging area for either Hale pump. It is separated from the lake by a berm and a concrete weir structure at the outlet of the canal. It is 4.2 miles long, 115’ wide, and averages 13’ deep.

2.2.10.8 Borated Water Supplies

Two sources of borated water have been evaluated for use during a Beyond-Design-Basis event. Each borated water source is discussed below.

- Refueling Water Storage Tank (RWST): H. B. Robinson is equipped with one RWST located at grade level just outside of Reactor Auxiliary Building. The tank is stainless steel, safety-related, seismically qualified, but not protected from missiles. The RWST borated volume is maintained greater than 300,000 gallons at a boron concentration between 1950 and 2400 ppm.
- Portable Boric Acid Mixing Tank: In the event that the RWST is unavailable or becomes depleted, two portable borated water mixing tanks are available to provide a suction source for the portable RCS Injection pumps. These mixing tanks will be transported from the PFSB and positioned near the respective RCS Injection pump. Dilution water will be added to the mixing tank by a portable pump from Lake Robinson. Bags of powdered boric acid will be mixed with the dilution water to achieve concentration of approximately 4400 ppm for maintaining adequate shutdown margin while making up RCS inventory. The maximum boron concentration that will be mixed is below the level at which precipitation concerns occur, even at temperatures down to 32°F.

2.2.11 Electrical Analysis

The Class 1E battery duty cycle of 3.25-3.75 hours for H. B. Robinson 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 1.25 hours for H. B. Robinson.

The strategy to re-power the stations vital DC buses requires the use of pre-staged diesel powered generators. The details of this strategy are described in section 2.2.6. above.

An additional replacement 480 VAC generator and 4kV diesel powered generators are available from the National SAFER Response Center (NSRC) for the Phase 3 strategy.

2.3 Spent Fuel Pool Cooling/Inventory

The basic FLEX strategy for maintaining Spent Fuel Pool (SFP) cooling is to monitor SFP level and provide makeup water to the SFP sufficient to maintain the normal SFP level.

2.3.1 Phase 1 Strategy

Using the data from Calculation RNP-M/MECH-1590, Time-to-Boil Curves for the Fuel Pool and Refueling Cavity (Reference 23), calculations indicate SFP boil-off to ten feet above the fuel racks will occur at approximately 23 hours after the ELAP occurs (assumes full core offload and 150˚F initial conditions). During non-outage conditions, the time to boiling in the pool is significantly longer, typically greater than 45 hours. The initial coping strategy for spent fuel pool cooling is to monitor spent fuel pool level using instrumentation installed as required by NRC Order EA-12-051.

2.3.2 Phase 2 Strategy

Phase 2 strategy is to initiate makeup using a portable pump to draft from Lake Robinson or the discharge canal and makeup to the SFP through several possible locations. The primary draft location is the south end of the Discharge canal. Other back-up locations include any accessible location along the lakeside. Required hose lengths and fittings are pre-staged on hose trailers. The pump and hose trailer will be towed to the draft point by tow vehicles also protected in the PFSB. The discharge of the pump would be connected to one of two hose connections outside of the Spent Fuel building in the Spent Fuel Pool Cooling (SFPC) room. The SFPC room is a seismic class I structure adjacent to the Spent Fuel building. An alternate strategy is to deploy a hose directly into the pool from the SFP operating deck if the building is accessible.

Additionally as required by NEI 12-06, spray monitors and sufficient hose length required for the SFP Spray Option are located in the PFSB.

2.3.3 Phase 3 Strategy

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

2.3.3 Structures, Systems, and Components

2.3.3.1 Primary Connection

The primary hose connection for SFP make-up is located in the SFPC room. The primary emergency SFP make-up connection is directly inside the door to the SFPC room at valve SFPC-742 and designed to accept a 3” hose with 2 ½” NHT connector.

Use of this makeup connection to the Spent Fuel Pool will not require entry into the Spent Fuel Building.

2.3.3.2 Alternate Connection

The alternate Phase 2 strategy for providing makeup water to the SFP is to deploy a hose directly into the SFP from the operating deck.

An additional alternate strategy utilizes a spray option to achieve SFP make-up. The 50.54(hh)(2) spray strategy (as required by NEI 12-06 Table D-3 for providing spray at 250 gpm) is to provide flow through portable spray monitors set up on the deck next to the SFP. A hose will be run from the discharge of the portable pump up to the SFP operating deck. From there, the hose may be run directly over the side of the pool or to a portable spray monitor. The spray monitor will spray water into the SFP to maintain water level.

All equipment used for the 50.54(hh)(2) spray strategy is portable equipment that is deployed from its storage location in the PFSB.

2.3.3.3 Ventilation

NEI 12-06, Table D-3, Summary of Performance Attributes for PWR SFP Cooling Functions, requires the following:

- Vent pathway for steam & condensate from SFP

  The purpose statement notes that steam from boiling pool can condense and cause access and equipment problems in other parts of plant.

The H. B. Robinson SFP can be vented through the normal SFP personnel door directly to the outside atmosphere without interfering with plant equipment (Reactor Auxiliary Building equipment would not be subjected to steam from the SFP).

The H. B. Robinson SFP building is accessed from the outside via a door at the 275’ elevation. There is also a large moveable hatch in the roof of the SFP (used for SFP casks). Either the door or the hatch can be used to vent the SFP. Steam and condensate cannot be vented into the Reactor Auxiliary Building.

Ventilation requirements to prevent excessive steam accumulation in the Spent Fuel Building are included in FLEX Support Guidelines (FSGs) and direct operators to open the normal access door to the Spent Fuel Building and the SFP Roof Hatch Cover if necessary to establish a steam vent pathway. Airflow through the door and hatch cover provides adequate vent pathways through which the steam generated by SFP boiling can exit the Spent Fuel Building.

2.3.4 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*.

2.3.5 Thermal-Hydraulic Analyses

Evaluations estimate that with no operator action following a loss of SFP cooling at the maximum design heat load (full core offload during refueling activities), the SFP will reach 200ºF in approximately 5 hours and boil off to a level 10 feet above the top of fuel in approximately 24 hours from initiation of the event (assumes a nominal initial SFP temperature of 120ºF). During non-outage conditions, the time to boil off to a level 10 feet above the top of fuel is significantly longer, typically greater than 45 hours. Assuming an estimated boil-off rate of approximately 60 gpm, either Hale pump is sufficient to maintain normal SFP level in an ELAP event.

2.3.6 Flex Pump and Water Supplies

2.3.6.1 Hale Pumps

H. B. Robinson also has two low pressure Hale Pumps. One pump is a 3000 gpm, 100 psig pump, the other is a 1500 gpm, 150 psig pump designated as the B.5.b (50.54(hh)(2)) pump.

Both Hale pumps are stored in the PFSB.

2.3.6.2 Discharge Canal

2.3.6.3 The discharge canal is easily accessed from the east or west deployment routes. The south end of the discharge canal has a convenient staging area for either Hale pump. It is separated from the lake by a berm and a concrete weir structure at the outlet of the canal. It is 4.2 miles long, 115’ wide, and averages 13’ deep.

2.3.6.4 Lake Robinson

Lake Robinson is another source of water for deployment of the Phase 2 SFP strategy. See 2.3.10.5 for a more complete description of Lake Robinson.

2.3.7 Electrical Analysis

The Spent Fuel Pool will be monitored by instrumentation installed by Order EA-12-051. The power for this equipment has backup battery capacity for 72 hours. Alternative power will be provided within 72 hours using on-site portable generators to provide power to the instrumentation and panels.

2.4 Containment Function

As described by NEI 12-06, no concurrent events occur during the beyond-design-basis external event (NEI 12-06 Section 3.2.1.3(4)), thus there are no line breaks in containment that would rapidly increase pressure. An engineering analysis (RNP-M/MECH-1877 (Reference 19)) was performed to determine the containment temperature and pressure response assuming extended loss of AC power (ELAP) and a trip from 100% reactor power at 100 days into the cycle. Results of RNP-MECH-1877 indicate the containment design limits for temperature and pressure will not be challenged in the first 43 days following the event assuming no actions are taken to cool, spray, or vent containment. This calculation also assumes that low leakage RCP seals are installed.

Given the extended coping time for the containment function, it is reasonable to assume sufficient resources will be available to implement one or more of the three strategies proceduralized in FSG-012, Alternate Containment Cooling, to protect the containment function. As such, actions to reduce Containment temperature and pressure and to ensure continued functionality of the key parameters will not be required immediately and will utilize off-site equipment and resources during Phase 3.

2.4.1 Phase 1

The Phase 1 coping strategy for Containment involves verifying Containment isolation per ECA-0.0, Loss of All AC Power, and monitoring Containment temperature and pressure using installed instrumentation. Control room indication for Containment pressure and Containment temperature will be retained for the duration of the ELAP as described in Section 2.4.5 below.

2.4.2 Phase 2

Phase 2 coping strategy is to continue monitoring Containment temperature and pressure using installed instrumentation. Phase 2 activities to repower instruments (Section 2.2.6) are required to continue Containment monitoring.

The Containment temperature will be procedurally monitored and, if necessary, the Containment temperature will be reduced to ensure that key Containment instruments will remain within analyzed limits for equipment qualification. Containment temperature reduction will require the implementation of a Containment cooling strategy. Various Containment cooling strategy options are discussed in Section 2.4.3 below.

2.4.3 Phase 3

Necessary actions to reduce Containment temperature and pressure and to ensure continued functionality of the key parameters will utilize existing plant systems restored by off-site equipment and resources during Phase 3. The most significant need is to provide 480VAC power to station pumps and provide for a cooling water source.

The Phase 3 coping strategy is to obtain additional electrical capability and redundancy for on-site equipment until such time that normal power to the site can be restored. This capability will be provided by a 480VAC portable diesel generator (DG) provided from the NSRC to supply power to either of the two Class 1E 480VAC buses. Additionally, by restoring the Class 1E 480VAC bus, power can be restored to selected 480VAC loads.

It is assumed the SW pumps are not available. H. B. Robinson has 4 available Hale pumps (see Section 2.2.10) that can be used to supply the SW headers from Lake Robinson through pre-fabricated FLEX connections on the SW strainers. The NSRC will also supply low pressure/high flow diesel driven pumps (up to 5,000 gpm) that can provide flow to existing site heat exchangers in order to remove heat from the containment atmosphere.

Several options were evaluated to provide operators with the ability to reduce the Containment temperature and pressure.

Ventilation Option

The 480VAC DG from the NSRC will be aligned to power a Class 1E 480VAC bus as described above, which will provide power to a CV HVH Unit 480VAC motor. A portable diesel generator can be used to power any one of the 4 site deepwells to supply CV cooling as directed in procedure SPP-038, Installation, Operation, and Removal of Supplemental Cooling For HVH-1, 2, 3, & 4 (Reference 34).

Spray Option

One spray option is to establish water spray within the Containment using the Containment Spray (CS) system from the RWST.

The 480VAC DG from the NSRC will be aligned to power a Class 1E 480VAC bus as described above, which will provide power to the CS pump 480VAC motor. This initial spray flow can provide heat removal from the Containment atmosphere.

Alternate Spray Option

An alternate spray option is to establish water spray within the Containment using the Containment Spray (CS) system from Lake Robinson in accordance with EDMG-005, Containment Vessel (CV). This strategy assumes portions of the fire water system survive such that fire water can be supplied to the Containment Spray Pumps. The fire water system can be supplied using a portable pump from the lake.

The 480VAC DG from the NSRC will be aligned to power a Class 1E 480VAC bus as described above, which will provide power to the CS pump 480VAC motor. This initial spray flow can provide heat removal from the Containment atmosphere.

External Spray Option

FSG-012, Alternate Containment Cooling, describes a strategy whereby portable pumps or Fire Department Pumpers are used to spray the CV using elevated platforms and fire monitors. This strategy has the potential to extend the time to a containment challenge to as much as 90 days.

2.4.4 Structures, Systems, Components

2.4.4.1 Ventilation Strategy

No FLEX mechanical equipment connections are required for the ventilation option. A FLEX generator capable of supplying a site deepwell pump and sufficient fire hose is required for this strategy.

2.4.4.2 Spray Strategies

The Containment spray option requires that the RWST is intact and has sufficient volume to supply CS Pumps. Lake Robinson can be used to replenish the RWST using a portable pump delivering to the RWST Drain FLEX connection at SI-837.

The Alternate Containment spray option requires both CS pumps and a portable pump to supply lake water to the CS pumps. It also requires that a flow element be removed to install a transition fitting to connect to the pump (EDMG-005).

The Alternate Containment Cooling strategy uses portable pumps or Fire Department Pumpers to spray the CV using elevated platforms and fire monitors. This strategy has the potential to extend the time to a containment challenge to as much as 90 days.

The existing site equipment required to implement the Containment cooling options discussed above are components of safety related systems and are protected by design from the site hazards.

The remaining equipment required to implement the Containment cooling options discussed above is either part of existing B.5.b strategies or is brought to the site from the NSRC and is not subject to the site hazards initiating the ELAP condition.

2.4.5 Key Containment Parameters

Instrumentation providing the following key parameters is credited for all phases of the Containment Integrity strategy. Instrumentation is maintained as described in Section 2.2.6 above.

- Containment Pressure: Containment pressure indication is available in the main control room (MCR) throughout the event.
- Containment Temperature: Containment temperature indication is available in the Control Room throughout the event.

2.4.6 Thermal-Hydraulic Analyses

Conservative evaluations have concluded that Containment temperature and pressure will remain below Containment design limits for approximately 43 days and that key parameter instruments subject to the Containment environment will remain functional for a minimum of seven days.

2.4.7 Flex Pump and Water Supplies

The NSRC is providing a high capacity low pressure pump which will be used if required to provide cooling loads. Water supplies are as described in Section 2.13.1.

2.4.8 Electrical Analysis

Several options described above required the powering of a 480 VAC bus. The portable equipment being supplied from the NSRC will provide adequate power to perform the noted strategies and are included in calculations to support the sizing of the 1 MW 480 VAC power being provided.

2.5 Characterization of External Hazards

The applicable extreme external hazards at H. B. Robinson Steam Electric Plant Unit No. 2 are seismic, high wind, extreme cold with ice, and high temperature.

2.5.1 Seismic

For Diverse and Flexible Coping Strategies (FLEX), the earthquake is assumed to occur without warning and results in damage to non-seismically designed structures and equipment. Non-seismic structures and equipment may fail in a manner that would prevent accomplishment of FLEX-related activities (normal access to plant equipment, functionality of non-seismic plant equipment, deployment of beyond-design-basis (BDB) equipment, restoration of normal plant services, etc.).

2.5.2 External Flooding

This hazard is not applicable to H. B. Robinson since the plant is built above the design basis flood level. As stated in the H. B. Robinson Updated Final Safety Analysis Report (UFSAR) Chapter 2 (Sections 2.4.2 and 2.4.4) the maximum flood elevation is 222 ft while the grade level is 225 ft. Per NEI 12-06 (Section 6.2.1), H. B. Robinson is classified as a dry site and the external flood hazard is, therefore, not applicable.

Since the site is not located on an estuary or open coast, surge flooding is not a concern. Tsunami flooding is not a concern for the site because of its inland location.

2.5.3 Severe Storms with High Wind

Current plant design bases address the storm hazards of hurricanes, high winds and tornados.

The high wind hazard is applicable for H. B. Robinson. H. B. Robinson is located in Darlington County, SC with coordinates Latitude 34° 24’ 02” N, Longitude 80° 09’ 05” W (UFSAR Section 2.1.1.1). Peak-gust wind speed, per NEI 12-06 Figure 7-1, is 170 mph. Tornado design wind speed per NEI 12-06 Figure 7-2, Block #172 (Region 1) is 200 mph. These values indicate that H. B. Robinson has the potential to experience severe winds from hurricanes and tornadoes with the capacity to do significant damage, which are generally considered to be winds above 130 mph as defined in NEI 12-06 Section 7.2.1.

2.5.4 Ice, Snow and Extreme Cold

H. B. Robinson is located in Darlington County, SC with coordinates Latitude 34° 24' 02" N, Longitude 80° 09' 05" W (UFSAR Section 2.1.1.1). H. B. Robinson is located below the 35th parallel. Per NEI 12-06, Figure 8-1, H. B. Robinson is in an area corresponding to "low to significant snow accumulations" and "low temperatures." The area represents a record snowfall that is approximately 18-25 inches accumulation over three days. Such snowfalls are considered unlikely to present a significant problem for deployment of FLEX equipment. H. B. Robinson is not required to address extreme snowfall. Per NEI 12-06, Figure 8-2, H. B. Robinson is located in a Level 5 area, which is characterized as "Catastrophic destruction to power lines and/or existence of extreme amount of ice." H. B. Robinson is required to consider the adverse effects of ice on the deployment of FLEX equipment.

2.5.5 High Temperatures

The extreme high temperature hazard is applicable for all sites in the United States based on NEI 12-06 Section 9.2. Virtually every state in the lower 48 contiguous United States has experienced temperatures in excess of 110°F and many in excess of 120°F. H. B. Robinson will consider the impacts of extreme high temperature conditions of 130°F on the procurement, storage, and deployment of FLEX equipment.

2.6 Protection of FLEX Equipment

The Permanent FLEX Storage Building (PFSB) is a single robust/hardened structure, which is sized to facilitate the storage, maintenance, and deployment of portable FLEX equipment and equipment/vehicles necessary to facilitate the deployment of N+1 FLEX equipment as a Phase II flexible coping strategy at H. B. Robinson during a BDBEE. The PFSB is classified as an uninhabited structure and is intended to function as a storage facility for equipment which will be deployed following a BDBEE. The building is designed to withstand the H. B. Robinson hazards described above. The PFSB is located at northern most location within the Owner Controlled Area (OCA).

Deployment pathways and haul routes were evaluated for liquefaction and remediation was not required.

The PFSB was designed and constructed under Engineering Change 90625.

PFSB location, deployment paths, and staging areas are shown in Figure 1: Z25R6, Staging Areas and Lighting Plan HBR2-9800.

Debris removal equipment is also stored inside the PFSB 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 PFSB storage location and its deployment location(s). This includes mobile equipment such as a front end loader, tow vehicles (tractor) and hose trailer or utility vehicle that are stored inside the PFSB.

Deployments of the FLEX and debris removal equipment from the PFSB are not dependent on AC power. All actions are accomplished by either on-site backup DC power, manual, or backup generator tied to the building.

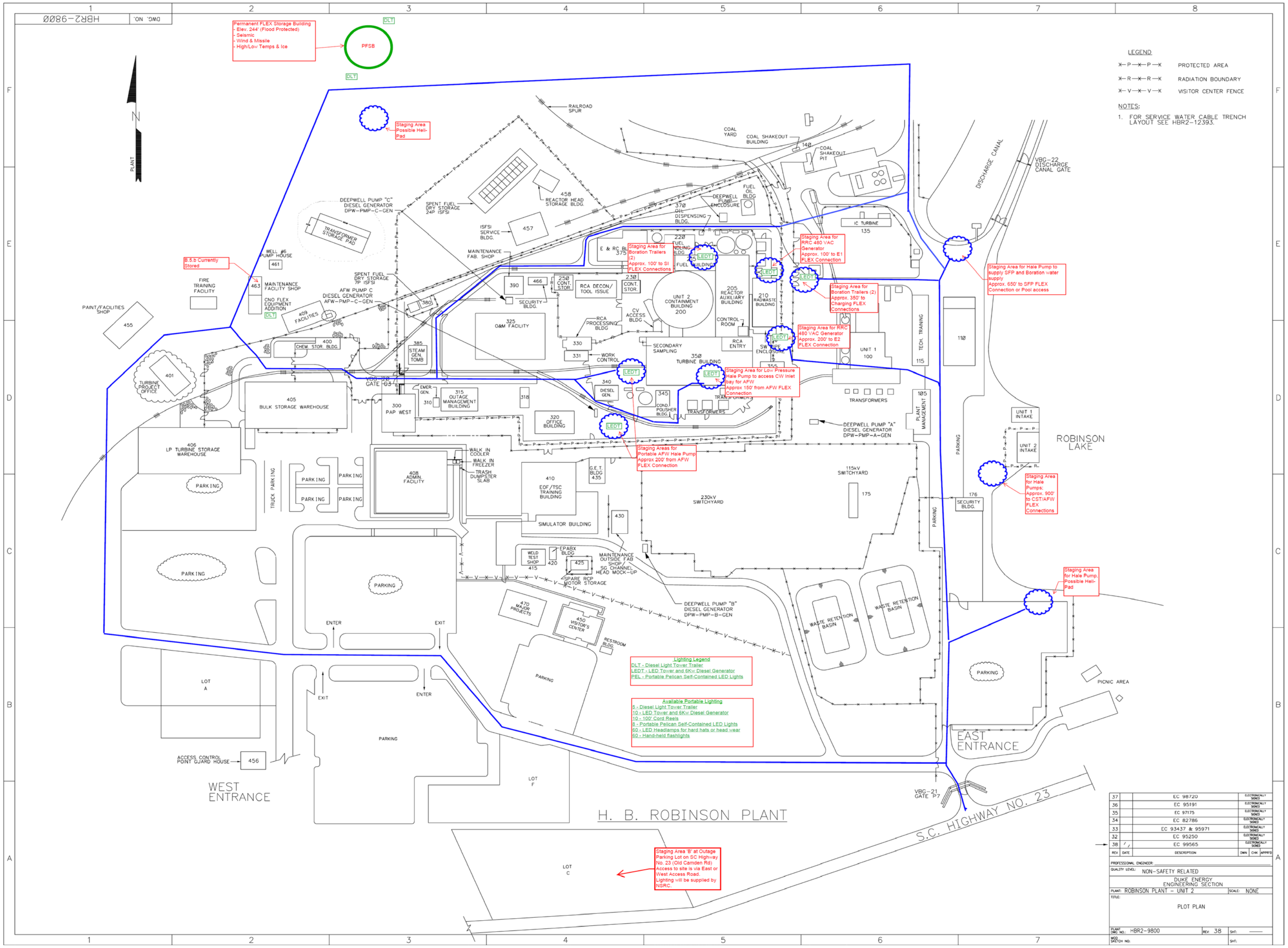


Figure 1: Z25R6, Staging Areas and Lighting Plan HBR2-9800

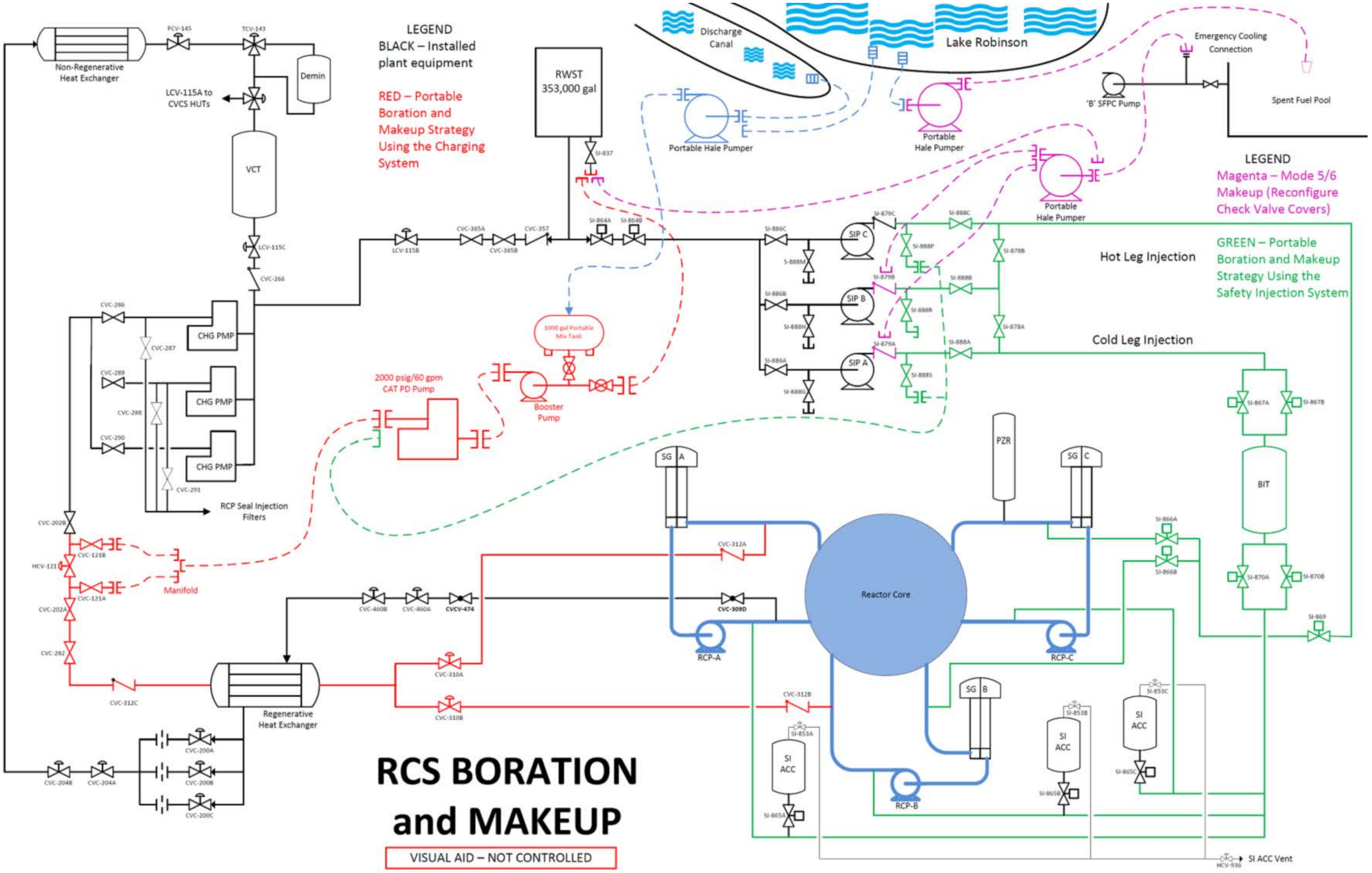


Figure 2: Z38R6, RCS Boration and Makeup

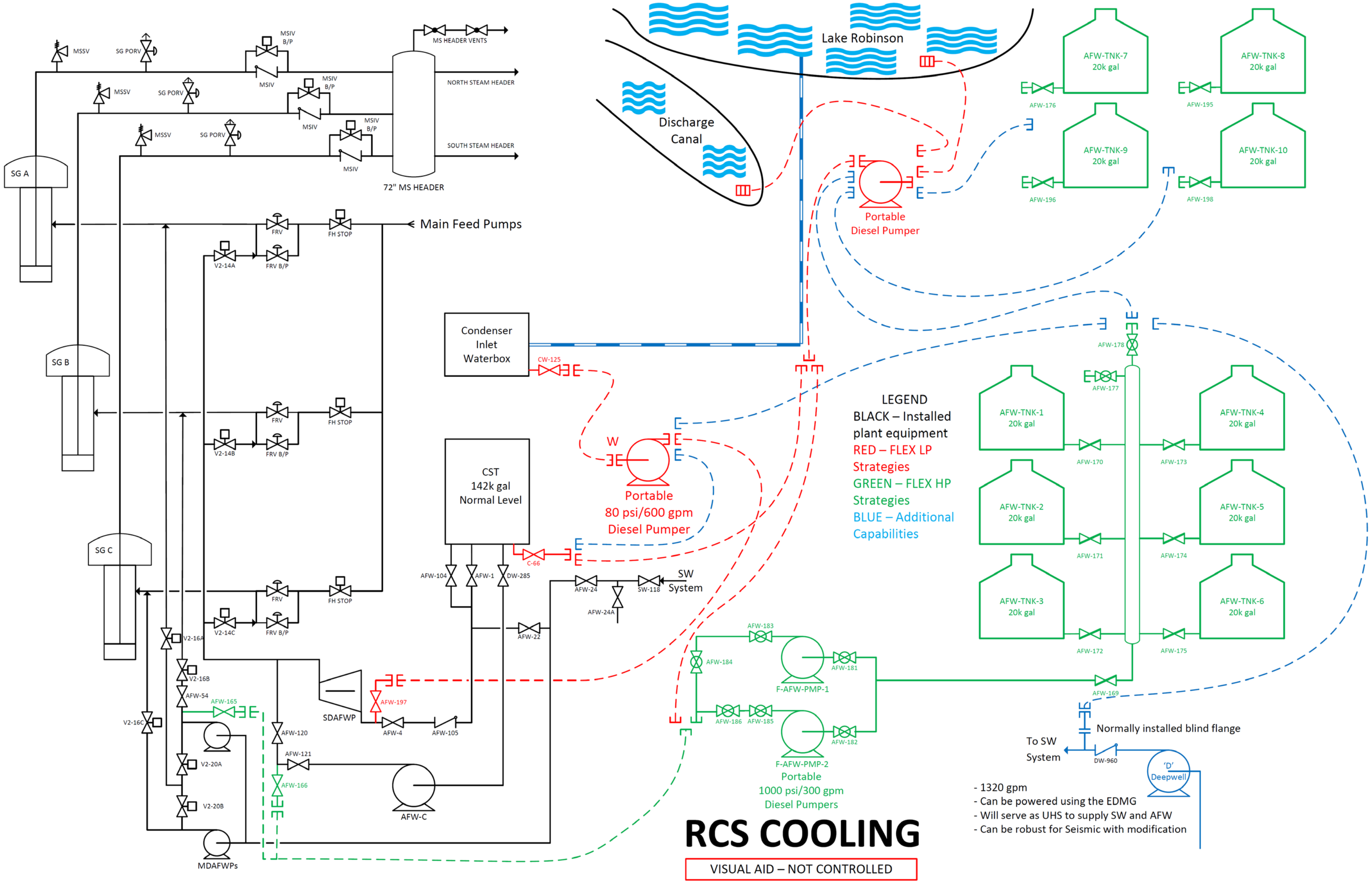


Figure 3: Z37R6, RCS Cooling

2.7 Planned Deployment of Flex Equipment

2.7.1 Haul Paths and Accessibility

Pre-determined, preferred haul paths have been identified and documented in the FLEX Support Guidelines (FSGs). Figure 1 shows the haul paths from the PFSB 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 preferred 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 PFSB to be protected from the severe storm and high wind hazards such that the equipment remains functional and deployable to clear obstructions from the pathway between the PFSB 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, and 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 BDB external event and subsequent ELAP event, FLEX coping strategies require the routing of hoses and cables to be run through various barriers in order to connect BDB 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 temporary cables/hoses routing is necessary to implement the FLEX coping strategies. Security doors and gates that rely on electric power to operate opening and/or locking mechanisms can be overridden by manual key locks; all operators and Security personnel carry the required key to open all doors and gates. The Security force will initiate 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 PFSB and various deployment locations be clear of debris resulting from seismic, high wind (tornado), or flooding events.

The stored FLEX equipment includes a CAT 924K front end loader to move or remove debris from the needed travel paths.

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 (Staging Area ‘B’) 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.

2.8 Deployment of strategies

2.8.1 AFW Makeup Strategy

Lake Robinson provides an indefinite supply of water, as make-up to the CST for supply to the SDAFW pump or directly to the suction of the portable diesel driven AFW pump. Lake Robinson will remain available for any of the external hazards listed in Section 2.5. Additionally, the discharge canal will also remain available for any of the external hazards listed in Section 2.5. Figures 2 and 3 provide a diagram of the flowpath and equipment utilized to facilitate these water supplies. A portable, diesel driven Hale pump will be transported from the PFSB to a location near the selected water source. A flexible hose will be routed from the pump suction to the water source where water will be drawn through a strainer sized to limit solid debris size to prevent damage to the SDAFW or the Hale pump. A flexible hose will be routed from the Hale pump discharge to the CST FLEX connection or to the suction of the SDAFWP. Water from the selected water source can also be pumped to the Spent Fuel Pool.

The primary Hale pump discharge connection is located within the seismic Turbine Building Class 1 Bay. The connection is protected from the external hazards described in Section 2.5.

The alternate Hale pump discharge connection is located within the seismic Class 1 Reactor Auxiliary Building MDAFWP Room. The connection is protected from the external hazards described in Section 2.5.

Figure 3 shows the possible flowpaths for RCS cooling; the strategies are described in detail in Section 2.2 above.

2.8.2 RCS Strategy

The RCS Injection pumps are stored in the PFSB and are protected against snow, ice, high and low temperatures, seismic, flood, high wind and associated wind-driven missiles.

The primary RCS Injection pump discharge connections are located inside the Reactor Auxiliary Building in the Charging Pump room and provide a path to the RCS through the charging system. Accordingly, these connections are protected against all BDB hazards.

The alternate RCS Injection pump discharge connections are located inside the Reactor Auxiliary Building in the Safety Injection (SI) Pump room and provide a path to the RCS through the SI system. Accordingly, these connections are protected against all BDB hazards.

Figure 2 shows the possible flowpaths for RCS boration and makeup; the strategies are described in detail in Section 2.2 above.

2.8.3 Electrical strategy

Two FLEX diesel generators will be stored in their deployed positions in the seismic Class 1 Reactor Auxiliary Building Drumming Room. Each generator will be sized to power two Vital Battery Chargers. Electrical cables and pre-installed quick connectors will be routed from the FLEX diesel generators to either of two distribution panels located in the Drumming Room. Similar electric cables stored in the drumming Room will be routed from either distribution panel, out the propped open door and down the hall to the Boric Acid Batching Tank Room. Cables stored in the Batching Tank Room will be connected to the cables from the distribution panels and routed through another door into the Vital Battery Room, where they will be connected to either redundant battery charger for each battery (A or A1, and B or B1 battery charger).

2.8.4 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, compressors, etc. The general coping strategy for supplying fuel oil to diesel driven portable equipment, i.e., pumps and generators, deployed to cope with an ELAP / LUHS, is to draw fuel oil out of any available existing diesel fuel oil tanks on the H. B. Robinson site.

While H. B. Robinson has several onsite fuel oil storage tanks (Diesel Fuel Oil Storage Tanks (DFOST), Alternate Fuel Oil Storage Tanks (AFOST), Unit 1 Fuel oil Storage Tanks, and Dedicated Shutdown Diesel FOST) not all are protected from all external hazards.

H. B. Robinson Steam Electric Plant Unit No. 2 has two 500 gallon fuel pumping trailers that can be used to retrieve fuel oil from the all tanks on site and deliver to the FLEX equipment staged in various plant locations. The portable tankers will be stored with approximately 800 gallons of diesel fuel in the PFSB. EC90737 provides FLEX connections to allow connectivity to the onsite fuel pumping trailers from the Diesel Fuel Oil Storage Tank Drain at FO-18 (2 inch - Diesel Oil Storage Tank Drain), and to provide FLEX connections on the Alternate Fuel Tank "A" at FO-217 and FO-244, and on Alternate Fuel Tank "B" at FO-219 and FO-245. The Alternate fuel oil tanks can also be accessed from each EDG room emergency day tank fill connections at FO-232 and FO-237. Hoses enable compatibility between the onsite fuel vehicles and the fuel oil storage tanks' access points.

Assuming a seismic event, there is an available volume of 19,800 gallons in the DFOST and Portable FLEX Fuel Oil Tankers #1 and #2 (both stored in the Permanent FLEX Storage Building (PFSB), protected from all H. B. Robinson hazards. This is sufficient to supply operating diesel equipment for approximately 11 days.

Assuming a high wind/missile event, there is an available volume of 5,264 gallons in the AFOST A and AFOST B (protected in the robust RadWaste Building) and Portable FLEX Fuel Oil Tankers #1 and #2 (both stored in the PFSB, protected from all H. B. Robinson hazards). This is sufficient to supply operating diesel equipment for approximately 3 days.

An analysis to determine the fuel consumption rate of all portable generators/equipment is presented in the table below, FLEX Equipment Fuel Usage and Refueling Chart. As noted in the chart, fuel oil sources are credited by hazard.

FLEX Equipment Fuel Usage and Refueling Chart

Equipment	Tank Size (gal)	GPH	GPD	Qty In Use	% Load	Total GPD for Mitigating Strategies	Approx. Time Between Refuels (Full Load)	Comments
Generator TS60T, 49 kw (HVAC Trailer)	80.0	4.3	103.2	0	100		18.5 hours	Note 1
Generator TS130T, 92 kw (Baldor Generators)	160.0	8.2	196.8	0	100		19.5 hours	Note 1
Generator QD1000, 10 kw (Command Trailer)	24.0	1.0	24.0	0	100		24.0 hours	Note 1
Generator XQ400 Cat, 365 kw (B.5.b TSDG)	470.0	30.0	720.0	0	100		14.0 hours	Note 1
Generator DG6E, 6 kw (Small Portable Gens)	4.6	1.0	24.0	5	50		4.0 hours	Note 2
Generator QSB7 DSGAC 150 kW (Drumming Room)	309.0	12.2	292.8	1	100		25.0 hours	Notes 4, 5
Light Tower RL4000, 6 kw (Equipment Trailers)	30.0	1.0	24.0	4	50		30.0 hours	Note 2
Compressor TCOM-25H, 25 cfm (Breathing Air)	13.0	4.5	108.0	0	100		3.0 hours	Note 1
Compressor 300HH, 300 cfm (Sullair)	56.0	6.5	156.0	0	100		8.5 hours	Note 1
Pump 3000 gpm @ 150#	350.0	25.0	600.0	1	50		14.0 hours	Note 3
Pump 1500 gpm @ 250# (B.5.b EDMP Hale)	240.0	15.35	368.4	1	50		15.5 hours	Note 3
Pump 60 gpm @ 1600# (Boration HP Pumper)	85.0	6.0	144.0	1	50		14.0 hours	Notes 4, 5
Pump 300 gpm @ 1000# (AFW IP Pumper)	200.0	26.3	631.2	1	100		7.0 hours	Notes 4, 5, 6
Pump 600 gpm @ 45# (AFW LP Pumper)	100.0	1.5	36.0	1	38		66.0 hours	Notes 5
Total Gallons						1,		

Note 1: Available equipment that is not required for mitigating strategies. Not included in daily fuel requirements.
Note 2: 6 kw generators are primarily used for outdoor lighting applications and assumed to operate 12 hrs/day (see EC88926R6, Attachment Z25AR6).
Note 3: Pumper is not expected to be in continuous use; expected use is one pump for tank refill or SFP makeup less than 12 hrs/day.
Note 4: Pumper not required for the 1st 12 hours; expected use is one pump less than 12 hrs/day for RCS boration and makeup.
Note 5: N+1 applies; 2 available, 1 in use at any time. Fuel usage and percent load were determined during the factory and site acceptance tests.
Note 6: Assuming these pumps are deployed at T=0 in an event, and due to the relatively short time between refuels, consider alternating the N and N+1 pumper at T=6 hours to allow ample time for the ERO to deploy refueling equipment.
Note 7: Additional supplies of diesel oil are available in the Hartsville area and from port terminals at Charleston, SC, Wilmington, NC, Fayetteville, NC and Raleigh, NC. “Ample trucking facilities exist to assure deliveries to the site within eight hours” per Technical Specification Basis B 3.8.3.

Fuel Sources in ELAP Event

Source	Available Fuel Oil	Basis	Timeline	Associated Hazards
Diesel Fuel Oil Storage Tank (DFOST)	19000 gal	TS SR 3.8.3.1	Immediate	Seismic, Flooding
Alternate Fuel Oil Storage Tanks (AFOST A, B)	2,232 gal (ea.)	EC59062	Immediate	Flooding, High Wind/Missiles
Portable FLEX Fuel Oil Tankers (#1, #2)	400 gal (ea.)	EC88926	6 hrs.	All (stored in PFSB)
Off-Site Fuel Oil Supplies NOTE 7	Unlimited	TS Basis 3.8.3	8 hrs.	Post Event – No Hazards

2.9 Offsite Resources

2.9.1 National SAFER Response Center

The industry established two (2) regional response renters designated the National SAFER Response Centers (NSRCs) to support utilities during BDB events. Duke 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 (5) sets of equipment, four (4) of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. In addition, on-site BDB equipment hose and cable end fittings are standardized with the equipment supplied from the NSRC. In the event of a BDB external event 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 Robinson, the local assembly areas is the Florence Regional Airport. From there, equipment can be taken to the H. B. Robinson site and staged at Staging Area ‘B’ or the PFSB by helicopter if ground transportation is unavailable. Communications will be established between the H. B. Robinson plant 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 SAFER Response Plan for H. B. Robinson.

2.9.2 Equipment List

The equipment stored and maintained at the NSRC for transportation to the local assembly area to support the response to a BDB external event at H. B. Robinson is listed in Table 1. Table 1 identifies the equipment that is specifically credited in the FLEX strategies for H. B. Robinson 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.

Table 1: NSRC Load-Out for H. B. Robinson

NSRC Load-Out for RNP Generic Equipment

Equipment Name	Trailer Type	Trailer Number	Length (Inch)	Width (Inch)	Height (inch)	Weight (Pounds)	Single Unit Site Quantity (Each)
Light Tower	Flatbed	1	170	54	60	1700	3
High Pressure (HP) Pump & Trailer	Dropdeck	2	131	73	113	8300 (C) 6820 (P) 1480 (T)	1
Steam Generator / Reactor Make-up (SG/RX) Pump & Trailer	Dropdeck	2	123	84	114	7360 (C) 5620 (P) 1740 (T)	1
Low Pressure High Flow (LP/HF) Pump & Trailer	Dropdeck	2	123	84	114	9880 (C) 8140 (P) 1740 (T)	1
HP Hose Module (Small)	Dropdeck Upper Deck Portion	2	123	84	60	6100	1
Low Pressure Medium Flow (LP/MF) Pump & Trailer	Dropdeck	3	123	84	114	9360 (C) 7620 (P) 1740 (T)	1
Hale Pump Hose Module (Large)	Dropdeck	3	123	84	100	7200	1
4160 Distrubution Center Trailer (Blue)	Dropdeck	3	147	93	90	7100	1
480 Volt Cable Trailer (Orange)	Dropdeck Upper Deck Portion	3	127	84	70	3780	1
4160 Volt 1.1 MW Turbine Generator (Blue)	Flatbed	4	178	70	97	18360 (C) 9180 (Ea)	2
4160 Volt Cable Trailer (Blue)	Flatbed	4	128	83	88	8020	1
480 Volt 1 MW Turbine Generator (Red)	Flatbed	5	178	70	97	8800	1
Turbine Generator 1000 Gallon Fuel Tanks	Flatbed	5	194	91	108 (S) 54 (Ea)	10,560 (TW) 7040 (S) 3520 (Ea)	3
480 Volt Breaker Cabinet (Contains Breaker, Neutral Ground Resistor, & Cables)	Flatbed	5	48	48	60	600	1
Fuel Transfer Pump	Flatbed	5	54	42	65	560	1
Hose Crate (Contains Dixon Fuel Transfer Pump Hoses, Fuel Hoses for Transcubes)	Flatbed	5	48	42	36	300	1
4160 Volt Neutral Ground Resistor and 4160 Connection Cables	Flatbed	5	48	48	36	700	2
Portable Fuel Tank 268 Gallons	Flatbed	5	46	46	52	1280	1

NSRC Load-Out for RNP Non-Generic Equipment

Equipment Name	Trailer Type	Trailer Number	Length (Inch)	Width (Inch)	Height (inch)	Weight (Pounds)	Single Unit Site Quantity (Each)
Water Treatment Disk Filter Module	Dropdeck	6	122	91	95	TBD	1
Water Treatment RO Skid 1 Module	Dropdeck	6	122	91	95	TBD	1
Water Treatment RO Skid 2 Module	Dropdeck	6	122	91	95	TBD	1
Water Treatment Cyclone Seperator Module	Dropdeck Upper Deck Portion	6	99	91	95	TBD	1
Water Treatment Plant Generator	Dropdeck	7	189	85	96	TBD	1
Water Treatment Plant Trailers (Stacked)	Dropdeck	7	125	87	44	2200	4
Water Treatment Plant Generator Cables	Dropdeck Upper Deck Portion	7	189	85	96	TBD	1

2.10 Habitability and Operations

2.10.1 Personnel and Equipment Operating Conditions

Upon loss of AC power, all Auxiliary Building power is lost, and thus no HVAC systems are available. Calculation NAI-1809-001, RNP-2 Reactor Auxiliary Building Extended Loss of AC Power FLEX Response (Ref 41) is a GOTHIC analysis of the H. B. Robinson RAB heatup and cooldown responses in summer and winter months in an ELAP condition. The analysis was owner reviewed in EC99569. A summary of each area expected to be manned or accessed and the appropriate FLEX strategy required follows.

<u>Summer (Case1):</u>

The following room/area temperatures remain below a value of 110°F during the 7-day transient. A dry bulb temperature of 110F° is notable in that it is part of the control room habitability guidelines used for station blackout and adopted for ELAP.

- Control Room H&V Room
- Cable Rooms 1 & 2
- Volume Control Tank Room
- Spray Additive Tank Room
- Waste Gas Compressors
- El 226’ North and South Corridors
- Inst Air Equip Area
- Waste Evap Equip
- Conc Tank Transfer Pump Room
- Boric Acid Evap Equipment A
- Boric Acid Evap Equipment B
- Sump Pump Room
- Charging Pump Room
- CCW Pmp/HX Room
- Waste Holdup Tank Room
- Demin Area
- Spent Resin Tank Room
- El 226’ Pipe Tunnel
- SI and CS Pump Room
- Diesel Generators A & B Rooms
- MDAFW Pump Room
- Sample Room
- AO Office and Corridor
- Non-Regen and Seal Water Heat Exchangers (Elev. 246)
- Gas Strippers (Elev. 246)
- RHR Heat Exchangers (Elev. 246)

The following rooms/areas exceed the uppermost habitability temperature limit, 110°F (Reference 11), during the 7-day transient. Guideline FSG-005, Initial Assessment and FLEX Equipment Staging, will direct an evaluation of rooms requiring access and list the available ventilation and heating equipment stored in the PFSB. Therefore, when personnel access to the following rooms/areas is required, a toolbox approach to temperature control and access will be employed using door openings, fans, portable blowers, portable HVAC units, and limited stay-times as necessary. Upon room/area temperatures exceeding 110°F, the toolbox approach will be utilized to provide personnel access as necessary. In the following discussions Case 1 refers to the summer base case (all doors closed) and Case 1A refers to analysis results assuming mitigating strategies are implemented as describe in each case.

In Case 1, the Control Room remains below 110°F for the first 120 hours, then remains below 120°F for the next 48 hours. In Case 1A, after 96 hours, the Control Room doors (SD48/FDR48, SD49/FDR49, FDR17 and SD60/FDR25) are blocked open and a portable blower is used to provide ventilating air to the room (existing strategy, see [Reference 13, Step 15 and Attachment 5]). It should be noted here that ECA-0.0, Loss of All AC Power – ELAP directs the opening of all Control Room and Hagan Room cabinets within 30 minutes after the beginning of an event, as well as opening all Control Room and Hagan Room doors to the outside based on habitability judgment by the operators. This results in the Control Room remaining below 110°F for the duration of the 7-day transient. Toolbox solutions such as emergency ventilation, air conditioning, or heating will be employed as necessary for access to the Control Room.

In Case 1, the Relay (Hagan) Room remains below 110°F for the first 130 hours, then remains below 120°F for the remainder of the 7-day transient. In Case 1A, after 96 hours, the Hagan Room doors are blocked open (see Case 1A Control Room). It should be noted here that ECA-0.0, Loss of All AC Power – ELAP directs the opening of all Control Room and Hagan Room cabinets within 30 minutes after the beginning of an event, as well as opening all Control Room and Hagan Room doors to the outside based on habitability judgment by the operators. This results in the Hagan Room remaining below 110°F for the duration of the 7-day transient. Beyond the 96th hour of the transient, toolbox solutions such as emergency ventilation, air conditioning, or heating will be employed as necessary for access to the Hagan Room.

In Case 1, the Safeguards Area remains below 110°F for approximately the first hour, remains below a value of 120°F for the next 47 hours, remains below 130°F for the next 100 hours and remains below 135°F for the remainder of the 7-day transient. In Case 1A, after 2 hours, the Safeguards Area doors (FDR13, FDR21 and SD45/FDR45) are blocked open. Case 1A also blocks open the exterior door (SD44/FDR44) in the adjacent Cable Room (Cable Room 2) for additional ventilation. This results in the Safeguards Area remaining below 110°F for the first hour, then remaining below 120°F for the remainder of the 7-day transient.

During an ELAP, continuous personnel access to the Safeguards Area is not required. However, when access is required, toolbox solutions will be employed as necessary.

In Case 1, the Electrical Equipment Area remains below 110°F for the first hour, remains below 120°F for the next 23 hours, remains below 130°F for approximately the next 96 hours, then remains below 135°F for the remainder of the 7-day transient. In Case 1A, after 2 hours, the Electrical Equipment Area doors (FDR11, FDR14, FDR15 and FDR16) are blocked open and a portable blower and flexible ductwork is used to provide air to the area. This results in the Electrical Equipment Area remaining below 110°F for the first hour, then remaining below 120°F for the remainder of the 7-day transient. During an ELAP, continuous personnel access to the Electrical Equipment Area is not required. When personnel access is required, toolbox solutions will be employed to provide access to the Electrical Equipment Area. Note: The Electrical Equipment Area houses ELAP required equipment. In addition to the toolbox solutions, cooled air will be supplied to the area to maintain equipment EQ temperatures (see below).

In Case 1, the Boric Acid Batching Tank Room remains at or below 110°F for the first 52 hours, then remains below a value of 120°F for the remainder of the 7-day transient. In Case 1A, after 48 hours, the Boric Acid Batching Tank Room doors (FDR12 and FDR28) are blocked open. As a result, the room remains below 110°F for the first 26 hours, then remains below 120°F for the remainder of the 7-day transient. Beyond the 26th hour of the transient, toolbox solutions will be employed for access to the Boric Acid Batching Tank Room.

In Case 1, the Battery Room remains below 110°F for approximately the first 52 hours, then remains below 120°F for the remainder of the 7-day transient. In Case 1A, after 48 hours, the Battery Room doors (FDR11 and FDR12, see Boric Acid Batching and Electrical Equipment Area Cases 1A above) are blocked open. As a result, the room remains at or below 110°F for the first 26 hours, then remains below 120°F for the remainder of the 7-day transient. Beyond the 26th hour of the transient, toolbox solutions will be employed for access to the Battery Room. It should be noted here that the Battery Room doors will be opened early in the transient (2-3 hours) to route cables to power the battery chargers. After this time the doors will remain open until the recovery phase, as a result, the room remains at or below 110°F for the remainder of the 7-day transient.

In Case 1, the MCC/Boron Analysis Room remains below 110°F for approximately the first 75 hours and will peak at approximately 112°F during the remainder of the 7-day transient. Beyond the 72nd hour of the transient, toolbox solutions will be employed for access to the MCC/Boron Analysis Room.

In Case 1, the H&V Room (HVE 2A/B and 5A/B) remains below 110°F for approximately the first 75 hours and will peak at approximately 112°F during the remainder of the 7-day transient. Beyond the 72nd hour of the transient, toolbox solutions will be employed for access to the H&V Room.

In Case 1, the Diesel Generator H&V Room remains below 110°F for approximately the first 26 hours and will peak at approximately 115°F during the remainder of the 7-day transient. Beyond the 26th hour of the transient, toolbox solutions will be employed for access to the Diesel Generator H&V Room.

In Case 1, the Elevation 246' Corridor remains below 110°F for approximately the first 50 hours and will peak at approximately 113°F during the remainder of the 7-day transient. Beyond the 50th hour of the transient, toolbox solutions will be employed for access to the Elevation 246' Corridor.

In Case 1, the RAB Supply Fan (HVE-1) Room remains at or below 110°F for approximately the first 98 hours and will peak at approximately 112°F during the remainder of the 7-day transient. Beyond the 98th hour of the transient, toolbox solutions will be employed for access to the RAB Supply Fan Room.

In Case 1, the Electrical Mezzanine remains below 110°F for approximately the first 26 hours and will peak at approximately 118°F during the remainder of the 7-day transient. Beyond the 26th hour of the transient, toolbox solutions will be employed for access to the Electrical Mezzanine.

In Case 1, the Boron Injection Tank Room remains below 110°F for approximately the first 72 hours and will peak at approximately 120°F during the remainder of the 7-day transient. Beyond the 72nd hour of the transient, toolbox solutions will be employed for access to the Boron Injection Tank Room.

In Case 1, the North Cable Vault remains below 110°F for approximately the first 96 hours and will peak at approximately 116°F during the remainder of the 7-day transient. Beyond the 96th hour of the transient, toolbox solutions will be employed for access to the North Cable Vault.

In Case 1, the South Cable Vault remains below 110°F for approximately the first 150 hours and will peak at approximately 111°F during the remainder of the 7-day transient. Beyond the 150th hour of the transient, toolbox solutions will be employed for access to the South Cable Vault.

Heatup calculations show that no action is required before the Emergency Response Organization (ERO) is manned for all areas that are required to manned continuously. A toolbox approach to temperature control and access will be employed when the ERO is manned after 6 hours using door openings, fans, spot coolers, and stay times as necessary.

Winter (Case 2):

The following room/area temperatures remain above a value of 50°F during at least the first 28 hours of the transient:

- Safeguards Area
- Cable Rooms 1 & 2
- Electrical Equipment Area

- Volume Control Tank Room
- Non-Regen and Seal Water Heat Exchangers (Elevation 246’)
- Gas Strippers (Elevation 246’)
- RHR Heat Exchangers Room (Elevation 246’)
- Charging Pump Room
- Waste Holdup Tank Room
- CCW Pumps and Heat Exchangers, Boric Acid Tanks Area
- Sampling Room
- AO Office and Corridor to RCA Entry
- Elevation 226’ North Corridor
- Elevation 226’ South Corridor
- Elevation 226’ Pipe Tunnel
- Instrument Air Equipment
- Demineralizer Area
- Waste Evaporator Equipment
- Spent Resin Storage Tank
- Discharge Concentrate Hold Tank Transfer Pump
- Boric Acid Evaporator Equipment A
- Boric Acid Evaporator Equipment B
- Sump Pump
- North Cable Vault
- South Cable Vault
- Boron Injection Tank Room

Portable HVAC equipment (blowers, duct work, two 5-ton heating and A/C units with a self-contained generator) will be stored in the Permanent FLEX Storage Building. FSG-5, Initial Assessment and FLEX Equipment Staging, contains instructions for assessing the need to deploy portable ventilation during an ELAP event. When temperatures fall and areas to be accessed become too cold for continued occupancy, a toolbox approach to temperature control and access will be employed using door openings, fans, portable heaters and limited stay-times as necessary.

The phase 3 strategy for re-powering 480V switchgear E1 and E2 and related MCCs will restore selected HVAC to the RAB.

Hydrogen Gas Generation and Accumulation (Case 3 and 3A):

In Case 3, the hydrogen concentration in the Battery Room remains below the site administrative limit of 2% for approximately the first 80 hours, then remains below a concentration of 3% for the remainder of the 7-day transient. This 3% concentration is conservative, as Reference 41 assumes both battery-cell banks charge simultaneously, at maximum hydrogen generation. In Case 3A, after 48 hours, the Battery Room doors are blocked open (see

Battery Room Case 1 and 1A above). This results in the hydrogen concentration in the Battery Room, Boric Acid Batching Tank Room and Electrical Equipment Area remaining below 1% for the duration of the 7-day transient. The hydrogen concentration in the Battery Room does not encroach the flammability limit of 4% (Reference 29).

It should be noted here that the Battery Room doors will be opened early in the transient (2-3 hours) to route cables to power the battery chargers. After this time the doors will remain open until the recovery phase, eliminating any hydrogen buildup in the room.

Spent Fuel Pool and Panel Enclosed Area:

Reference 24 is a GOTHIC analysis of the temperature response of the SFP during an ELAP. The analysis assumes an initial Spent Fuel Pool temperature of 121°F. The analysis results in the Spent Fuel Pool boiling, considered to occur at 200°F, approximately 7 hours into the 7-day transient. Item 8 above calculations indicate SFP boil-off to ten feet above the fuel racks will occur at approximately 23 hours after the ELAP occurs (assumes full core offload and 150˚F initial conditions). EC90622 is initiated to install the required FLEX connection to provide SFP makeup without accessing the SFP Operating Floor.

Additionally, the Spent Fuel Pool Operating Floor remains below approximately 135°F for the first 8 hours and will peak at approximately 197°F during the remainder of the 7-day transient. During an ELAP, personnel access to the SFP Operating Floor is not required.

2.10.2 Heat Tracing

Steam line pressure transmitters (SG Pressure) have electrical freeze protection powered from non-safety related power panels. These sensing lines may be subject to freezing in extreme cold conditions. H. B. Robinson initiates a freeze protection program prior to the winter months in accordance with OP-925, Cold Weather Operation (Reference 25). Freeze protection circuits and temporary enclosures heated by 480 VAC electric heaters are used in the procedure. The main steam line pressure transmitters are included in the cold weather operation procedure as Attachment 10.13. FLEX equipment includes two Baldor T130 480 VAC generators and two 480VAC portable heaters stored in the PFSB. One of these generators can be deployed to power the portable heaters as necessary in an ELAP event.

2.11 Lighting

Upon loss of AC power, plant lighting is provided by 8 hour battery packs and by vital batteries A and B. The vital lighting in the control room will be restored by providing power back to the battery chargers as described in Item 4 above. When Appendix R light batteries are depleted, portable lighting will be used in areas of the plant necessary for event mitigation. That lighting will be stored in the Permanent FLEX Storage Building. All battery powered portable equipment will be supported by battery tenders during storage.

Additional portable lighting and generators have been procured to facilitate implementation of FLEX strategies. The additional portable lighting units will reduce human error and increase safety during a BDBEE event. The additional portable lighting will augment battery powered head and hand lamps, and will need to be coordinated with each FLEX strategy's needs using a toolbox approach for deployment (See Attachment Z25R6 E-10 HBR2-09800 Staging Areas and Lighting Plot Plan for proposed lighting strategies.) The following areas at a minimum will require portable area lighting:

- Drumming room
- RAB 2nd floor hallway
- Charging Pump Room
- Battery Room
- E1/E2 room
- SFP/RWST area
- EDG Rollup Door area
- Radwaste Building area to access fuel oil supplies
- Radwaste Building area to stage Phase 3 generators
- Intake Structure (Phase 3)
- AFW and CST areas
- Permanent FLEX Storage Building

The strategy for getting power restored to other critical lighting areas in Phase 3 is by modifying the current 480V switchgear E1 and E2 as described in Section 2.2.3 above. The NSRC will supply 3 additional diesel lighting towers after approximately 24 hours.

2.12 Communications

A standard set of assumptions for a BDB ELAP event is identified in NEI 12-01, Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities, May 2012.

On site:

Indoor and outdoor locations where temporary BDB equipment is used may be served with either hand-held radios, or satellite phones. There will be 30 dedicated hand-held radios available for the implementation of the FLEX strategies. Sufficient batteries and chargers are also available. All dedicated radios and satellite phones are stored in protected structures and attached to battery chargers while in storage.

Off-Site:

Satellite phones are the only reasonable means to communicate off-site when the telecommunications infrastructure surrounding the nuclear site is non-functional. They connect with other satellite phones as well as normal communications devices.

NEI 12-01, Section 4.1 outlines the minimum communication pathways to the federal, state, and local authorities. 20 satellite phones are available for offsite communications. All FLEX related phones are stored in protected locations. Additionally, Chesterfield, Darlington, and Lee County Emergency Management Directors were provided with satellite phones in their respective Emergency Operations Centers.

2.13 Water sources

2.13.1 Secondary Water Sources

Table 2 provides a list of potential water sources that may be used to provide cooling water to the SGs 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 3 are provided below and are in sequence in which they would be utilized, based on their availability after an ELAP/LUHS event.

Table 2 – Water Sources

Water Sources	**Usable Volume (Gallons)**	**Applicable Hazard**				**Time Based on Decay Heat**
		Satisfies Seismic	Satisfies High Winds	Satisfies Low Temp	Satisfies High Temp	
CST (Phase 1)	170,000	Y	N	Y	Y	7.5 hr.
AFW Tanks	120,000	Y	N	Y	Y	13.5 hr. [1]
'D' Deepwell	Indefinite	N	Y	Y	Y	Indefinite
Lake Robinson	Indefinite	Y	Y	Y	Y	Indefinite
Discharge Canal	Indefinite	Y	Y	Y	Y	Indefinite

[1]Assumes use of portable intermediate pressure pumps.

The on-site water sources have a wide range of associated chemical compositions. Therefore, extended periods of operation with the addition of these various on-site water sources to the SGs were evaluated for impact on long term SG performance and SG material (e.g., tube) degradation and potential impact on the heat transfer capabilities of the SGs. Use of the available clean water sources, tanks and condenser, are limited only by their quantities. The water supply from Lake Robinson and the discharge canal is essentially unlimited by quantity, but is limited by quality, specifically the concentration of total suspended solids (TSS).

The evaluation shows that the water from Lake Robinson or the discharge canal could be used for approximately 283 hours after Condensate Storage Tank (CST) and AFW Tank depletion before the SG design blockage limit would be expected to be reached, assuming a conservative TSS level of 500 ppm. Water from the deepwells could be used for about 700 hours after CST and AFW depletion before the SG design blockage limit would be expected to be reached.

The results of the water quality evaluation show that the credited, fully protected, on-site water sources provide for an adequate AFW supply source for a much longer time than would be required for the delivery and deployment of the Phase 3 NSRC reverse osmosis (RO) / ion exchange equipment to remove impurities from the on-site natural water sources. The RO units have a capacity up to 300 gpm. Once the reverse osmosis / ion exchange equipment is in operation, the on-site water sources provide for an indefinite supply for purified water.

2.14 Shutdown and Refueling Analysis

H. B. Robinson Steam Electric Plant, Unit No. 2 will abide by the Nuclear Energy Institute position paper entitled "Shutdown/Refueling Modes" addressing mitigating strategies in shutdown and refueling modes. This position paper is dated September 18, 2013 and has been endorsed by the NRC staff. These mitigating strategies are defined below.

The reactor core cooling and heat removal strategies discussed above are effective as long as the RCS in intact and the SGs are available for use. The window between elimination of natural circulation availability and when the refueling cavity is flooded is considered in the Modes 5 & 6 core cooling strategy development. During this window the RCS partially drained and vented.

When the RCS is depressurized and drained to reduced inventory, the SGs are no longer coupled to the core and core cooling is accomplished through evaporative cooling. Injection flow to remove decay heat is less than 150 gpm (Refs 32, 33). In Modes 5 and 6 RCS makeup for core cooling and inventory control in an ELAP event will be accomplished with a portable diesel pumper rated at 300 gpm at 1000 psig. The portable pumper can take suction from the Refueling Water Storage Tank (RWST) via a FLEX connection at SI-837, RWST Drain, or SFP via an Emergency Cooling Connection (ECC) in the SFP Cooling System and deliver through pre-staged connections in the safety injection lines. The SFP can also be accessed by using portable hoses and a pumper directly from the SFP operating floor. If the SFP is used as a source of borated water, the SFP can be replenished using existing SFP makeup strategies and manual addition of boric acid to the SFP. Calculations in EC95216 can be extrapolated to show that the addition of approximately 100 lbs. of boric acid per 1000 gallons of SFP makeup is sufficient to maintain shutdown margin in the SFP and the RCS. Installation of the FLEX connections will be controlled using the shutdown risk management process as described in the Shutdown Modes Position Paper endorsed by the NRC (Ref 29). OMP-003, Shutdown Safety Function Guidelines, is revised to include the following preparations:

- Prior to venting the RCS (pressure below 200 psig) and until the cavity is flooded with the vessel cover removed, the following pre-emptive actions shall be taken to ensure FLEX mitigation strategies are maintained for RCS Cooling in the condition:

- The replacement check valve covers for SI-879A and SI-879B along with the necessary tools to remove the existing covers and install the replacement covers are staged in the SI Pump Room.

- The FLEX connection spool piece for SFPC-796 along with the necessary tools to remove the existing spool piece flange and install the FLEX connection spool piece are staged in the SFP Pump Room.

- Individuals are designated to accomplish the action for installing the check valve cover on either SI-879A or SI-879B. The individuals must be designated in writing, understand and acknowledge the assignment, and maintain the ability to accomplish the task within two hours of the loss of RHR Core Cooling.
- Individuals are designated to accomplish the action for installing the FLEX connection spool piece for SFPC-796. The individuals must be designated in writing, understand and acknowledge the assignment, and maintain the ability to accomplish the task within two hours of the loss of RHR Core Cooling.

The RWST is not protected from all hazards (i.e. tornado missiles). In the unlikely event that a tornado missile will damage the RWST, procedures will direct the operators to use the SFP as an alternative supply of borated water. The lake or discharge canal would be available following a tornado event, providing a method for restoring core cooling for all hazards during Modes 5 & 6. The above strategy is depicted in the RCS Boration and Makeup Strategies Conceptual Sketch on page 35.

2.15 Sequence of Events and Staffing

Table 3 below presents a Sequence of Events (SOE) Timeline for an ELAP/LUHS event at Robinson. The timeline was developed by Operations, Security, Emergency Planning, and the H. B. Robinson Fukushima Response Organization in a real-time table top format using Emergency Operating Procedures and FLEX Support Guidelines. 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. The timeline is based on an ELAP/LUHS BDBEE without warning and minimum shift staffing as defined in PLP-007, Robinson Emergency Plan, Rev. 82 (Reference 14). The Staffing Study is documented in NEI 12-01 Phase 2 Extended Loss of AC Power (ELAP) ERO Staffing Analysis Report, Rev. 0, which was submitted to the NRC in December 2014. The Staffing Study is explained in more detail below.

Table 3: Sequence of Events Timeline

Time (T+mins)	Position(s)	Action	Duration (min)
0	CRS	Entry into ECA-0.0, Loss of All AC Power - ELAP. Direct RO1 and RO2 to perform immediate action steps 1-3, Check Reactor Trip, Check Turbine Trip, and Dispatch an Operator to perform Attachment 1, Restoring AC Power from the Dedicated Shutdown Diesel Generator (DSDG)	2
0	RO1	Perform ECA-0.0 immediate actions, step 1, Check Reactor Trip	2
0	RO2	Perform ECA-0.0 immediate actions, step 2, Check Turbine Trip, and step 3, Dispatch AO2 to perform step 3, Dispatch an Operator to perform Attachment 1, Restoring AC Power from the DSDG	4
4	AO2	Perform ECA-0.0, step 3, Attachment 1, Restoring AC Power From the DSDG	5

Time (T+mins)	Position(s)	Action	Duration (min)
4	CRS	Direct RO1 to perform ECA-0.0, step 4, Check If RCS Is isolated and step 5, Check CCW Pump Running For RCP Seal Cooling	1
5	CRS	Direct RO2 to perform ECA-0.0, step 6, Check AFW Flow	1
5	RO1	Perform ECA-0.0, step 4, Check If RCS Isolated, and step 5, Check CCW Pump Running For RCP Seal Cooling	2
6	CRS	Direct RO2 to perform ECA-0.0, step 7, Try To Restore Power To Any AC Emergency Bus	2
6	CRS	Direct RO2 to perform ECA-0.0, step 7, Try To Restore Power To Any AC Emergency Bus	2
6	RO2	Perform ECA-0.0, step 6, Check AFW Flow. Direct AO3 to perform ECA-0.0, step 6 RNO, FSG-002, Alternate AFW Suction Source	1
7	AO3	Perform ECA-0.0, step 6 RNO, Check CST Available	6
8	CRS	Direct RO1 to perform ECA-0.0, step 8, Establish Charging and RCP Seal Injection Flow	1
8	RO2	Perform ECA-0.0, step 7, Try To Restore Power To ANY AC Emergency Bus; Direct AO1 and AO4 to perform ECA-0.0, Attachment 5, Restoring Power From the EDGs	1
9	AO1	Perform ECA-0.0, Attachment 5, Restoring Power From the EDGs	6
9	AO2	Return to WCC	until dispatched
9	AO4	Perform ECA-0.0, Attachment 5, Restoring Power From the EDGs	6
9	CRS	Read ECA-0.0, step 9, Restore AC power While Continuing With Subsequent Actions; Conduct status brief in control room to determine plant conditions.	6
9	RO1	Read ECA-0.0, step 8, Establish Charging and RCP Seal Injection Flow	1
13	AO3	Return to WCC	until dispatched
15	AO1	Return to WCC	until dispatched
15	AO4	Return to WCC	until dispatched
15	CRS	Declare an ELAP. Direct ECA-0.0, step 9, RNO a.1) Complete FSG-004, ELAP DC Load Shed/management Deep Load Shed and a.2) Initiate FSG-005, Initial Assessment and FLEX Equipment Staging	1
15	RO2	Direct AO2 to perform FSG-002, Alternate AFW Suction Source	1
15	SM	Declare Site Area Emergency	1
16	AO2	Perform FSG-002, step 1, Check Condenser Inlet Waterbox-Desired as Water Source	1

Time (T+mins)	Position(s)	Action	Duration (min)
16	CRS	Direct STA to perform FSG-005, Initial Assessment and Staging, step 1, Assess condition of Plant Systems and Equipment using Attachment 1, Control Room System Assessment	1
16	RO2	Direct AO1 and AO6 to perform FSG-004, ELAP DC Load Shed/Management	1
16	SM	Prepare and approve Emergency Notification Form (ENF), initial SAE	3
17	AO1	Perform FSG-004, step 2, Shed Selected DC Bus Loads, Attachment 1, Battery ELAP Deep Load Shed and step 3, Locally Check MCC-A and MCC-B voltage greater than 105.6 V	14
17	AO2	Perform FSG-002, step 2, RNO, Attachment 1, Condenser Inlet Water Box Suction to SDAFW Pump	1
17	RO2	Perform FSG-004, step 1, Check channel/Train Instruments and evaluate parameter trends before removing redundant channels/trains	1
17	CRS	Direct ECA-0.0, step 10, Check Power to an Emergency Bus-Restored	1
17	AO6	Perform FSG-004, step 2, Attachment 1, Battery ELAP Deep Load Shed	13
17	STA	Perform FSG-005, Initial Assessment and Staging, step 1, Assess condition of Plant Systems and Equipment using Attachment 1, Control Room System Assessment	5
18	AO2	Perform FSG-002, Attachment 1, step 1, Obtain FLEX equipment, step 2, Obtain locked valve key, and step 3, Ensure LP Flex Pump is staged.	4
18	AO3	Perform FSG-002, Attachment 1 , step 5, Connect FLEX Pump Suction Assembly	5
18	AO4	Perform FSG-002, Attachment 1, Condenser Inlet Waterbox Suction to the SDAFW Pump, step 4, Ensure AFW-197 and CW-125 are closed, and step 6, Connect the FLEX Pump Discharge Assembly	8
18	CRS	Direct AO5 to perform ECA-0.0, step 11, Defeat Automatic Loading of Non-running Safeguards Equipment By Dispatching An Operator To Perform Attachment 6, Removing Control Power From Safeguards Equipment	1
19	AO5	Perform ECA-0.0, step 11, Defeat Automatic Loading of Non-running Safeguards Equipment By Dispatching An Operator To Perform Attachment 6, Removing Control Power From Safeguards Equipment	23
19	CRS	Read ECA-0.0, step 12, Locally close condenser Hotwell Isolation Valves	1
19	SM	Direct AO7 to notify State and Counties, initial SAE	1
20	AO7	Perform State and County notification	40

Time (T+mins)	Position(s)	Action	Duration (min)
20	CRS	Direct RO2 to perform ECA-0.0, step 13, Obtain keys and open all cabinet doors in the Control Room and Hagan Room	1
20	SM	Direct Security to activate the ERO and perform accountability	1
21	CRS	Direct RO1 to perform ECA-0.0, step 14, Check SG Status	1
21	RO2	Perform ECA-0.0, step 13, Obtain keys and open all cabinet doors in the Control Room and Hagan Room	5
21	Sec	Perform site accountability	24
21	SM	Direct STA to activate ERDS	1
21	STA	Activate ERDS	1
22	RO1	Perform ECA-0.0, step 14, Check SG status	2
24	CRS	Direct RO1 to perform ECA-0.0, step 15, Check control room habitability	1
25	CRS	Read ECA-0.0, step 16, Determine if Control Room Emergency Ventilation is needed	1
25	RO1	Perform ECA-0.0, step 15, check control room habitability	1
26	AO2	Perform FSG-002, Attachment 1, step 7.a., Open AFW-197 and step 7.b. Open and uncap AFW-7	2
26	AO3	Perform FSG-002, Attachment 1, step 7.a, Unlock and close AFW-4	1
26	AO4	Perform FSG-002, Attachment 1, step 7.a., Open CW-125	1
26	CRS	Direct RO1 to perform ECA-0.0, step 17, Check S/G Secondary Pressure Boundaries are intact on all S/G's	1
27	AO3	Perform FSG-002, Attachment 1, step 7.h., Start SDAFW pump by opening one or more steam valves	3
27	AO4	Perform FSG-002, Attachment 1, step 7.e., Close AFW-7	1
27	CRS	Direct RO1 to perform ECA-0.0, step 18, Check if S/G tubes are intact	1
27	RO1	Perform ECA-0.0, step 17, Check S/G Secondary Pressure Boundaries are intact on all S/G's	1
27	RO2	Perform FSG-005, step 2, Notify Security	2
28	AO2	Perform FSG-002, Attachment 1, step 7.d., Start the LP FLEX pump	4
28	CRS	Direct RO1 to perform ECA-0.0, step 19, Check intact S/G levels	1
28	RO1	Perform ECA-0.0, step 18, Check if S/G tubes are intact	1
29	CRS	Direct RO1 to perform ECA-0.0, step 20, Check DC bus loads	2
29	RO1	Perform ECA-0.0, step 19, Check intact S/G levels	1
29	RO2	Perform FSG-005, step 3, Check long term SG feedwater	1
30	AO3	Return to WCC	until dispatched
30	AO3	Perform FSG-004, Attachment 2, Re-Energizing Battery Chargers using FLEX DG-1A, step 1, Locate equipment	1

Time (T+mins)	Position(s)	Action	Duration (min)
30	AO6	Return to WCC	until dispatched
30	RO2	Perform FSG-005, step 4, Manage alternate FLEX Power Supplies	3
31	AO1	Return to WCC	until dispatched
31	AO6	Perform FSG-004, step 4, Attachment 2, Re-Energizing Battery Chargers using FLEX DG-1A, step 1, Locate equipment	1
31	CRS	Direct RO1 to perform ECA-0.0, step 21, check main generator hydrogen pressure	1
31	RO1	Perform ECA-0.0, step 20, Check DC bus loads	1
32	AO1	Perform FSG-004, Attachment 2, Re-Energizing Battery Chargers using FLEX DG-1A, step 1, Locate equipment	1
32	AO2	Return to WCC	until dispatched
32	AO6	Perform FSG-004, Attachment 2, step 2, Stage the color coded cables shown in Figures 1, 2, and 3	20
32	CRS	Direct RO1 to perform ECA-0.0, step 22, Check Non-Emergency DC Bus Loads	1
32	RO1	Perform ECA-0.0, step 21, Check Main Generator hydrogen pressure. Direct AO2 to perform ECA-0.0, step 21 RNO, Depressurize the Main Generator, and step 22, Locally open breakers for Emergency Bearing Oil Pump and Air Side Seal Oil Back-up Pump.	2
33	AO1	Perform FSG-004, Attachment 2, step 2, Stage the color coded cables shown in Figures 1, 2, and 3	20
33	AO3	Return to WCC	
33	AO4	Perform FSG-002, Attachment 1, step 7.i., Open AFW control valves (AFW-V2-14A, -14B, and -14C)	duration
33	CRS	Direct RO1 to perform ECA-0.0, step 23, Check CST level	1
33	RO2	Direct WCC to perform FSG-005, step 5, Notify NSRC and INPO	2
34	AO2	Perform ECA-0.0, step 21 RNO, Depressurize the Main Generator	5
34	AO3	Perform FSG-004, Attachment 2, step 2, Stage the color coded cables shown in Figures 1, 2, and 3	20
34	CRS	Direct RO1 to perform ECA-0.0, step 24, Monitor RCS Integrity	1
34	RO1	Perform ECA-0.0, step 23, Check CST level	1
35	CRS	Direct RO1 to perform ECA-0.0, step 25, Depressurize intact SGs to 290 psig	1
35	RO1	Perform ECA-0.0, step 24, Monitor RCS Integrity	1
35	RO2	Read FSG-005, steps 6-15	duration
35	WCC	Perform FSG-005, step 5, Notify NSRC and INPO	5

Time (T+mins)	Position(s)	Action	Duration (min)
36	CRS	Direct RO1 to perform step 26, Check reactor subcritical	1
36	RO1	Perform ECA-0.0, step 25, Depressurize Intact S/Gs to 290 psig	1
37	CRS	Direct RO1 to perform steps 27-30, Check SI status, Ensure Containment Isolation Phase A, Check Containment Ventilation Isolation Valves, Check CV Pressure has remained less than 10 PSIG	2
37	RO1	Perform ECA-0.0, step 26, Check reactor subcritical	1
37	RO1	Perform steps 27-30, Check SI status, Ensure Containment Isolation Phase A, Check Containment Ventilation Isolation Valves, Check CV Pressure has remained less than 10 PSIG	2
39	AO2	Perform ECA-0.0, step 22, Locally open breakers for Emergency Bearing Oil Pump and Air Side Seal Oil Back-up Pump	5
39	CRS	Direct RO1 to perform ECA-0.0, step 31, Check core not degraded	1
39	RO1	Perform ECA-0.0, step 31, Check core not degraded	1
40	CRS	Direct RO1 to perform ECA-0.0, step 32, Core Exit Thermocouples less than 1200	1
41	CRS	Direct RO1 to perform ECA-0.0, step 33, Check plant conditions	1
41	RO1	Perform ECA-0.0, step 32, Check Core Exit Thermocouples less than 1200	1
42	CRS	Read ECA-0.0, step 34, Depressurize Intact S/Gs to 170 PSIG for long-term cooling	1
42	RO1	Perform ECA-0.0, step 33, Check plant conditions	1
43	AO2	Return to WCC	until dispatched
43	CRS	Direct RO1 to perform ECA-0.0, step 35, Check AC emergency bus power restored	2
44	AO5	Return to the WCC	until dispatched
45	RO1	Perform ECA-0.0, step 35, Check AC emergency bus power restored	2
52	AO6	Perform FSG-004, Attachment 2, step 3, Install the portable ductwork to connect the Drumming Room Diesel Supply and Exhaust Fan	3
53	AO1	Perform FSG-004, Attachment 2, step 3, Install the portable Ductwork to connect the Drumming Room Diesel Supply and Exhaust Fan	3
54	AO3	Perform FSG-004, Attachment 2, step 3, Install the portable Ductwork to connect the Drumming Room Diesel Supply and Exhaust Fan	3
55	AO6	Perform FSG-004, Attachment 2, step 4, Connect cables	10
56	AO1	Perform FSG-004, Attachment 2, step 4, Connect cables	10

Time (T+mins)	Position(s)	Action	Duration (min)
57	AO3	Perform FSG-004, Attachment 2, step 4, Connect cables	10
60	AO7	Perform NRC notification, initial SAE	until relieved
65	AO6	Perform FSG-004, Attachment 2, step 5, Open breakers	3
66	AO1	Perform FSG-004, Attachment 2, step 5, Open breakers	3
67	AO3	Perform FSG-004, Attachment 2, step 5, Open breakers	3
68	AO6	Perform FSG-004, Attachment 2, step 9, Close Battery Disconnect Switches (energize the Battery Chargers)	2
69	AO1	Perform FSG-004, Attachment 2, step 6, Start FLEX-ENG-1a	1
70	AO1	Perform FSG-004, Attachment 2, step 9, Start battery charger	2
70	AO3	Perform FSG-004, Attachment 2, step 8, Close breakers	2
70	AO6	Return to WCC	until dispatched
72	AO1	Perform FSG-004, Attachment 2, step 10, Monitor energized battery chargers	1
72	AO3	Perform FSG-004, Attachment 2, step 11, Monitor 125 V DC buses MCC-A and MCC-B	1
73	AO1	Perform FSG-004, Attachment 2, step 12, Notify control room	1
73	AO3	Return to WCC	until dispatched
74	AO1	Return to WCC	until dispatched
76	SM	Prepare and approve Emergency Notification Form (ENF), follow up SAE	3
79	SM	Direct WCC to deliver ENF to AO7 (on open line with NRC), relieve AO7 as NRC Communicator and direct AO7 to notify State and Counties, followup SAE	1
80	WCC	Deliver follow up SAE ENF to AO7 (on open line with NRC), relieve AO7 as NRC Communicator and direct AO7 to notify State and Counties, followup SAE	1
81	AO7	Perform State and County notification, follow up SAE	40
121	AO7	Return to Control Room	until dispatched
136	SM	Prepare and approve Emergency Notification Form (ENF), follow up SAE	3
139	SM	Direct AO7 to notify State and Counties, follow up SAE	1
140	AO7	Perform State and County notification, follow up SAE	40
180	AO7	Return to Control Room	until dispatched
196	SM	Prepare and approve Emergency Notification Form (ENF), follow up SAE	3
199	SM	Direct AO7 to notify State and Counties, follow up SAE	1
200	AO7	Perform State and County notification, follow up SAE	40

Time (T+mins)	Position(s)	Action	Duration (min)
240	AO7	Return to Control Room	until dispatched
256	SM	Prepare and approve Emergency Notification Form (ENF), follow up SAE	3
259	SM	Direct AO7 to notify State and Counties, follow up SAE	1
260	AO7	Perform State and County notification, follow up SAE	40
300	AO7	Return to Control Room	until dispatched
316	SM	Prepare and approve Emergency Notification Form (ENF), follow up SAE	3
319	SM	Direct AO7 to notify State and Counties, follow up SAE	1
320	AO7	Perform State and County notification, follow up SAE	40
360	AO7	Return to Control Room	until dispatched

2.15.1 Staffing

Using the methodology of the 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 Robinson Nuclear Plant on-shift staff and augmented Emergency Response Organization (ERO) to respond to a Beyond Design Basis External Event (BDBEE) was performed. The results were provided to the NRC in letter RNP-RA/14-0128 dated December 17, 2014. The NRC endorsed the staffing assessment in a letter to H. B. Robinson dated 5/12/2015, H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2 – RESPONSE REGARDING PHASE 2 STAFFING SUBMITTALS ASSOCIATED WITH NEAR-TERM TASK FORCE RECOMMENDATION 9.3 RELATED TO THE FUKUSHIMA DAI-ICHI NUCLEAR POWER PLANT ACCIDENT (TAC NO. MF5453) (ADAMS Accession No. ML15124A523).

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

A. an extended loss of AC power (ELAP)
B. an extended loss of access to ultimate heat sink (UHS)
C. impact on the unit
D. 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, Maintenance, Radiation Protection, Chemistry, Security, Emergency Preparedness and industry consultants performed tabletop exercises in August and October 2014 to conduct the on-shift portion of the assessment. The participants reviewed the assumptions and applied existing procedural guidance, including applicable draft FLEX Support Guidelines (FSGs) for coping with a BDBEE using minimum on-shift staffing. Particular attention was given to the sequence and timing of each procedural step, its duration, and the on-shift individual performing the step to account for both the task and time motion analyses of NEI 10-05, *Assessment of On-Shift Emergency Response Organization Staffing and Capabilities*.

The on-shift staffing analysis concluded that there were no task overlaps for the activities that were assigned to the on-shift personnel.

The expanded ERO analysis concluded that sufficient personnel resources exist in the current H. B. Robinson augmenting ERO to fill positions for the expanded ERO functions. Thus, the ERO resources and capabilities necessary to implement Transition Phase coping strategies performed after the end of the “no site access” 6-hour time exist in the current program.

2.16 Programmatic Elements

2.16.1 Overall Program Document

CSD-EG-RNP-8888, Flexible Response to Extended Loss of All AC Power (FLEX), provides a description of the Diverse and Flexible Coping Strategies (FLEX) Program at H. B. Robinson. The key elements of the program include:

- Maintenance of the FSGs including any impacts on the interfacing procedures (EOPs, AOPs, EDMGs, SAMGs, etc.)
- Maintenance and testing of FLEX equipment
- Portable equipment deployment routes, staging areas, and connections to existing mechanical and electrical systems
- Validation of time critical operator actions
- The PFSB and the Regional Response Center
- Hazards Considerations (Flooding, seismic, high winds, etc.)
- Supporting evaluations, calculations and FLEX series drawings
- Tracking of commitments and equipment unavailability
- Staffing, Training and Emergency Drills
- Configuration Management
- Program Maintenance

In addition, the program description includes (1) a list of the FLEX basis documents that will be kept up to date for facility and procedure changes, (2) a historical record of previous strategies and their bases, and (3) the bases for ongoing maintenance and testing activities for the FLEX equipment.

The instructions required to implement the various elements of the FLEX Program and thereby ensure readiness in the event of a Beyond Design Basis External Event are contained in a nuclear fleet administrative procedure.

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. Changes for the FLEX strategies will be reviewed with respect to operations critical documents to ensure no adverse effect.

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.

2.16.2 Procedural Guidance

The inability to predict actual plant conditions that require the use of Beyond Design Basis (BDB) 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 BDB external event conditions, and are not used inappropriately in lieu of existing procedures. When BDB equipment is needed to supplement Emergency Operating Procedures (EOPs) or Abnormal Operating Procedures (AOPs) strategies, the EOP or AOP, Severe Accident Management Guidelines (SAMGs), or Extreme Damage Mitigation Guidelines (EDGMs) will direct the entry into and exit from the appropriate FSG procedure.

FLEX strategy support guidelines have been developed in accordance with PWROG guidelines. 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 ECA-0.0, “Loss of All AC Power - ELAP” 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-20, Loss of RHR (ELAP)
- AOP-36, Spent Fuel Pit Events

FSG maintenance will be performed by the Station Procedures group via the Procedure Action Request in VPAP-0502, Procedure Process Control. In accordance with site administrative procedures, NEI 96-07, Revision 1, and NEI 97-04, Revision 1 are to be used to evaluate changes to current procedures, including the FSG, 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 BDB 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.

2.16.3 Training

Duke Energy's Nuclear Training Program of H. B. Robinson has been revised to assure personnel proficiency in the mitigation of BDB external events 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 BDB external events 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 BDB external event 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 BDB external event 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. The H. B. Robinson simulator and model were updated to account for new strategies implemented in the early stages (< 6 hours) of a BDBEE ELAP/LUHS.

Where appropriate, integrated FLEX drills will be organized on a team or crew basis and conducted periodically; with all time-sensitive actions to be evaluated over a period of not more than eight years. It is not required to connect/operate permanently installed equipment during these drills.

2.16.4 Equipment List

The equipment stored and maintained at the H. B. Robinson PFSB necessary for the implantation of the FLEX strategies in response to a BDB external event at Robinson is listed in Table 4. Table 4 identifies the quantity, applicable strategy, and capacity/rating for the major BDB equipment components only, as well as, various clarifying notes. Table 5 provides a more detailed matrix of all FLEX mitigating strategies and required equipment.

2.16.5 Equipment Maintenance and Testing

Periodic testing and preventative maintenance of the BDB equipment conforms to the guidance provided in INPO AP-913. A fleet procedure has been developed to address Preventative Maintenance (PM) using EPRI templates or manufacturer provided information/recommendations, equipment testing, and the unavailability of equipment.

EPRI has completed and has issued “Preventive Maintenance Basis for FLEX Equipment – Project Overview Report” (Report 3002000623). Preventative Maintenance Templates for the major FLEX equipment including the portable diesel pumps and generators have also been issued.

The PM Templates include activities such as:

- Periodic Static Inspections – Monthly walkdown
- Fluid analysis (Yearly)
- Periodic operational verifications – Quarterly starts
- Periodic functional verifications with performance tests – Annual 1 hour run with pump flow and head verifications

The EPRI PM Templates for FLEX equipment conform to the guidance of NEI 12-06 providing assurance that stored or pre-staged FLEX equipment are being properly maintained and tested. EPRI Templates are used for most equipment. However, in those cases where EPRI templates were not available, Preventative Maintenance (PM) actions were developed based on manufacturer provided information/ recommendations.

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 BDB 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., use of alternate suitable equipment or supplemental personnel) within 72 hours.

2.17 4.2 FLEX Portable Equipment Summary

Table 4, Portable Equipment Summary, is a summary listing of FLEX portable equipment assigned to FLEX mitigating strategies by function.

Table 4 Portable Equipment Summary

Reactor Core Cooling

Portable Equipment Requirements	EC No.	Comments
o 2 diesel driven low pressure pumps (600 gpm @ 20-75 psig). o Sufficient suction and discharge hose to allow for turbine building staging area and discharge to the suction of the SDAFWP o Pre-staged in the Turbine Building	94741	EC94741 contains all relevant strategy calculations. Use of this pump is a high wind and missile protection strategy.
o 2 diesel driven intermediate pressure Hale pumps (300 gpm @ 1000 psi) o Sufficient suction and high pressure discharge hose to allow for various staging areas o Pre-staged in the Protected Area	95263	1 pump satisfies the NEI 12-06, Section 3.2.2. (13) requirement to have a portable backup for the SDAFWP. EC95263 contains all relevant strategy calculations. Use of these pumps is a seismic protection strategy.
o 1 diesel driven low pressure Hale pump (1500 gpm @ 250 psi) o 1 diesel driven low pressure Hale pump (3000 gpm @ 150 psi) o Sufficient suction and discharge hose to allow for various staging areas o Stored in the protected PFSB	94743	2 pumps satisfy the NEI 12-06, Section 3.2.2. (13) requirement to have a portable backup for the SDAFWP.

RCS Boration/Inventory

Portable Equipment Requirements	EC No.	Comments
RNP has two (2) trailer mounted high pressure boration units (N, N+1) that consist of (each): o 1 diesel driven high pressure positive displacement pump (60 gpm @ 2000 psi) o 1 mixing tank (1000 gal) o 28 bags ($55^{\#}$ each) dry boric acid; sufficient to mix 7 batches (1000 gal. each) of 4000 ppm boric acid solution at temperatures approaching 32˚F o 1 electric booster pump to support the high pressure pump $NPSH_R$ with associated 6 Kw diesel generator o 1 diesel driven Hale fire pump to supply the water to the 1000 gal. tank o Sufficient suction and high pressure discharge hose to allow for various staging areas o Stored in the protected PFSB	95216	At least 1 boration unit will be stored in the Permanent FLEX Storage Building, protected against Robinson hazards. EC95216 contains all relevant strategy calculations. This strategy is for Modes 1-4.
o 2 diesel driven Hale fire pumps (1500 gpm and 3000 gpm @ 250 psig) o 2 diesel driven Hale fire pumps (300 gpm 3 @ 1000	90622	A portable pumper will be staged near the door to the SFP Cooling Room, take a suction from the

psig) ○ Sufficient suction and high pressure discharge hose to allow for various staging areas ○ Stored in the protected PFSB		Emergency Cooling Connection (ECC) at the suction of the SFPC Pumps, and deliver the borated water to the reconfigured HHSI Pump discharge check valves (the valve bonnets will be replaced with pre-staged flanged FLEX connections when needed). The second pump is used for SFP makeup from the lake or discharge canal. Boric acid will added to the SFP manually as needed. This strategy is for Modes 5-6.
Instrumentation		
Equipment Requirements	EC No.	Comments
○ 2 pre-staged diesel driven generators (150 KW) ○ 2 sets of cables stored on K-Karts ○ Installed receptacles/breakers on each battery charger ○ Pre-staged in the Reactor Auxiliary Building	90617	This alternate strategy (as defined in NEI 12-06) is explained in detail in Enclosure 1.
Instrumentation		
Equipment Requirements	EC No.	Comments
○ 2 pre-staged diesel driven generators (150 KW) ○ 2 sets of cables stored on K-Karts ○ Installed receptacles/breakers on each battery charger ○ Pre-staged in the Reactor Auxiliary Building	90617	This alternate strategy (as defined in NEI 12-06) is explained in detail in Enclosure 1.
Instrumentation		
Equipment Requirements	EC No.	Comments
○ Fluke Multi-Meters ○ Yeti Inverter Power Packs ○ Instrument probes and cables	90734	Local Instrument readings are proceduralized in FSG-7, Loss of Vital Instrumentation or Control Power
Phase 3 Electrical Power		
Equipment Requirements	EC No.	Comments
○ 1 NSRC supplied diesel driven generator (1000 KW) ○ 2 sets of cables stored on K-Karts and trailers ○ 2 DB-50 Bus Feed Adapters ○ 2 sets of cable adapters for use in the EDG CT cabinets ○ K-Karts, Bus Feed Adapters, cable adapters stored in the PFSB and Reactor Auxiliary Building	90617	Equipment will be stored in protected locations (PFSB and RAB).

SFP Cooling		
Portable Equipment Requirements	EC No.	Comments
○ 2 diesel driven Hale fire pumps (1500 gpm and 3000 gpm @ 250 psig) ○ Sufficient suction and high pressure discharge hose to allow for various staging areas ○ Stored in the protected PFSB	90622	Either pump can be dual purpose to support the RCS Boration/Inventory strategy. The use of these pumps is an existing strategy.

2.18 4.2 FLEX Equipment and Strategies Summary

Table 5, 4.2 FLEX Equipment and Strategies Matrix by Function, is a detailed listing of FLEX strategies that includes all plant and portable equipment assigned to FLEX mitigating strategies by function. This table outlines all phases of response, required equipment for unavailability tracking, required FLEX connections, related engineering change numbers, and credited hazards.

Table 5, 4.2 FLEX Equipment and Strategies Matrix by Function

FUNCTION	STRATEGY DESCRIPTION	REQUIRED EQUIPMENT	FLEX SPECIFICATIONS OR RATINGS	REQUIRED FLEX CONNECTIONS	EC NO.	COMMENTS
Reactor Core Cooling and Heat Removal	Phase 1 SG Feed using SDAFWP and CST	• MS-V1-8A • MS-V1-8B • MS-V1-8C • AFW-V2-14A • AFW-V2-14B • AFW-V2-14C • SDAFWP • CST	N/A	N/A	N/A	Seismic Only
	Phase 2 SG Feed using SDAFWP and CW Inlet Bay Alternate Cooling Source (ACS) and Low Pressure Pump to supply SDAFWP Suction	• MS-V1-8A • MS-V1-8B • MS-V1-8C • AFW-V2-14A • AFW-V2-14B • AFW-V2-14C • SDAFWP • Low Pressure Pump (2) • Suction Hoses (2) • Discharge Hoses (2)	2 ea. 600 GPM @ 30 PSI with a 100 PSI (MAX) 12' VERTICAL LIFT THROUGH 35' (LENGTH) 6" SUCTION HOSE NET SUCTION LIFT REQUIRED MUST BE > 15FT Only one pump is in use at a time.	• CW Inlet Bay Dip Tube and FLEX Connection (CW-125) • SDAFWP Suction FLEX Connection (AFW-197) • FLEX Connection at C-66	94741	High Wind/Missile Only
	CST Makeup from CW Inlet Bay Alternate Cooling Source (ACS) and Low Pressure Pump	• Low Pressure Pump (2) • Suction Hoses (2) • 2000' Discharge Hoses (2)	3000 gpm @ 150 psig; 1500 gpm @ 200 psig	• CW Inlet Bay Dip Tube and FLEX Connection (CW-125) • FLEX Connection at C-66	90622	
		• Intermediate Pressure	2 ea. 300 GPM @ 1000 psig	• AFW-166 • AFW-165	95263 96480	Seismic Only

Table 5, 4.2 FLEX Equipment and Strategies Matrix by Function

FUNCTION	STRATEGY DESCRIPTION	REQUIRED EQUIPMENT	FLEX SPECIFICATIONS OR RATINGS	REQUIRED FLEX CONNECTIONS	EC NO.	COMMENTS
	SG Feed using Pre-Staged High Pressure Portable Pumps and Pre-Staged ACS Tanks	Portable Pumps (2) • Pre-Staged ACS Tanks (10) • Pump Suction Hoses • Braided SS Discharge Hose (500') from pump to AFW-165 via south side of turbine building. • Braided SS Discharge Hose (300') AFW-166 to AFW-165 via north side of turbine building through RAB. • C-66 FLEX connection • ACS Tanks • Pump Suction Valves • Pump Discharge Valves • Any available Hale pump	3000 gpm @ 150 psig; 1500 gpm @	• FLEX Connection at		Strategy is designed for use of AFW-166 at the SDAFWP discharge FLEX connection to meet the 61 minute time limit for NTTF 2.1 Actions Taken (non-committed interim actions).

Table 5, 4.2 FLEX Equipment and Strategies Matrix by Function

FUNCTION	STRATEGY DESCRIPTION	REQUIRED EQUIPMENT	FLEX SPECIFICATIONS OR RATINGS	REQUIRED FLEX CONNECTIONS	EC NO.	COMMENTS
	CST Makeup from Lake Robinson Alternate Cooling Source (ACS) and Low Pressure Pump	• Pump Suction Hoses • Pump Discharge Hoses (5” @ 1900’ and 3” @ 250’) OR • Pump Discharge Hoses (5” @ 850’ and 3” @ 1250’)	200 psig	C-66		
	Isolate SI Accumulators using a DB-50 Bus Feed Adapter and the pre-staged generators used for Phase 2 Battery strategy described in Instrumentation below.	• DB-50 Bus Feed Adapter • See EC90617 for the list of required generator equipment and cables.			90628 90617	
	Phase 3 Continuation of Phase 2 coping strategies with the addition of NSRC water treatment support to use lake water.	• NSRC Water Treatment Skid • NSRC Pumper and hoses				
RCS Inventory Control & Subcriticality	Phase 1 RNP does not have a viable Phase 1 coping strategy for RCS Inventory Control and Subcriticality.	N/A		N/A	N/A	N/A

Table 5, 4.2 FLEX Equipment and Strategies Matrix by Function

FUNCTION	STRATEGY DESCRIPTION	REQUIRED EQUIPMENT	FLEX SPECIFICATIONS OR RATINGS	REQUIRED FLEX CONNECTIONS	EC NO.	COMMENTS
	Phase 2 Portable RCS boration and makeup using HP pumper, boron mixing tank, Hale pump, and hose trailer. Modes 1-4	See EDMG-014 for extensive list of required equipment. Note that this equipment has been consolidated on 4 discreet, dedicated trailers: • High Pressure Pump (CAT Pump) trailer (2) • 1000 gal. Mix Tank trailer; includes KNAACK boxes for tools, boron, booster pump, and generator. (2) • Hose trailer (2) • Low Pressure Hale Pump trailer (2) Note: the 4 components listed above constitute one 'boration skid'.	See EC95216 for all equipment specifications.	• CVC-121A • CVC-121B • SI-888P • SI-888S	95216	EC90622 RWST Drain Connection EC90623 FLEX connections satisfy NTTF 4.2. Portable boration. See Calculation RNP-M/MECH-1880.
	Portable RCS boration and makeup using HP pumper, boron mixing tank, Hale pump, and hose trailer. Modes 5-6	• 1000 psig/300 gpm Hale pump • Hose trailer	Pump must be capable of >/= 200 gpm through SI-897A or SI-897B with pre-fabricated valve bonnet hose	• SI-879A • SI-879B • Pre-fabricated valve bonnet for SI-879A	90622 90623	

Table 5, 4.2 FLEX Equipment and Strategies Matrix by Function

FUNCTION	STRATEGY DESCRIPTION	REQUIRED EQUIPMENT	FLEX SPECIFICATIONS OR RATINGS	REQUIRED FLEX CONNECTIONS	EC NO.	COMMENTS
			connection.	• Pre-fabricated valve bonnet for SI-879B • SFPC ECC Pre-fabricated pump suction connection • RWST Drain FLEX Connection		
	Phase 3 Continuation of Phase 2	N/A		N/A	N/A	N/A
Containment Function	Phase 1 RNP does not require a Phase 1 strategy to protect the Containment Function. Containment parameter monitoring is discussed in Instrumentation below.	N/A		N/A	N/A	Results of RNP-MECH-1877 indicate the Containment design limits for temperature and pressure will not be challenged in the first 43 days following the event assuming no actions are taken to cool, spray, or vent Containment. This calculation also assumes that low leakage RCP seals are installed.
	Phase 2 RNP does not require a Phase 2 strategy to protect the Containment Function. Containment parameter monitoring is discussed in Instrumentation below.	N/A		N/A	N/A	See RNP-M/MECH-1877 comment above.

Table 5, 4.2 FLEX Equipment and Strategies Matrix by Function						
FUNCTION	STRATEGY DESCRIPTION	REQUIRED EQUIPMENT	FLEX SPECIFICATIONS OR RATINGS	REQUIRED FLEX CONNECTIONS	EC NO.	COMMENTS
	Phase 3 Spray Containment Dome with any available water source (lake, discharge canal, deepwell) using a Hale Pump and Monitor Nozzles. Given the extended coping times available, any of the 4 site deepwells can accessed and SPP-038, Installation, Operation, and Removal of Supplemental Cooling For HVH-1, 2, 3, & 4 can be used with portable power to any of the HVH units in Containment.	• Hale Pumper • Hoses • Monitor Nozzles • NSRC Generator		N/A	N/A	RNP has 4 Hale Pumps on site for FLEX use; not all would be in use at the same time. Monitor Nozzles are available in hose trailers. In addition, the NSRC will deliver an additional 2 Hale Pumps. GOTHIC analysis of the dome spray effectiveness shows extended times to reach containment function limits (approx. 90 days).
SFP Cooling	Phase 1 RNP does not have a viable Phase 1 coping strategy for SFP cooling or makeup.	N/A		N/A	N/A	N/A
	Phase 2 SFP Cooling is through evaporative cooling. SFP makeup uses a Hale Pump at the discharge canal to deliver water to the SFP	• Hale Pumper • Tractor • Hoses • Monitor Nozzles	1500 gpm EDMP Hale Pump	FLEX connection at SFPC-742	90622	RNP-M/MECH-1886 This is an established RNP strategy; see EDMG-11, Attachment 12.

Table 5, 4.2 FLEX Equipment and Strategies Matrix by Function

FUNCTION	STRATEGY DESCRIPTION	REQUIRED EQUIPMENT	FLEX SPECIFICATIONS OR RATINGS	REQUIRED FLEX CONNECTIONS	EC NO.	COMMENTS
	pool from operating deck or through a FLEX connection on the SFP Cooling System.					See System 9045
	<u>Phase 3</u> Continuation of Phase 2	N/A		N/A	N/A	N/A
Instrumentation	<u>Phase 1</u> Required instrumentation remains available on vital battery busses. Coping time of 3.75 hrs/3.25 hrs respectively for each battery.	• 125V DC MCC "A" • 125V DC MCC "B"		N/A	N/A	RNP-E-6.032, Fukushima Flex 4.2 Phase 1 – Load Profile Calculation for Battery A and B
	<u>Phase 2</u> Vital Battery Chargers will be re-powered by pre-staged generators in the Reactor Auxiliary Building using pre-staged cables and installed FLEX connections at each of the 4 vital battery chargers.	See EC90617 for the extensive list of required equipment. Fluke 726 Digital Multimeters		• Emergency FLEX Disconnect Switch for 'A' Battery Charger • Emergency FLEX Disconnect Switch for 'A-1' Battery Charger • Emergency FLEX Disconnect Switch for 'B' Battery Charger • Emergency FLEX Disconnect Switch for 'B-1' Battery Charger	90617	This is a complete FLEX 4.2 Phase 2/3 strategy.

Table 5, 4.2 FLEX Equipment and Strategies Matrix by Function

FUNCTION	STRATEGY DESCRIPTION	REQUIRED EQUIPMENT	FLEX SPECIFICATIONS OR RATINGS	REQUIRED FLEX CONNECTIONS	EC NO.	COMMENTS
	Required instrumentation can be ‘read’ using Fluke portable instruments and YETI Power Packs and FSG-7.	YETI Portable Power Packs & Batteries Fluke 726 Digital Multimeters			90734	FSG-7, Loss of Vital Instrumentation or Control Power.
	<u>Phase 3</u> Continuation of Phase 2	N/A		N/A	N/A	N/A
Equipment Storage	Permanent FLEX Storage Building (PFSB); storage facility designed to withstand applicable RNP hazards.	N/A		N/A	90625	This PFSB will store all N and N+1 mitigating strategies equipment. Other equipment not classified as “mitigating strategy” equipment as defined in NEI 12-06, may be stored in other locations or facilities (BLDG. 463 or the B.5.b warehouse).
Equipment Deployment	Portable equipment will be deployed from the PFSB over evaluated haul paths to their staging areas using the CAT 924K front loader, B.5.b tractor, or one of other various tractors and trucks staged around the site. Fuel oil will be dispensed from any	Various Tractors and trucks • 2 x 500 gallon FO trailers with 25 gpm 12 VDC	CAT 924K Wheel loader B.5.b Tow tractor B.5.b Tow tractor	N/A FO connectors staged in FO	90625 90737	Haul paths were evaluated for liquefaction and remediation was not required.

Table 5, 4.2 FLEX Equipment and Strategies Matrix by Function

FUNCTION	STRATEGY DESCRIPTION	REQUIRED EQUIPMENT	FLEX SPECIFICATIONS OR RATINGS	REQUIRED FLEX CONNECTIONS	EC NO.	COMMENTS
	available DFOST, AFOST, or IC Turbine FOST using two 500 gallon fuel trailers.	pump and hoses • Tow tractor • 800' Fuel Hose		trailers		
Available Equipment not directly tied to a particular strategy	Available for all FLEX pump needs identified in strategies	Hale Pump	3000 gpm @ 150 psig; 1500 gpm @ 200 psig			Can be used to supply water to: • Fill CST • Suction of SDAFWP • Refill SFP • Fire Service System • Borated Injection Tank • RWST • Core Cooling • CV Spray • Suction to Diesel Auxiliary Feedwater Pumps
	Hose Trailers (2)	Each trailer has: • 2700' of 5" LDH fire hose • 1200' of 3" fire hose • 600' of 1 ½" hydraulic hose • 10 bags of boric acid • 5" to 2 ½" gated wye (3 outlets)				Can be used to supply water to: • Fill CST • Suction of SDAFWP • Refill SFP • Fire Service System • Borated Injection Tank • RWST • Core Cooling • CV Spray • Suction to Diesel Auxiliary Feedwater Pumps

Table 5, 4.2 FLEX Equipment and Strategies Matrix by Function

FUNCTION	STRATEGY DESCRIPTION	REQUIRED EQUIPMENT	FLEX SPECIFICATIONS OR RATINGS	REQUIRED FLEX CONNECTIONS	EC NO.	COMMENTS
	480 VAC Portable Electric Power	CNO FLEX TS-130 Generator	2 ea. 100 kw @ .8 pf, 127 kva, 480v 3ϕ, 208v 3ϕ, 240v 1ϕ or 120v 1ϕ.			
	Portable HVAC Unit	CNO FLEX TS-60 Generator / HVAC Unit	• 49 kw @ .8 pf, 60 kva, 480v 3ϕ, 208v 3ϕ, 240v 1ϕ or 120v 1ϕ. • (2) five ton portable HVAC units with ducting.			
	Portable 6KW diesel generators	CNO FLEX DG6E Generator	8 ea. 5.5 kw continuous, 240v 1ϕ or 120v 1ϕ.			Can be used to supply power to: • portable fans. • portable lights. • charge satellite phones • charge portable radios.
	B.5.b Portable Diesel Generator	Extreme Damage Mitigation	365 kw, 480c 3ϕ.			Can be used to supply power to: • 2 Battery chargers, cable (3ϕ #2 awg available in B.5.b supplies). • close accumulator valves. • MCCs • Service Water Pump • Charging Pump • CCW Pump • CV Spray Pump • Deepwell Pump

Table 5, 4.2 FLEX Equipment and Strategies Matrix by Function

FUNCTION	STRATEGY DESCRIPTION	REQUIRED EQUIPMENT	FLEX SPECIFICATIONS OR RATINGS	REQUIRED FLEX CONNECTIONS	EC NO.	COMMENTS
	CNO FLEX HP Breathing Air Compressor	SCBA Replenishment	25 scfm @ 6000 psi, 7.5 kw generator.			Can be used for: • Fill N2 bottle with air to supply motive force to PORVs • portable lights. • Breathing Air for SCBA's
	CNO FLEX Sullair Air Compressor		300 scfm, pressure 80 to 200 psi.			
	CNO FLEX Command Trailer		10 kw generator 120v 1ϕ			Can be used to supply power to: • portable fans. • portable lights. • charge satellite phones • charge portable radios.