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U. S. Nuclear Regulatory Commission
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Washington, D. C. 20555-0001

Edwin I. Hatch Nuclear Plant – Units 1 and 2
Notification of Full Compliance of Required Action for
NRC Order EA-12-049 Mitigation Strategies for
Beyond-Design-Basis External Events

Ladies and Gentlemen:

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Order EA-12-049, *Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events*, to Southern Nuclear Operating Company (SNC). This Order was immediately effective and directs the Edwin I. Hatch Nuclear Plant (HNP) - Units 1 and 2 to develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities in the event of a beyond-design-basis external event. This letter provides the notification required by Item IV.C.3 of Order EA-12-049 that full compliance with the requirements described in Attachment 2 of the Order has been achieved for both HNP Units 1 and 2 on December 31, 2016. SNC previously notified the NRC of the Unit 1 compliance with the Order on May 3, 2016.

Enclosure 1 summarizes HNP Units 1 and 2's compliance with Order EA-12-049. Enclosure 2 contains the HNP Units 1 and 2 Final Integrated Plan (FIP) which provides strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities in the event of a beyond-design basis external event. Prior to the issuance of Order EA-12-049, the Nuclear Energy Institute notified the NRC of an industry initiative on procurement of equipment for the diverse and flexible coping strategy (letter dated February 24, 2012). The HNP Units 1 and 2 FIP includes a list of equipment used for implementation of this Order which is more refined and supersedes the list which was procured for the 2012 initiative.

The HNP FIP is based on NEI 12-06, Rev. 2 with the exception of Appendix E which was finalized after the validation process was completed. Other aspects of NEI 12-06, Rev. 2, while not applicable to this Order compliance, will be utilized for upcoming submittals (e.g., use of re-evaluated hazards, Appendix G and Appendix H) and rulemaking (e.g., references to NEI 13-06 and NEI 14-01).

This letter contains no new NRC commitments. If you have any questions, please contact John Giddens at 205.992.7924.

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NRR

Mr. C. R. Pierce states he is the Regulatory Affairs Director for Southern Nuclear Operating Company, is authorized to execute this oath on behalf of Southern Nuclear Operating Company and, to the best of his knowledge and belief, the facts set forth in this letter are true.

Respectfully submitted,

C. R. Pierce

C. R. Pierce
Regulatory Affairs Director

CRP/JMG/GLS

Sworn to and subscribed before me this 13 *day of* February*, 2017.*

Laura L. Crofts
Notary Public

My commission expires: 10-8-2017

Enclosures: 1. Compliance with Order EA-12-049

2. Edwin I. Hatch Final Integrated Plan

cc: Southern Nuclear Operating Company
Mr. S. E. Kuczynski, Chairman, President & CEO
Mr. D. G. Bost, Executive Vice President & Chief Nuclear Officer
Mr. D. R. Vineyard, Vice President – Hatch
Mr. M. D. Meier, Vice President – Regulatory Affairs
Mr. B. J. Adams, Vice President – Engineering
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U.S. Nuclear Regulatory Commission
Ms. C. Haney, Regional Administrator
Mr. M. D. Orenak, NRR Project Manager – Hatch
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State of Georgia
Mr. R.E. Dunn, Director – Environmental Protection Division

Edwin I. Hatch Nuclear Plant – Units 1 and 2
Notification of Full Compliance of Required Action for NRC Order EA-12-049
Mitigation Strategies for Beyond-Design-Basis External Events

Enclosure 1

Compliance with Order EA-12-049

Introduction

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Reference 1), to Southern Nuclear Operating Company (SNC). This Order was effective immediately and directed the Edwin I. Hatch Nuclear Plant (HNP) - Units 1 and 2 to provide diverse and flexible strategies (FLEX) in response to Order EA-12-049. SNC developed an Overall Integrated Plan (OIP) (Reference 6 and revised in Reference 11) to provide FLEX. The information provided herein, as well as the implementation of the OIP, documents full compliance for HNP Units 1 and 2 in response to the Order (Reference 1).

Open Item Resolution

Following issuance of the NRC Audit Report (Reference 16), there were no open items from either it or the NRC Interim Staff Evaluation (ISE) (Reference 9). All identified items in the audit and previous confirmatory items have been addressed and documented in the site CAP program.

- ISE Open Items – HNP Units 1 and 2 has no open or pending items
- Licensee Identified Open Items – HNP Units 1 and 2 has no open or pending licensee identified open items
- Audit Questions/Audit Report Open Items – HNP Units 1 and 2 FLEX has no open or pending items

Milestone Schedule – Items Complete

HNP Unit 1 & 2 Milestone	**Completion Date**
Submit 20 Day Letter Acknowledging Receipt of Order	March 2012
Submit Overall Integrated Plan	February 2013
1st 6 Month Update	August 2013
Unit 1 – 1st Refueling Outage	February 2014
2nd 6 Month Update	February 2014
3rd 6 Month Update	August 2014
4th 6 Month Update	February 2015
Unit 2 – Implementation Outage*	March 2015
5th 6 Month Update	August 2015
Develop Modifications	November 2015
Develop Training Material	November 2015
Develop Strategies (Hatch Response Plan) with National SAFER Response Center	December 2015
Develop Operational Procedure Changes	December 2015
Develop FSGs	February 2016
6th 6 Month Update	February 2016
Phase 2 Equipment Procurement Complete	February 2016

HNP Unit 1 & 2 Milestone	Completion Date
Implement Training	February 2016
Unit 1 Walk-throughs or Demonstrations	February 2016
Issue U1 FSGs	February 2016
Unit 1 - 2nd Refueling Outage / Implementation Complete	**March 2016**
7th 6 Month Update	August 2016
Unit 2 Walk-throughs or Demonstrations	December 2016
Issue U2 FSGs	December 2016
Unit 2 - Implementation Complete	**December 31, 2016**

* Full compliance by 12/31/2016 since second U2 refueling outage is after 12/31/2016

Order EA-12-049 Compliance Elements Summary

The elements identified below for HNP Units 1 and 2 are included in the Final Integrated Plan (FIP) (Enclosure 3) and demonstrate compliance with Order EA-12-049.

Strategies - Complete

HNP Units 1 and 2 strategies are in compliance with Order EA-12-049. There are no strategy related Open Items, Confirmatory Items, or Audit Questions/Audit Report Open Items.

Modifications - Complete

The modifications required to support the FLEX strategies for HNP Units 1 and 2 have been fully implemented in accordance with the station processes.

Equipment - Procured and Maintenance & Testing - Complete

The equipment required to implement the FLEX strategies for HNP Units 1 and 2 has been procured, initially tested, received at HNP, site acceptance tested and performance verified as recommended in accordance with NEI 12-06, *Diverse and Flexible Coping Strategies (FLEX) Implementation Guide*, and is available for use.

Maintenance and testing requirements are included in the HNP Preventative Maintenance Program such that equipment reliability is monitored and maintained. All maintenance and testing activities have been identified. All six month or less PM's have been developed and performed. Greater than 6 month PMs have been developed and will be performed on their scheduled due date.

Protected Storage - Complete

The storage facility required to implement the FLEX strategies for HNP Units 1 and 2 has been constructed and provides adequate protection from the applicable site hazards. The equipment required to implement the FLEX strategies for HNP Units 1 and 2 is stored in its protected configuration.

Procedures - Complete

FLEX Support Guidelines (FSGs) for HNP Units 1 and 2 have been developed and integrated with existing procedures. The FSGs and applicable procedures have been verified and are available for use in accordance with the site procedure control program.

Training - Complete

Training for HNP Units 1 and 2 personnel has been completed in accordance with an accepted training process, as recommended in NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide.

Staffing - Complete

The Phase 2 staffing study for HNP (Reference 12) has been completed in accordance with 10 CFR 50.54(f) letter (Reference 2). The NRC has reviewed the Phase 2 staffing study and concluded that it adequately addresses the response strategies needed to respond to a beyond design basis external event using HNP procedures and guidelines. This is documented in NRC letter dated February 7, 2016 (Reference 18). After completion of validation and verification activities, SNC updated the phase 2 staffing study to accurately reflect personnel assignments and task durations, but no changes were made to minimum staffing numbers, and no time limits were exceeded for Time Sensitive Actions.

Communications - Complete

HNP committed to compliance with the communications capabilities in accordance with the 10 CFR 50.54(f) letter (Reference 2). Implementation of the backup satellite service ultimately did not include shared cellular or data capability as originally planned; however, those capabilities were not relied on for compliance. The Rapidcom system has the capability to provide data communications should the TSC deem it is needed.

National SAFER Response Centers - Complete

SNC has established a contract with Pooled Equipment Inventory Company (PEICo) and has joined the Strategic Alliance for FLEX Emergency Response (SAFER) Team (Equipment Committees) for off-site facility coordination. It has been confirmed that PEICo is ready to support HNP Units 1 and 2 with Phase 3 FLEX equipment stored in the National SAFER Response Centers in accordance with the site specific SAFER Response Plan.

Validation - Complete

SNC has completed validation in accordance with industry developed guidance to assure required tasks, manual actions and decisions for FLEX strategies are feasible and may be executed within the constraints identified in the FLEX FIP for Order EA-12-049.

FLEX Program Document - Established

The SNC HNP FLEX Program Document has been developed in accordance with the requirements of NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide.

References:

1. NRC Order Number EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, dated March 12, 2012.
2. NRC Letter, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident, dated March 12, 2012.
3. NRC Interim Staff Guidance JLD-ISG-2012-01, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, Revision 0, dated August 29, 2012.
4. NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, Revision 0, dated August 2012.
5. Edwin I. Hatch Nuclear Plant - Units 1 and 2 Southern Nuclear Operating Company's Initial Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (EA-12-049), dated October 23, 2012.
6. Edwin I. Hatch Nuclear Plant - Units 1 and 2 Southern Nuclear Operating Company's Overall Integrated Plan in Response to Commission Order with Regard to Mitigation Strategies for Beyond-Design-Basis External Events (EA-12-049), dated February 27, 2013.
7. Edwin I. Hatch Nuclear Plant - Units 1 and 2 First Six-Month Status Report of the Implementation of the Requirements of the Commission Order with Regard to Mitigation Strategies for Beyond-Design-Basis External Events (EA-12-049), dated August 27, 2013.
8. Edwin I. Hatch Nuclear Plant - Units 1 and 2 Second Six-Month Status Report of the Implementation of the Requirements of the Commission Order with Regard to Mitigation Strategies for Beyond-Design-Basis External Events (EA-12-049), dated February 26, 2014.
9. NRC Letter, Edwin I. Hatch Nuclear Plant, Units 1 and 2 - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC NOS. MF0712 and MFO713), dated February 27, 2014.
10. Edwin I. Hatch -Commitment Change Notification Regarding Recommendation 9.3 dated June 23, 2104.
11. Edwin I. Hatch Nuclear Plant - Units 1 and 2 Third Six-Month Status Report of the Implementation of the Requirements of the Commission Order with Regard to Mitigation Strategies for Beyond-Design-Basis External Events (EA-12-049) dated August 26, 2014, including Enclosure 2 – Hatch Units 1&2 Mitigation Strategies (FLEX) Overall Integrated Implementation Plan (OIP), Revision 4.
12. Edwin I. Hatch Nuclear Plant – Units 1 and 2 Response to Request for Information Pursuant to Title 10 CFR 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the NTTF Review of Insights from the Fukushima Daiichi Accident, dated March 12, 2012, dated October 9, 2014.
13. Edwin I. Hatch Nuclear Plant - Units 1 and 2 Fourth Six-Month Status Report of the Implementation of the Requirements of the Commission Order with Regard to Mitigation

14. Strategies for Beyond-Design-Basis External Events (EA-12-049), dated February 26, 2015.

15. Edwin I. Hatch Nuclear Plant - Units 1 and 2 Fifth Six-Month Status Report of the Implementation of the Requirements of the Commission Order with Regard to Mitigation Strategies for Beyond-Design-Basis External Events (EA-12-049), dated August 27, 2015.

16. NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, Revision 2, dated December 2015.

17. NRC letter, Edwin I. Hatch Nuclear Plant, Units 1 and 2 - Report for the Onsite Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Pool Instrumentation Related to Orders EA-12-049 and EA-12-051 (TAC NOS. MF0712, MF0713, MF0721, and MF0722), dated January 13, 2016.

18. NRC Interim Staff Guidance JLD-ISG-2012-01, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, Revision 1, dated January 22, 2016.

19. NRC Letter, Edwin I. Hatch Nuclear Plant, Units 1 and 2 - Response regarding Phase 2 Staffing Submittals associated with Near-Term Task Force Recommendation 9.3 related to the Fukushima Dai-ichi Nuclear Power Plant Accident (TAC NOS. MF5038 and MF5039) date February 7, 2016.

20. Edwin I. Hatch Nuclear Plant - Units 1 and 2 Sixth Six-Month Status Report of the Implementation of the Requirements of the Commission Order with Regard to Mitigation Strategies for Beyond-Design-Basis External Events (EA-12-049), dated February 29, 2016.

21. Edwin I. Hatch Nuclear Plant Units 1 and 2, Notification of Commitment Completion - NTTF Recommendation 9.3, dated March 14, 2016.

22. Edwin I. Hatch Nuclear Plant Unit 1 Completion of Required Action for the NRC Orders EA-12-049 & EA-12-051 Mitigation Strategies for Beyond-Design-Basis External Events and Reliable Spent Fuel Pool Level Instrumentation, dated May 3, 2016.

23. Edwin I. Hatch Nuclear Plant - Units 1 and 2 Seventh Six-Month Status Report of the Implementation of the Requirements of the Commission Order with Regard to Mitigation Strategies for Beyond-Design-Basis External Events (EA-12-049), dated August 29, 2016.

Edwin I. Hatch Nuclear Plant – Units 1 and 2
Notification of Full Compliance of Required Action for NRC Order EA-12-049
Mitigation Strategies for Beyond-Design-Basis External Events

Enclosure 2

Edwin I. Hatch Nuclear Plant
Final Integrated Plan

(91 pages)

FINAL INTEGRATED PLAN

U.S. NUCLEAR REGULATORY COMMISSION

ORDER EA-12-049

STRATEGIES FOR BEYOND DESIGN BASIS EXTERNAL EVENTS

HATCH NUCLEAR PLANT

Units 1 and 2

Revision 0

February 2017

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 on four of the units. All direct current (dc) power was lost early in the event on Units 1 and 2 and after some period of time at the other units. Core damage occurred in three of the units along with a loss of containment integrity resulting in a release of radioactive material to the surrounding environment.

The United States (US) Nuclear Regulatory Commission (NRC) assembled a Near-Term Task Force (NTTF) to advise the Commission on actions the US nuclear industry should take to preclude core damage and a release of radioactive material after a natural disaster such as that seen at Fukushima. The NTTF report (Reference 3.1) contained many recommendations to fulfill this charter, including assessing extreme external event hazards and strengthening station capabilities for responding to Beyond-Design-Basis External Events (BDBEEs).

Based on NTTF Recommendation 4.2, the NRC issued Order Enforcement Action (EA)-12-049 (Reference 3.2) on March 12, 2012 to implement mitigation strategies for BDBEEs. The order provided the following requirements for strategies to mitigate BDBEEs:

1. Licensees shall develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment integrity and spent fuel pool (SFP) cooling capabilities following a BDBEE.

2. These strategies must be capable of mitigating a simultaneous loss of all alternating current (ac) power and loss of normal access to the ultimate heat sink and have adequate capacity to address challenges to core cooling, containment integrity and SFP cooling capabilities at all units on a site subject to the Order.

3. Licensees must provide reasonable protection for the associated equipment from external events. Such protection must demonstrate that there is adequate capacity to address challenges to core cooling, containment integrity and SFP cooling capabilities at all units on a site subject to the Order.

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

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

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

- Phase 1 - The initial phase requires the use of installed equipment and resources to maintain or restore core cooling, containment integrity and SFP cooling capabilities.
- Phase 2 - The transition phase requires providing sufficient, portable, on-site equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from off site.
- Phase 3 - The final phase requires obtaining sufficient off-site resources to sustain those functions indefinitely.

NRC Order EA-12-049 (Reference 3.2) required licensees of operating reactors to submit an overall integrated plan by February 28, 2013, that included a description of how compliance with these requirements would be achieved. 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 3.3), which provides guidelines for nuclear stations to assess extreme external event hazards and implement the mitigation strategies specified in NRC Order EA-12-049. The NRC issued Japan Lessons Learned Interim Staff Guidance JLD-ISG-2012-01 (Reference 3.4), dated August 29, 2012, which endorsed NEI 12-06 Rev. 0 with clarifications on determining baseline coping capability and equipment quality. Since that time, NEI 12-06 Rev. 2 was issued (Reference 3.98) and endorsed by the NRC on January 22, 2016 (Reference 3.99).

NRC Order EA-12-051 (Reference 3.5), issued coincident with EA-12-049, required licensees to install reliable SFP instrumentation with specific design features for monitoring SFP water level. This order was prompted by NTTF Recommendation 7.1 (Reference 3.1).

NEI 12-02 (Reference 3.6) provided guidance for compliance with Order EA-12-051. The NRC determined that, with the exceptions and clarifications provided in JLD-ISG-2012-03 (Reference 3.7), conformance with the guidance in NEI 12-02 is an acceptable method for satisfying the requirements in Order EA-12-051.

This Final Integrated Plan (FIP) addresses compliance with NRC Order EA-12-049. Compliance with Order EA-12-051 for Unit 1 can be found in Reference 3.94 and for Unit 2 in Reference 3.111.

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

2.1 General Elements

2.1.1 General Criteria and Baseline Assumptions

The assumptions used for the evaluations of a Hatch Nuclear Pant (HNP) ELAP/loss of normal access to the ultimate heat sink (LUHS) event and the development of diverse and flexible coping strategies (FLEX) are stated below.

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

- The applicable boiling water reactor (BWR) criteria and initial plant conditions listed in NEI 12-06, Revision 2 (Reference3.98), Sections 3.2.1.1 - 3.2.1.6, are applicable to HNP without exception.
- BDBEE hazards, when referred to in this document, are the applicable hazards from NEI 12-06. The applicable hazards for Hatch are described in Section 2.7 in this document. These hazards are bounded by the current design basis hazards as described in the FSAR (References 3.15 and 3.16).
- Additional staff resources are expected to begin arriving at 6 hours and the site will be fully staffed 24 hours after the event (Reference 3.97).
- Temperature is not expected to impact the utilization of off-site resources or the ability of personnel to implement the required FLEX strategies.
- Seismically qualified is used in this FIP to describe criteria as defined in HNP FSAR Section 3.7A (Ref. 3.16).
- The assumptions listed in NEI 12-06, Rev. 2, Section 3.2.1, General Criteria and Baseline Assumptions, are applicable to HNP.

2.2 Strategies

2.2.1 Objective and Approach

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

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 concurrent with 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) and Strategy Implementing Guidelines (SIGs). SIGs were developed to have operator actions in the field included in a separate "operator friendly" procedure format. The FSGs and SIGs together are equivalent to the industry generic FSG structure.

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

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

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

NOTE: The strategy descriptions below are the same for both of the Hatch units. Any differences and/or unit specific information is included where appropriate.

2.2.2 Method of Compliance with NRC Order EA-12-049

The following paragraphs describe HNP Units 1 and 2 compliance with NRC Order EA 12-049 to mitigate a postulated ELAP concurrent with LUHS event.

Core decay heat is removed by using the reactor core isolation cooling (RCIC) system. The steam-driven RCIC pump will supply water to the reactor pressure vessel (RPV) from the condensate storage tank (CST), or from the suppression pool (i.e. torus) when the CST is depleted. Steam from the reactor operates the RCIC pump turbine, with the steam exhaust discharging to the suppression pool. Operators will lower RPV pressure by exhausting steam through the safety relief valves (SRVs) to the suppression pool. Pressure will be controlled in a reduced specified band to enable continued RCIC operation. A portable, diesel-driven FLEX pump will be operated to supply makeup water to the CST from the UHS (Altamaha River), or to inject water to the reactor vessel via the normal residual heat removal (RHR) system flow path, if the RCIC system is no longer available.

A portable FLEX diesel generator (DG) will be used to power up both divisions of Class 1E emergency 600 volts alternating current (VAC) buses C and D. This will allow energizing Class 1E battery chargers and selected motor control centers so that power is available to critical loads such as required motor operated valves, necessary dc components and desired ac instrumentation. HNP will utilize the industry National SAFER Response Centers for supplies of Phase 3 equipment.

HNP utilizes anticipatory venting via the hardened containment vent system (HCVS) to maintain containment pressure and temperature within acceptable values. Venting is planned to be initiated in sufficient time to allow for continued RCIC operation and to maintain containment pressure below its design value. The venting strategy is consistent with the NRC endorsement of BWR Containment Venting (Anticipatory Venting) per ML13358A206 via implementation of Boiling Water Reactor

Owners Group (BWROG) Emergency Procedure Guideline (EPG)/Severe Accident Guideline (SAG), Revision 3.

Coping strategies using installed plant equipment and portable FLEX equipment can continue for greater than 72 hours. Since no time sensitive Phase 3 actions have been identified, instructions for connection and utilization of NSRC equipment for long term coping or recovery will be provided by Technical Support Center (TSC) personnel who will have assessed the condition of the plant and infrastructure, plant accessibility, and additional available off-site resources (both equipment and personnel) following the BDBEE.

In the postulated ELAP event, the SFPs will initially heat up due to the unavailability of the normal cooling system. A FLEX pump will be aligned and used to provide river water either through portable hoses directly into the pool or through spray nozzles on the refuel floor. In addition, the FLEX pump can be connected to the residual heat removal service water (RHRSW) system piping at the Intake Structure, which can be cross-connected to the seismically qualified plant service water (PSW) system piping in the reactor building. The PSW piping provides an emergency fill connection to the SFP cooling system makeup piping. These methods will ensure that a sufficient volume of water remains above the top of the stored fuel assemblies at all times. The long term strategy for SFP makeup is to continue the strategies described above, including when supplemented by portable equipment delivered from the NSRC. However, the actions for use of the NSRC equipment are not relied upon in the FLEX strategy during the first 72 hours following an ELAP with concurrent LUHS.

The strategy for core cooling for Mode 4 is, in general, similar to those for Modes 1-3. The strategy for containment protection is via the HCVS vent or containment openings during Modes 4 and 5 if containment cannot be closed. Refer to Section 2.17 for more detail on shutdown modes.

The specific strategies described in Sections 2.3, 2.4, 2.5 and 2.6 below are capable of mitigating an ELAP concurrent with LUHS resulting from a BDBEE by providing adequate capability to maintain or restore core cooling, containment integrity, and SFP cooling capabilities at HNP. 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 HNP emergency operating procedures in accordance with established change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59.

2.3 Electric Power

2.3.1 Phase 1 Strategy

Following an ELAP concurrent with LUHS, inverters would maintain main control room (MCR) instrumentation and required control features with power supplied from the station batteries. Critical 125/250 Vdc would also be maintained from the batteries. In order to extend battery life for all station blackout (SBO) events, operators are directed to take steps to minimize the load on the station batteries by shedding unnecessary loads in accordance with station procedures. Load shedding of all non-essential loads will be completed within 75 minutes after the start of the event. Battery calculations (Option 7 in References 3.30, 3.31, 3.32 and 3.33) demonstrate that the limiting train of battery capacity for station 125/250 volts direct current (Vdc) batteries A and B is sufficient to provide power to critical loads for greater than 14 hours. Communications equipment will utilize onboard battery capacity to allow onsite communications.

2.3.2 Phase 2 Strategy

A 600V FLEX DG will be connected to 600V bus C and bus D providing the ability to power battery chargers A/B or C and D/E or F, respectively, which charge the station batteries and supply dc loadsat or before 10 hours into the event (time sensitive at 14 hours). The 600V FLEX DGs are sized (Reference 3.34) to power two 125/250 Vdc battery chargers per division, RCIC controls, MCR coolers, RHR motor operated valves (MOVs), and other selected loads. The deployment areas of the 600V FLEX DGs are shown in Figure 6, Site Plot Plan. One 600V FLEX DG will be staged at the control building west wall and will power bus C on Unit 1 and 2. The other 600V FLEX DG will be staged south of the Unit 2 Turbine Building and will power bus D on Unit 1 and 2. Cables from the generators are run to connection boxes installed in the west cable way to support the FLEX strategies at the control building. The alternate strategy consists of powering the 600V battery chargers directly from the FLEX DGs, via temporary cables, to FLEX permanent transfer switch/receptacle units near the chargers.

2.3.3 Phase 3 Strategy

The long term strategy is to continue to use 600V power, supplemented by the NSRC equipment indefinitely. Additional 4kV generators are available from the NSRC and may be used as desired but are not required for Phase 3 coping strategies. Since no time sensitive Phase 3 actions have been identified, instructions for connection and utilization of NSRC equipment for long term coping or recovery will be provided by TSC personnel who will have assessed the condition of the plant and infrastructure, plant accessibility, and additional available off-site resources (both equipment and personnel) following the BDBEE. An example of this follows:

Two 1 MW 4kV turbine generators from the NSRC per unit can may be connected together using NSRC provided paralleling equipment and necessary cables. The NSRC 4kV power can be connected to either 4160 volt switchgear E or G. TSC procedures contain instructions to address phase rotation.

2.3.4 Systems, Structures and Components

2.3.4.1 Installed dc Electrical Power

The station 125/250 Vdc system for each unit consists of two 125/250 Vdc independent and redundant switchgear assemblies, six static-type battery chargers, two independent service batteries A and B. These dc systems are credited in the Phase 1 coping strategies to maintain critical instrumentation loads until supplied by a 600V FLEX DG. The station 125/250 Vdc system provides power to critical instruments, SRVs, emergency control room lighting, RCIC system, and other required dc loads.

The safety-related batteries and associated dc distribution systems are protected from BDBEE hazards (References 3.15 and 3.16).

2.3.4.2 Installed Inverters to Power Selected Instrumentation and HCVS Equipment

Some of the control room instrumentation, a portion of which are required for FLEX strategies is fed from a safety-related, seismically qualified inverter powered from the 125/250 Vdc batteries. For each unit, one 250V/120 Vac inverter is installed on each division to ensure access to essential instrumentation during and after the event.

The inverters also feed selected ac valves associated with FLEX strategies.

As part of FLEX coping strategies, the hardened vent valves in the containment building will be powered through the entire FLEX event (see Section 2.6.4.3). Since the hardened vent line has Division I and Division II valves installed in series, both must open to vent containment. These valves receive power from the permanently installed inverters. Two normally open, safety-related, seismically qualified fused disconnect switches (R26 M132 and M133) were installed to provide a cross-tie connection (alternate capability) between Division I and Division II inverters.

During an ELAP, dc power from the station service batteries will be used to power the HCVS equipment. The HCVS equipment is powered from permanently installed inverters connected to 250 VDC switchgears A (R22-S016) and B (R22-S017). Operation of the HCVS valves will be controlled from the MCR panels (see Section 2.6.4.3).

2.3.5 FLEX Connections

2.3.5.1 Primary Electrical Connection

BDBEE hazard protected 600V FLEX connection boxes, and associated conduit and cable connect to safety-related/seismically qualified breakers to power bus C (Division I) and bus D (Division II) from the 600V FLEX DG following an ELAP resulting from a BDBEE. Connection of the 600V FLEX DG to bus C (Division I) and bus D (Division II) provides the ability to supply dc load and power battery chargers which charge the Division I and II batteries.

The 600V FLEX connection boxes, which serve as the primary connection points for the 600V FLEX DGs, are located in the west cableway underneath the west side of the Unit 1 control building (Division I), and underneath the south wall of the Unit 2 turbine building (Division II). The connection boxes provide the color coded connections for the 600V FLEX DG to be plugged into the system.

The primary staging area for one 600V FLEX DG will be outside the service building near the Unit 1 control building's west wall. The second 600V FLEX DG will be staged near the south side of the Unit 2 turbine building. Each FLEX DG will power one division on both units. This provides the capability of powering at least one division in each unit should one of the two FLEX DG connection points become unavailable. See Figure 3.

2.3.5.2 Secondary Electrical Connection

The alternate strategy connects the 600V FLEX DG to existing battery chargers to provide power to the dc buses. Division I and II battery chargers can be fed from the 600V FLEX DGs through six seismically mounted receptacles for each unit. Safety related, seismically qualified manual transfer switches are installed for each battery charger to provide the connection to the receptacles. Temporary cables will be brought from the 600V FLEX DG through either the main door on the north side of the service building, roll up doors on the Unit 1 and Unit 2 turbine buildings, or the air lock in Unit 1's reactor building and through the control building and will be connected to two of the three battery chargers in each division.

2.3.6 Electrical Analysis

Battery calculations demonstrate that the limiting train (2A) of battery capacity is sufficient to provide power for critical loads for 14 hours following a load shed (Option 7 in References 3.30, 3.31, 3.32 and 3.33). The Class 1E battery duty cycle of 14 hours for HNP 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 (Reference 3.47) as endorsed by the NRC (Reference 3.48). According to Table 4, the minimum time margin between the calculated battery duration for the FLEX strategy and the maximum deployment time for the 600V FLEX DGs to supply the dc loads is approximately 4 hours for

HNP. Validation and verification has shown a time margin of greater than 5 hours.

2.3.7 <u>600V FLEX Diesel Generator</u>

The selected diesel generator has sufficient capacity to supply the Phase 2 loads as determined by the 600V FLEX DG sizing calculation (Reference 3.34).

2.4 <u>Reactor Core Cooling and Heat Removal Strategy Modes 1-3</u>

Initially, core decay heat is removed by adding water to the RPV and releasing steam from the RPV via the SRV to the suppression pool (torus). Water will initially be added by the turbine-driven RCIC pump, taking suction from the seismically qualified CST.

During the first hour after shutdown caused by the BDBEE, the reactor remains isolated and pressurized with RCIC or high pressure coolant injection (HPCI) providing core cooling, drawing water from the CST. The SRVs control reactor pressure.

The operator is directed to take steps to minimize the load on the station batteries by shedding unnecessary loads in accordance with FSG procedures; load shedding is completed within 75 minutes after the BDBEE, thus ensuring the limiting station battery train (2A) will have greater than 14 hours capability and will be available until the FLEX 600V DG's are placed in service on or before ten hours.

Using manual control of SRVs, reactor pressure is reduced as necessary to maintain cooldown rate at 100°F/hr and to maintain the suppression pool in the acceptable region of the heat capacity temperature limit (HCTL) curve (time sensitive at the point of approaching the unsafe region of the HCTL curve at approximately 3 hours 20 minutes).

At approximately hour five, the use of the HCVS is initiated to provide long term core cooling capability thru RCIC and maintain containment parameters within limits.

Between hours five and six (time sensitive at 6.8 hours), due to the depletion of the CST, RCIC suction is swapped from the CST to the suppression pool to preserve RCIC availability.

At approximately hour ten a FLEX pump is placed in service to makeup water to the CST.

When suppression pool low level impacts RCIC required net positive suction head (NPSH), RCIC suction is swapped from the suppression pool to the CST (time sensitive at 19 hours).

2.4.1 Phase 1 Strategy

Core Cooling and Heat Removal

Immediately following the ELAP event, main steam isolation valves (MSIVs) automatically close, feedwater is lost, and SRVs automatically cycle to control pressure, causing reactor water level to decrease. RCIC and HPCI automatically start with suction from the CST and operate to inject makeup water to the reactor vessel. This injection recovers the reactor level to the normal band. The SRVs control reactor pressure. HPCI is secured at 4 minutes and RCIC provides all makeup flow to the reactor vessel after HPCI is secured. The RCIC trip and isolation signals that could possibly prevent RCIC operation during the ELAP are overridden in accordance with procedural direction. Additionally, the automatic depressurization system (ADS) will be placed in 'inhibit' to prevent automatic initiation of ADS. This is necessary to ensure reactor pressure is not reduced to a pressure which would prevent operation of RCIC.

The method of reactor pressure control is by operation of the SRVs. Operator control of reactor pressure using SRVs requires dc control power and pneumatic pressure (supplied by station batteries and the drywell pneumatics system piping (References 3.15 and 3.16)). For Phase 1, the power for the SRVs is supplied by the station batteries. At event initiation the normal pneumatic supply is lost due to loss of power to the air compressors, but each SRV is provided an accumulator for backup pneumatics (Reference 3.16 Section 5.2.2.2.3). In addition, the liquid nitrogen storage tank automatically supplies backup pneumatic pressure for SRV operation and the unit specific nitrogen storage tanks can be cross-tied, thus providing a large volume of pneumatic supply to either unit.

The suppression pool continues to heat up due to RCIC exhaust and SRV cycling. During the time that suppression pool temperature is increasing operators reduce reactor pressure to a pressure range (150 to 300 pounds per square inch gage(psig)) by manual operation of SRVs maintaining less than 100°F/hr cooldown rate (Reference 3.19). This pressure reduction is initiated at approximately 1 hour after the initiation of the event to provide margin to the unsafe region of the HCTL curve

(References 3.23 and 3.73). If the suppression pool temperature reaches the unsafe region of the HCTL, RPV emergency depressurization is required (References 3.20 and 3.21). However, in accordance with EPGs and per BWROG guidance, EOPs have been revised to allow termination of RPV emergency depressurization at a pressure that will allow continued RCIC operation, if the steam driven injection system is the sole means of core cooling (Reference 3.22).

During the ELAP event, while SRVs are cycling to relieve reactor pressure, the suppression pool is accumulating the reactor coolant volume blown down from the reactor vessel and suppression pool level and temperature continue to increase (Reference 3.24). The wetwell vent is opened to maintain the suppression pool temperature within acceptable parameters. The effect of opening containment vents is to reduce suppression pool inventory, stop the increase of suppression pool temperature, and prevent suppression pool temperature from exceeding 230°F. Operation of RCIC under these conditions may continue until the suppression pool water level reaches the Technical Specifications (TS) low level limit of 146 in.

Suction of the RCIC pump will be initially from the seismically qualified CST (References 3.15 and 3.16). The CST is nominally a 500,000 gallon tank (References 3.15 and 3.16); however, only the bottom half of the tank is missile protected and only 100,000 gallons of this missile protected volume is credited for injection to the RPV for high wind hazards (Reference 3.24). Based on the minimum volume of water available in the CST the protected inventory of the CST is available to provide flow to the RPV for approximately 6.8 hours (Reference 3.24).

When level in the CST is nearing depletion, operators will swap RCIC suction from the CST to the suppression pool. At this point, the suppression pool temperature is approximately 215°F (Reference 3.24).

2.4.2 <u>Phase 2 Strategy</u>

Primary Strategy Core Cooling and Heat Removal

The primary strategy for maintaining reactor core cooling in Phase 2 remains basically the same as in Phase 1 beginning after the suctionsource is swapped back to the CST from the suppression pool, and is dependent upon the continued operation of the RCIC pump in automatic mode from the MCR (i.e., with operators controlling the RCIC flow controller). The RCIC pump is capable of feeding the RPV provided there is adequate steam pressure available to drive the turbine and an adequate supply of water in the CST. When CST water becomes depleted, the CST will be replenished using the FLEX pump taking suction from the UHS (Altamaha River). Phase 2 begins when RCIC suction becomes reliant on the refilled CST.

During Phase 2, reactor pressure is controlled by manual operation of SRVs as described in Phase 1. As backup to the nitrogen tank and the SRV accumulators, pre-staged emergency nitrogen (N2) bottles can be valved in per 34SO-P70-001-1 (2), drywell pneumatic system (Reference 3.27).

Alternate Strategy Core Cooling and Heat Removal

In the event that adequate steam pressure is no longer available to drive the RCIC pump's turbine, the Phase 2 alternate coping strategy for reactor core cooling requires connecting a FLEX pump for injection of water into the RPV via the RHR injection flow path. The same connections from the river to the reactor building, as used in the primary strategy, are able to supply water to the RHRSW header in the reactor building. The RHR system cross-tie valves, E11-F073A(B) and F075A(B), will be opened so that makeup water can be injected via the normal RHR-low pressure cooling injection (LPCI) flow path. See Figures 1 and 2 which illustrate the makeup and injection strategies discussed above. If the RPV is still pressurized, then SRVs will be opened to depressurize to a pressure at which the FLEX pump can maintain RPV level (less than approximately 150 psig per Reference 3.29).

2.4.3 Phase 3 Strategy

Primary Strategy

The primary coping strategy is to extend the Phase 2 strategy for reactor cooling to 72 hours and beyond with no immediate reliance on equipment from the NSRC until after 72 hours.

This requires long-term reliance on:

- continued Phase 2 RPV injection strategies with RCIC using the CST as the suction source, provided that there is sufficient reactor pressure available to operate RCIC. CST makeup strategy from the FLEX pump at the river continues and removal of excess heat in containment is accomplished by venting the wetwell using the HCVS system, or

- continued Phase 2 RPV injection strategies with the FLEX pump from the Altamaha River and removal of excess heat in containment accomplished by venting the wetwell using the HCVS system.

NSRC equipment is utilized to backup the Phase 2 equipment and to transition to Phase 3 coping.

See Table 7 for a list of equipment that will be delivered to the site by the NSRC; refer to Section 2.11 for a discussion on NSRC supplied equipment.

Since no time sensitive actions have been identified, instructions for connection and utilization of NSRC equipment for long term coping or recovery will be provided by TSC personnel who will have assessed the condition of the plant and infrastructure, plant accessibility, and additional available off-site resources (both equipment and personnel) following the BDBEE.

2.4.4 Systems, Structures, Components

2.4.4.1 Reactor Core Isolation Cooling Pump

The RCIC pump is utilized to maintain the heatsink for decay heat removal following an ELAP concurrent with a LUHS event, by supplying water to the RPV. The RCIC system consists of a steam-driven turbine-pump unit and associated valves and piping capable of delivering makeup water to the RPV. The steam supply to the turbine comes from the reactor vessel. The steam exhaust from the turbine dumps to the suppression pool. The pump can take suction from the CST or from the suppression pool. The pump discharges either to the feedwater line or to a full-flow return test line to the CST. The RCIC pump is a safety related, seismically qualified component which is located in the reactor building, a seismically qualified structure, and therefore protected from BDBEE hazards (Reference 3.16, Section 5.5.6). The BWROG has performed a RCIC study (Reference 3.18) which will allow operation of RCIC at a lube oil temperature >230°F

2.4.4.2 RCIC Pump Discharge Isolation/Flow Control Valves

The RCIC pump discharge motor-operated isolation/flow control valves are used to modulate the flow to maintain the required RPV water level. The valves can be controlled from either the MCR or local panels. Additionally, the valves can be operated locally if dc power is lost. dc power is maintained throughout the event, initially by the safety-related station batteries and subsequently by the battery chargers once the onsite 600V FLEX DG is operating, which ensures power will be available for the valves. Refer to HNP FSAR (Reference 3.16) Section 5.5.6 for a description of the isolation/flow control valves.

The RCIC pump discharge motor-operated isolation/flow control valves and their motors are both Seismic Category 1 components which are also protected from the effects due to the design basis tornado (Reference 3.16, Section 3.5 and Table 3.2-1).

2.4.4.3 Safety Relief Valves

During the initial stages of the event, heat generated by the reactor is dissipated by steam release by the SRVs. Refer to HNP FSAR (Reference 3.16) Section 5.5.2 for a description of the SRVs. The SRVs are seismically qualified components which are also protected from BDBEE hazards (Reference 3.16, Section 3.5). The nitrogen storage tanks (NSTs) and nitrogen inerting system piping to the SRVs are also seismically qualified (Reference 3.19, Section 3.8.4 and 9.3.6) and do not isolate during a loss of power. The nitrogen supply system piping from the nitrogen storage tanks has the ability to be cross-connected between Unit 1 and Unit 2 such that if one of the tanks should be damaged or have insufficient nitrogen pressure for SRV operation, the other tank can supply the necessary nitrogen for SRV operation. During Phase 2, reactor pressure will be controlled manually from the MCR by the operator using SRVs. As backup to the nitrogen tank and the SRV accumulators, pre-staged emergency N2 bottles can be valved in per procedures (Reference 3.27).

2.4.4.4 Suppression Pool

The suppression pool or torus, is the heat sink for reactor vessel SRV discharges and RCIC turbine steam exhaust following a BDBEE. It is also the suction source for the RCIC pump for providing core cooling after the suction of the RCIC is swapped from the CST to the suppression pool and before transfer back to the CST, once the CST is being replenished. Refer to HNP FSAR (Reference 3.16) Section 3.8.2 for a description of the suppression pool.

The suppression pool is a safety-related seismically qualified structure which is protected from BDBEE hazards (Reference 3.16 Table 3.2-1).

2.4.4.5 Hardened Containment Vent System

The HCVS will be used to maintain the suppression pool temperatures below 230°F by venting steam from the suppression pool to the main stack. The suppression pool pressure is maintained below 19 psig (Reference 3.24).

The HCVS is a safety-related seismically qualified system which is protected from BDBEE hazards (Reference 3.16, Section 9.3.1.4)

2.4.4.6 Condensate Storage Tank

Each unit has one (1) CST with a credited inventory of 100,000 gallons of water (Reference 3.16, Section 9.2.6.3). Based on the minimum volume of water available, the credited volume in the CST can support core cooling and heat removal requirements in MODES 1 through 4 for approximately the first 6 hours (see Reference 3.24). The CST is used as the initial source of water for RPV make-up and is the primary long term storage tanks for make-up water after RCIC suction is transfered back to the CST from the suppression pool. The volume of water in the missile protected portion of the tanks is more than the volume credited in the FLEX strategies for use by RCIC. Refer to HNP FSAR (Reference 3.16) Section 9.2.6 for a description of the CST.

Based on review of current seismic analysis of the CSTs, the Unit 1 and Unit 2 CSTs are seismically qualified and would be available as a source of makeup water to the reactor via the RCIC system. The RCIC and HPCI piping and connections to the CST are seismically qualified based on FSAR Sections 4.7.2 and 6.3.1 respectively for Unit 1, and Sections 5.5.6.3 and 6.3.2.3 for Unit 2 (References 3.15 and 3.16), and based on Unit 1 and Unit 2 piping class summaries (References 3.35 and 3.36).

The enclosure walls surrounding the tanks provide protection from tornado missiles.

The CST is a safety-related seismically qualified structure which is protected from BDBEE hazards (Reference 3.16, Section 9.2.6).

2.4.4.7 Ultimate Heat Sink (Altamaha River)

The FLEX pump will be placed in service at approximately 10 hours to provide make up to the CST from the Altamaha River. The UHS is designed to provide adequate cooling water to dissipate waste heat from the plant. Refer to HNP FSAR (Reference 3.16) Section 2.4.1 for a description of the UHS.

2.4.5 FLEX Connections

2.4.5.1 FLEX Pump RPV Discharge Connections

The discharge of the FLEX pump will be directed to the RPV via hose and adapters connected to either of two connection points (primary and alternate) located at the intake structure and in the reactor building at plant grade level. Permanent RHR piping is used to inject into the RPV from either path. The primary pathway connects the FLEX pump at the intake via a ground level valve into the RHRSW permanent piping which is cross tied with the RHR system to allow RPV injection using either division of RHR. The alternate pathway utilizes temporary hose from the FLEX pump at the intake to the FLEX connection into the RHRSW piping at the reactor building.

2.4.5.2 Cross-Tie Connection between RHRSW and the PSW

Cooling is necessary to support habitability of the control room and, if necessary, the RCIC equipment area. Additionally, SFP makeup via permanent plant piping is required per NEI

12-06. Each unit has seismically qualified tie-ins for each division of the RHRSW and PSW system to supply the control room coolers, RCIC room coolers, and SFP makeup via the PSW header from the RHRSW system (Figure 1). The use of normally closed double isolation valves ensures separation of the systems.

Since the FLEX pump strainers allow larger suspended solids into the system than the PSW system strainers, a FLEX portable strainer is installed in the cross-tie.

2.4.5.3 Condensate Storage Tank Connection

Easily accessible, diverse, seismically qualified, fill connection point on the CST, using the existing CST core spray system suction line is available to support CST makeup for each unit using the FLEX pump. The FLEX connection piping has an isolation valve and check valve to prevent accidental draining of the CST. A hose will be used to connect this piping to the RHRSW piping in the reactor building (Figure 2).

2.4.5.4 Primary Core Cooling Phase 2 Connection

The FLEX pump (3000 gallon per minute (gpm)) deployed near the intake structure at the Altamaha river will be connected to the Division I seismically qualified RHRSW piping via FLEX hose and flanged connections at the intake structure (Figure 1).

The FLEX pump will be deployed at the intake structure, and two submersible pumps will be lifted by a crane attached to the pump skid to deploy the submersible pumps in the river. The FLEX pump discharge will be connected with flexible hoses to seismically qualified RHRSW piping (Division I for Unit 1 and Unit 2) at the intake structure.

2.4.5.5 Alternate Core Cooling Phase 2 Connection

A flanged connection point has been provided for connecting a hose to an existing reactor building penetration (X-161 for Unit 1, and to X-138 for Unit 2) which serves as an alternate connection for the FLEX pumps to the RHRSW system (Figure 2) (References 3.84 and 3.85). Stainless steel braided hoses also exist with Storz connections that can be routed through the penetrations on each unit (for hookup).

2.4.5.6 Intake Structure Connection

Installed connections provide a means of connecting the RHRSW system to the UHS via the FLEX pump following a BDBEE (References 3.84 and 3.85). To provide water to the RHRSW system, 5 branches containing safety-related manual valves are connected to the existing 18 in. RHRSW Division I piping in the intake structure (Figure 1). This connection piping is located inside the intake structure valve pit. These valves and the associated piping are protected by the existing valve pit missile shield grating. Following a BDBEE, hoses will be run from these connection points to the FLEX pump, which will be deployed at the intake structure near the UHS.

2.4.6 Key Reactor Parameters

The instruments monitoring the listed parameters in Table 1 for reactor core cooling and decay heat removal strategy remain available following specified load shed actions outlined in plant procedures. Analyses (References 3.30, 3.31, 3.32 and 3.33) indicate this strategy provides critical instrumentation relying on the Station Batteries until supplied by a 600V FLEX DG. Only a single channel of instrumentation is needed for FLEX strategy implementation.

In addition, local indications will remain available and the key reactor parameters can be determined from a local reading using standard instrumentation and control (I&C) instruments.

Table 1 - Essential Monitored Parameters and Associated Instrumentation
(Unit 1 shown, similar for Unit 2)

Parameter	Available Channel (Indication Location)	Power Source
Reactor Water Level	1C32-N004B	Div I 125 Vdc Station Batteries
Reactor Water Level	1C32-N004C	Div II 125 Vdc Station Batteries
Reactor Water Level	1B21-N091A	Div I 125 Vdc Station Batteries
Reactor Water Level	1B21-N091B	Div II 125 Vdc Station Batteries
Reactor Water Level	Ch1: 1B21-N091C	Div I 125 Vdc

Table 1 - Essential Monitored Parameters and Associated Instrumentation
(Unit 1 shown, similar for Unit 2)

Parameter	Available Channel (Indication Location)	Power Source
	Ch2: 1B21-N090A Ch3: 1B21-N085A	Station Batteries
Reactor Water Level	Ch1: 1B21-N091D Ch2: 1B21-N090D Ch3: 1B21-N085B	Div II 125 Vdc Station Batteries
Reactor Pressure	1C32-N005B	Div I 125 Vdc Station Batteries
Reactor Pressure	1C32-N005C	Div II 125 Vdc Station Batteries
Drywell & Suppression pool Pressure	X1: 1T48-PT-N023A X2: 1T48-PT-N008A	Div I 120 Vac Critical Instrument Bus 1A
Drywell & Suppression pool Pressure	X1: 1T48-PT-N023B X2: 1T48-PT-N008B	Div II 120 Vac Critical Instrument Bus 1B
Drywell & Suppression pool Temperature	1: 1T48-TE-N009A 2: 1T48-TE-N009C 3: 1E11-TE-N027A 4: 1T48-TE-N009E 5: 1T48-TE-N009G 7: 1T47-TE-N001J 8: 1T47-TE-N001K 9: 1T47-TE-N001L 10: 1T47-TE-N002 11: 1T47-TE-N004 12: 1T47-TE-N006 13: 1T47-TE-N008 14: 1T47-TE-N009	Div I 120 Vac Critical Instrument Bus 1A
Drywell & Suppression pool Temperature	1: 1T48-TE-N009B 2: 1T48-TE-N009D 3: 1E11-TE-N027B 4: 1T48-TE-N009F 5: 1T48-TE-N009H 7: 1T47-TE-N001A 8: 1T47-TE-N001B 9: 1T47-TE-N001M 10: 1T47-TE-N003 11: 1T47-TE-N005 12: 1T47-TE-N007 13: 1T47-TE-N010	Div II 120 Vac Critical Instrument Bus 1A
Suppression pool Water Level	X1: 1T48-LT-N021A X2: 1T48-PT-N020A	Div I 120 Vac Critical Instrument Bus 1A
Suppression pool Water Level	X1: 1T48-LT-N021B X2: 1T48-PT-N020B	Div II 120 Vac Critical Instrument Bus 1B
Condensate Storage Tank Level	1E51-LS-N060 1E51-LS-N061	Div I 125 Vdc Station Batteries
dc bus Voltage	1R42-R600/R603	Div. 1 and 2 125 Vdc Station Batteries
Spent Fuel Level	1G41-N104A	Unit 1 Div. I 600Vac

Table 1 - Essential Monitored Parameters and Associated Instrumentation
(Unit 1 shown, similar for Unit 2)

Parameter	Available Channel (Indication Location)	Power Source
		1R24-S011 with backup batteries
Spent Fuel Level	1G41-N104B	Unit 2 Div. II 600Vac 2R24-S012 with backup batteries
Spent Fuel Level	2G41-N104A	Unit 1 Div. I 600Vac 1R24-S011 with backup batteries
Spent Fuel Level	2G41-N104B	Unit 2 Div. II 600Vac 2R24-S012 with backup batteries

Contingencies for alternate instrumentation monitoring are provided to the MCR team following a BDBEE via procedural guidance for establishing alternate indications for essential instrumentation.

Portable FLEX equipment is supplied with the local instrumentation needed to operate the equipment. The use of these instruments is detailed in the operating procedures for each piece of FLEX equipment.

2.4.7 Thermal Hydraulic Analyses

The FLEX strategies used to implement the coping capabilities are discussed in detail in the following sections. The strategies are based on the results of a plant specific Modular Accident Analysis Program (MAAP4) analysis (Reference 3.24, Case 1) and the GEH analysis (Reference 3.25).

This analysis demonstrates that the strategies provide the ability of HNP to successfully cope from the baseline conditions of the ELAP concurrent with a LUHS resulting from a postulated BDBEE using diverse and redundant combinations of installed and portable equipment. The analysis also demonstrates that the overall coping capabilities provide sufficient margin during each of the coping durations described above so as to provide defense-in-depth against the many unknowns associated with BDBEEs. The coping strategy for each essential function is evaluated and described in detail in the following sections.

2.4.7.1 Secondary Analysis

Immediately following the ELAP event, reactor core cooling (decay heat removal) will be accomplished by flow from the RPV through the SRVs to the suppression pool. The RCS make-up is accomplished by operation of the RCIC pump supplying water to the RPV. Suction to the RCIC pump will be from the seismically qualified CST or suppresion pool, which is also protected from tornado missiles (Reference 3.16, Section 3.5). At approximately 4.5 hours operators manually depressurize the RPV to 150 psig by opening one SRV and maintain pressure between 150 – 300 psig by cycling one SRV. At around 5 hours, the wetwell vent is opened such that the suppression pool does not exceed 230°F. Each unit has one CST, each with a credited inventory equal to 100,000 gallons of water (Reference 3.16, Section 9.2.6.3). Based on the minimum volume of water available, the credited volume in the CST can support core cooling and heat removal requirements in MODES 1 through 4 for a minimum of 6.8 hours (Reference 3.24). When the RCIC pump suction is transferred from the CST to the suppression pool (and until the suction source is transferred back to the CST due to elevated suppression pool water temperatures) conservative net positive suction head required (NPSHR) of 11.8 ft. is below the net positive suction head available (NPSHA) (References 3.24, 3.37, 3.38 and 3.39) (HNP-1 NPSH requirements are bounding for HNP 2). Thus prior to the CST water being depleted, the suction of RCIC is swapped to the suppression pool. Then when the suppression pool reaches low level of 146 in., at approximately 19 hours, suction of RCIC is switched back to the replenished CST.

When adequate steam pressure is no longer available to drive the RCIC pump's turbine, the alternate coping strategy for reactor core cooling requires depressurization of the RPV and connecting the FLEX pump for injection of water into the RPV.

2.4.7.2 MAAP Analysis

MAAP4 code benchmarking for the program's use in support of post-Fukushima applications is discussed in detail in Section 5 of EPRI Report 3002001785 "Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications" (Reference 3.44), which includes MELCOR code result comparisons as well as direct result comparisons to actual plant pressure and temperature data from Fukushima Dai-ichi Units 1, 2, and 3. The EPRI report concludes that the MAAP4 code is acceptable for use in support of the industry response to Order EA-12-049.

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

Key modeling parameters cited in Tables 4-1 through 4-6 of the "MAAP4 Application Guidance, Desktop Reference for Using MAAP4 Software, Revision 2" (Electric Power Research Institute Report 1020236 – Reference 3.86) are specifically addressed in the MAAP4 Analysis (Reference 3.24). The MAAP4 code is readily capable of analyzing the two-phase flow conditions from the RPV, and validations were performed for the key parameters that are checked for these two-phase level and flow conditions. Modeling of heat transfer and losses from the RPV, decay heat, and the plant-specific inputs are also described and followed standard practices.

2.4.8 Recirculation Pump Seal Leakage

The MAAP4 Analysis (Reference 3.24) assumed an initial primary system leakage of 36 gpm at full reactor pressure based on 18 gpm per pump. The primary system leakage is assumed to start at time zero and vary with reactor pressure. The leakage is determined using an area in order to allow variations in the leakage value depending on primary side pressure conditions. The seal leakage that occurs during FLEX RCIC/HPCI system operation does not challenge the RPV makeup capabilities of these systems. It is included to account for potential steam leakage in the drywell and the resulting temperature effects.

2.4.9 Shutdown Activity Analysis

Not applicable to BWRs for FLEX since all rods are assumed inserted and the analysis does not predict re-criticality.

2.4.10 FLEX Pumps, FLEX Equipment and Water Supplies

2.4.10.1 FLEX Pump

Throughout Phase 2, either the RCIC pump with suction from the suppression pool or CST, or the FLEX pump, with suction from either the CST or the Altamaha River, will be in operation and aligned to discharge to the RPV (see Figure 1). The FLEX pump is deployed and ready for operation at approximately 10 hours into the event. The discharge of the FLEX pump will be directed to refill the CST via hose and adapters connected RHRSW connection points (see Sections 2.4.5.1 and 2.4.5.2). The FLEX pump is sized based on the decay heat removal requirements at one hour after reactor shutdown. This corresponds to a minimum flow rate of a 1,370 gpm (685 gpm to each unit) at 512 feet of discharge head which is sufficient to feed the RPV with a pressure inside the RPV of 70 psig (Reference 3.45, Design Input 4.1). Performance data (Reference 3.87, page 39 of 705) for the FLEX pump demonstrates it is capable of providing 1,500 gpm at over 575 feet of discharge head.

The bounding case evaluated in Reference 3.45 to size the FLEX pump is that in which the FLEX pump takes suction from the Altamaha River and discharges through the RHRSW permanent piping from the intake to the reactor building. This bounding case for the FLEX pump supplies both Unit 1 and Unit 2 simultaneously to provide: CST makeup to RPV via RCIC, SFP portable spray monitors, MCR cooling, and RCIC room cooling.

Prior to depletion, makeup to the CST will be provided from the RHRSW by the FLEX pump. The FLEX pump suction will be aligned to the RHRSW via a FLEX connection point (see Section 2.4.5.4). The FLEX pump discharges to the CST via a FLEX fill connection point. Hoses will be used for the supply connection (See Figure 1).

The pump package (Reference 3.87) includes one centrifugal diesel-driven FLEX pump (600 hp). The main pump has four suction hose connections and four discharge hose connections. This package also includes:

- Two submersible pumps, hydraulically-driven, with floatation devices and suction screens,
- A control panel for the main pump and the submersible pumps and

- A 2.5 ton crane with a 15 ft. extendable boom for deployment of the submersible pumps mounted on the FLEX pump package trailer.

2.4.10.2 Filtration of River Water

Evaluation by GE Hitachi concluded that there would not be a serious threat to the fuel from use of river water but some level of filtration was recommended to minimize potential clogging of the fuel bundles. It was further recommended that river water from the FLEX pump be directed through strainers that perform similarly to the RHRSW system strainers (Reference 3.29).

The two hydraulic submersible pumps are fitted with 3/16 in. mesh screens to filter out debris in the river. Suction to the pump is also fitted with a deflector plate to deflect any small debris that goes through the mesh screen from going directly to the pump.

These submersible pumps are individually controlled via the control panel on the trailer. Pump flow can be adjusted to take one pump out of service for cleaning and not affect the operation of the pump in-service. During the time a submersible pump is out of service, Operations can prioritize which flow paths must be continuously supplied and which ones could be scaled back.

A portable 1/16 in. mesh strainer is provided in the PSW system at the RHRSW-PSW cross-tie piping to further reduce the debris size going to the MCR ventilation coolers. This strainer has the same level of straining as the existing PSW strainers.

2.4.10.3 FLEX Air Compressor

A portable FLEX air compressor is available to supply 185 cubic feet per minute (CFM) of compressed air at 100 psig during the event. This diesel-driven air compressor can adequately supply the required compressed air requirements to operate a pneumatic wrench for RHR valve manipulation and to maintain the SFP transfer canal gap seals inflated.

2.4.10.4 Water Supplies

Condensate Storage Tanks

The lower portion of the seismically qualified CST is protected from tornado missiles. Each unit has one CST, each with a credited inventory equal to 100,000 gallons of water (Reference 3.16). Based on the minimum volume of water available, the credited volume in the CSTs can support core cooling and heat removal requirements in Modes 1-3 for approximately 6.8 hours (Reference 3.24). At this time the RCIC suction is swapped to the suppression pool until approximately 19 hours which is greater than the time required to have the portable FLEX operational.

Suppression Pool (Torus)

The suppression pool is safety-related seismically qualified steel torus shaped pressure vessel located below and encircling the drywell, with a major diameter of 107 ft. 1 in. and a cross-sectional inside diameter of 28 ft. 1 in. The suppression pool is protected from all applicable events. The suppression pool contains a maximum of 90,550 ft^3 of water and has a minimum net airspace above the pool of ~ 109,712 ft^3 (Reference 3.16, Section 6.2.1.2.1.2). The normal suppression pool water level is maintained between ≥ 146 in. and ≤ 150 in. per LCO 3.6.2.2 of the Technical Specifications (Reference 3.19). The initial volume of water in the suppression pool can provide approximately 12 additional hours of makeup after depletion of the initial inventory of the CST.

Altamaha River

The ultimate source of water for HNP is the Altamaha River, which is located approximately 850 ft from the Unit 1 reactor building (Reference 3.16, Section 2.1.1.3).

2.4.10.5 Borated Water Supplies

Not applicable to BWRs for FLEX.

2.5 Spent Fuel Pool Cooling/Inventory

In an ELAP event, the SFPs will initially heat up due to the unavailability of the normal cooling system. The structures, systems and components (SSCs) of Units 1 and 2 associated with spent fuel pool cooling following an ELAP event are essentially identical and, therefore, the three phase strategy developed is the same for both units. The basic FLEX strategy for maintaining SFP cooling is to monitor SFP level utilizing the SFP level instrumentation and initiating SFP makeup as soon as resources are available; however makeup will be initiated prior to the SFP level reaching 15 feet above the spent fuel racks. No Phase 1 actions are required for SFP cooling/inventory other than opening the roof vents.

For Phase 2, the FLEX pump drawing water from the Altamaha River will be aligned to the PSW via the RHRSW to add water to the SFPs of both units to maintain level. Three paths will be available for SFP makeup: via hoses directly discharging into the pools; via connections to the existing SFP makeup lines; or via hoses directed to portable spray monitors positioned around the SFPs (see Figure 1). Deployment of hoses will begin prior to the time to boil to maintain a sufficient amount of water above the top of the fuel assemblies for cooling and shielding purposes. The time to boil is maintained in the MCR on a daily basis so the time for deployment of the hoses to the SFP area is consistently known by the MCR staff. The long term strategy for SFP cooling is to continue the strategies described above and can be supplemented by portable equipment delivered from off-site (NSRC).

2.5.1 Phase 1 Strategy

The only Phase 1 action is to open the SFP tornado vents and door. (Section 2.5.4.3).

Requirements for SFP makeup are based on the design basis heat loads. The normal SFP water level at the event initiation is 21 ft. (Reference 3.19, Specification 3.7.8) over the top of the stored spent fuel. Using the design basis maximum heat load, the SFP water inventory will heat up from 110°F to 212°F during the first 12 hours for Unit 1 and Unit 2 (Reference 3.49). SFP level monitoring is accomplished using the coping strategy described below for instrumentation and controls.

2.5.2 Phase 2 Strategy

The spray capability flow rate is bounding for all SFP cooling baseline capabilities (i.e., the three methods described below). Based on needs identified for Phase 2, makeup or spray may be chosen by alignment of the appropriate hose to the discharge of a pump capable of providing the minimum flow rate with enough discharge pressure to provide the appropriate spray pressure from the monitor nozzles and to overcome head losses associated with discharge hoses and any other discharge connections. Since the SFP is designed so that it does not require borated water to maintain subcritical conditions, the Altamaha River is the credited source of makeup in this scenario. The FLEX pump is capable of providing spray for both SFPs (500 gpm total flow) for an indefinite period (Reference 3.102). The FLEX pump provides flow to the RHRSW piping of the reactor building, as described in Section 2.4.5.2, to supply water to the FLEX piping in the reactor building for Method 1 and 3 and directly to the fuel pool cooling piping for Method 2. Separate sets of hoses and the necessary makeup equipment (tools, spray monitor nozzles, wyes, etc.) for hose spray and makeup will be stored on the 203'elevation, one floor below the SFP area. Figures 6 and 7 provide a sketch for the arrangement of hoses and piping.

Prior to the spent fuel pool reaching 200°F, staging hoses for makeup inside the refueling floor will be accomplished. Hoses on the 203' elevation, below the refueling floor will be staged prior to makeup being required. This strategy consists of routing hoses from the manifold on the ground elevation (3-way valve placed on the FLEX piping) up a stairwell to the 228' elevation. The hoses are long enough to reach the SFP for makeup and spray on each unit. A transition piece on the refueling floor is provided to connect two hoses: one that discharges directly into the SFP (Method 1) and one that can supply the monitor spray nozzles (Method 3).

Makeup Strategy Method 1 – SFP makeup via hoses directly into the SFP

Direct makeup to the SFP will be accomplished by hoses staged on the 203' elevation, one floor below the refuel floor. This makeup strategy employs hoses for each SFP. Since the SFP area may become inaccessible as Phase 2 progresses, hoses inside the refueling floor will be deployed prior to the SFP reaching 200°F to minimize the need for personnel access to the SFP area following degraded environmental conditions in the SFP area following the ELAP event (Figure 6).

Makeup Strategy Method 2 – SFP makeup via a connection to SFP cooling piping

The FLEX pump via the RHRSW to the PSW system crosstie, as described in Section 2.4.5.2, provides SFP make-up via connection to the seismically qualified PSW emergency fill connection to the seismically qualified fuel pool cooling makeup piping and the SFP makeup diffuser. This injection source requires operator action to isolate other valves (all accessible without having to access the refuel floor area) in interfacing systems. This method of makeup will supply 75 gpm, per pool (Figure 7).

Makeup Strategy Method 3 - Spray capability via portable monitor nozzles

To assure spent fuel cooling in the event that methods described above prove insufficient, spray capability with portable monitor nozzles from the refueling floor will be provided. The monitor nozzles are deployed prior to the SFP reaching 200°F to minimize the need for personnel access to the SFP area following degraded environmental conditions in the SFP area following the ELAP event. The spray strategy consists of deploying a hose to a pre-determined location in the SFP area, splitting flow into two separate hoses for each SFP which connect to spray monitors located in the two most accessible corners of each SFP (see Figure 6).

2.5.3 Phase 3 Strategy

The long term strategy for SFP cooling is to continue the Phase 2 strategy supplemented by portable equipment delivered from off-site. See Table 2 for a list of equipment that will be delivered to the site by the NSRC after notification by the plant; refer to Section 2.11 for a discussion on NSRC supplied equipment.

As resources become available, actions can be taken to transition away from extended Phase 2 coping strategies. Since no time sensitive Phase 3 actions have been identified, instructions for connection and utilization of NSRC equipment for long term coping or recovery will be provided by TSC personnel who will have assessed the condition of the plant and infrastructure, plant accessibility, and additional available off-site resources (both equipment and personnel) following the BDBEE.

2.5.4 Structures, Systems, and Components

2.5.4.1 Primary Connection

Makeup Strategy Method 1 (Hoses)

Makeup from the FLEX pump connected to the RHRSW at the intake structure to supply water to the FLEX piping in the reactor building (see Section 2.4.5.2). Hoses will be run from the 130' elevation to the refueling floor. A hose long enough to reach the SFP is permanently stored and available on elevation 203' for filling the SFP or to allow connecting to the monitor spray nozzles.

Makeup Strategy Method 2 (SFP Cooling Piping)

Makeup is provided with the FLEX pump connected and providing flow to the RHRSW system piping at the intake structure and cross-connecting the RHRSW system to the seismically qualified PSW system piping in the reactor building (see Section 2.4.5.5). The PSW piping provides an emergency fill connection to the SFP makeup cooling piping.

Makeup Strategy Method 3 (Spray Nozzles)

Makeup from the FLEX pump connected to the RHRSW at the intake structure to supply water to the FLEX piping in the reactor building (see Section 2.4.5.2). Hoses will be run from the 130' elevation to the refueling floor. A hose long enough to reach the SFP is permanently stored and available on elevation 203' to allow connecting to monitor spray nozzles.

2.5.4.2 Alternate Connection

Alternate connection for the three methods described above is through the reactor building penetration X-161 (Unit 1) and X-138 (Unit 2). Hoses will be connected to the penetrations via storz adaptors, or stainless steel braided hoses placed through the penetrations to facilitate connections to FLEX header on elevation 130' in the reactor building.

2.5.4.3 Ventilation

SFP bulk boiling will create adverse temperature, humidity, and condensation conditions in the SFP area which requires a ventilation vent pathway to exhaust the humid atmosphere from SFP area. The primary pathway will be established by manually opening the reactor refueling roof vents. An alternate ventilation path can be established by opening doors that allow steam to escape through the air lock doors. In order to establish flow of air through the SFP area it is necessary to open stairwell doors at the refuel floor elevation and the 130' elevation. Both of these strategies are provided in the technical support guidelines (TSG) (Reference 3.53, Attachment 20.). Establishing the vent path will occur prior to the time that the SFP commences boiling, no sooner than 12 hours into the event when in Modes 1-4, and 4.2 hours when in Mode 5.

2.5.4.4 Transfer Canal Seismic Gap Seals

The transition piece which connects the transfer canal between Unit 1 and Unit 2 is provided with pneumatic seals to prevent leakage of water from the transfer canal. The seals are supplied by the service air system with a backup supply from an accumulator that provides sufficient air to keep the seismic gap seals pressurized for 24 hours as noted in HNP-1 FSAR Section 10.11.3 (Reference 3.15). During Phase 2 the transition assembly seals are pressurized as necessary by valving in backup air from the FLEX air compressor staged on the east side of the reactor building. The air compressor will be connected at the reactor building penetration and supplies the transition assembly seals via hose run from the 130' elevation to the service air system that supplies the seals.

2.5.5 Key Spent Fuel Pool Parameters

The key parameter for the SFP makeup strategy is the SFP water level. The SFP water level is monitored by the instrumentation (1/2G41-N104A/B) that was installed in response to Order EA-12-051, Reliable Spent Fuel Pool Instrumentation (Reference 3.5).

2.5.6 Thermal-Hydraulic Analyses

An analysis was performed (Reference 3.49) that determined with the maximum expected SFP heat load immediately following a full-core offload, the SFP will reach a bulk boiling temperature of 212°F in approximately 4.2 hours and boil off to a level 15 ft above the top of fuel in approximately 18 hours unless additional water is supplied to the SFP. Total required flow for the most limiting case (full-core offload with full SFP) to make up for boil off is approximately 72 gpm per pool.

The time to reach 200°F is conservative in regard to the time to reach 212°F. Since verification of the time to reach 200°F in the SFP is performed daily and reported on the morning report, the time to reach 200°F will be utilized to guide task performance in the SFP area. Additional conservatism has been included in the implementing procedures (FSGs) to begin these activities at approximately the 8 hour time frame.

Based upon results summarized in SNC Nuclear Fuels letter CAH-11-019, *Plant Hatch INPO IER 11-2 Spent Fuel Pool Time-to-200 °F Graphs* Case 6 (Reference 3.110) 30 day, post refueling time to reach 200°F is approximately 42 hours.

2.5.7 FLEX Pump and Water Supplies

2.5.7.1 FLEX Pump

One large FLEX pump was determined to be acceptable to provide all cooling water needs for both units. See Section 2.4.10.1.

2.5.7.2 Ultimate Heat Sink

Altamaha River is the ultimate heat sink and it is the primary source of water to provide makeup to the SFP.

2.5.8 Electrical Analysis

The SFP will be monitored by instrumentation (1/2G41-N104A/B) installed in response to Order EA-12-051. This equipment has a backup battery; with a minimum battery life of 24 hours to allow for power restoration from 600V FLEX DG (Reference 3.52).

2.6 Containment Integrity Modes 1-3 and Mode 4 with RPV Intact

Plant Hatch has a GE BWR Mark I style containment with an upper dry portion (drywell) connected to a wet annular suppression pool (wetwell). An indefinite coping strategy has been developed to maintain containment integrity at HNP Units 1 and 2 following an ELAP with LUHS event. The SSCs of Units 1 and 2 associated with containment integrity following an ELAP event are essentially identical and, therefore, the three phase strategy developed is the same for both units

In accordance with NEI 12-06 (Reference 3.3), the containment is assumed to be isolated following the event. As the suppression pool (or torus) heats up and begins to boil, the containment will begin to heat up and pressurize. Additionally, because it is necessary to ensure the capability of SRVs to perform the pressure relief function, and it is necessary to maintain containment integrity, the containment will be vented to reduce suppression pool inventory and containment pressure. The HCVS has been enhanced to ensure required vent operations (References 3.54 and 3.55). HCVS will be operated with control from the MCR.

The suppression pool temperature is also a limiting factor for implementation of the ELAP strategy. It is controlled by venting and does not exceed 230°F (Reference 3.24).

At approximately hour five, the use of the HCVS is initiated to provide long term core cooling capability thru RCIC and maintain containment parameters within limits. The containment design pressure is 56 psig. Containment pressure limits are not reached during the event (Reference 3.24) because the HCVS is opened prior to exceeding any containment pressure limits.

Thus, containment integrity is not challenged and remains functional throughout the event. Monitoring of containment (drywell) pressure and temperature is available via permanently installed plant instrumentation using the coping strategy described below for instrumentation and controls.

2.6.1 Phase 1

The suppression pool level rises due to the transfer of inventory from the CST to the suppression pool via RCIC, and from the reactor vessel to the suppression pool via the SRVs. According to the MAAP analysis (Reference 3.24) the drywell and the suppression pool pressures are controlled by opening the wetwell vent (at approximately 5 hours) to prevent initially entering the unsafe regions of the HCTL or SRV tail pipe limit. During the initial coping period, installed plant equipment is used to maintain the essential function of containment integrity.

2.6.2 Phase 2

Use of the HCVS is continued throughout the event with the FLEX generator providing power to the valves and other components of the HCVS.

2.6.3 Phase 3

As resources become available, actions can be taken to transition away from extended Phase 2 coping strategies. Since no time sensitive Phase 3 actions have been identified, instructions for connection and utilization of NSRC equipment for long term coping or recovery will be provided by TSC personnel, who will have assessed the condition of the plant and infrastructure, plant accessibility, and additional available off-site resources (both equipment and personnel) following the BDBEE.

2.6.4 Structures, Systems, Components

2.6.4.1 Containment

During the BDBEE which results in an ELAP concurrent with LUHS, containment integrity is maintained by normal design features of the containment. The containment design pressure is 56 psig and the containment design temperature is 281°F for Unit 1 and 340°F for Unit 2 (Reference 3.16, Section 6.2.3.1.1). Refer to HNP FSAR (Reference 3.16) Section 6.2.1 for a description and discussion of design capabilities of the containment.

2.6.4.2 Containment Coolers

No time sensitive actions have been identified for maintaining containment integrity; however, containment coolers, when supplemented by portable equipment (i.e., pumps for cooling water and DG for powering the fans) delivered from off-site (NSRC), can be aligned to support maintaining containment integrity long term. Refer to HNP FSAR (Reference 3.16) Section 9.4.6 for a description and discussion of design capabilities of the containment coolers.

The containment coolers are seismically qualified components which are also protected from the effects due to the design basis tornado and BDBEE hazards (Reference 3.16 Section 3.5).

2.6.4.3 Hardened Containment Vent System (HCVS)

During a BDBEE which results in an ELAP concurrent with LUHS, the HCVS provides a means of relieving excessive containment pressure directly to the main stack. Key valves within the HCVS system are provided with uninterruptible power and uninterruptible/backup air supply. Alternate pneumatics are provided by:

- seismic II/I bottle rack containing three nitrogen bottles installed on the 158' elevation of the reactor building to provide a backup motive force to HCVS air operated valves (AOVs) to facilitate RCIC operation and maintain containment parameters.
- two 400 gallon installed air accumulator tanks on the 185' elevation in the reactor building are connected into the air lines to the actuators of the key HCVS valves.

The power source for the HCVS valves is provided by two critical instrument cabinets fed from inverters which are powered from 250 VDC switchgears A and B, which in turn are connected to station service batteries A and B. The station service batteries are recharged by the 600V FLEX DG.

2.6.5 Key Containment Parameters

The instruments monitoring containment (drywell and suppression pool) pressure and temperature and suppression pool level remain available following specified load shed actions outlined in plant procedures. Analyses (References 3.30, 3.31, 3.32 and 3.33) indicate this strategy provides critical instrumentation relying on the station batteries until supplied by a 600V FLEX DG.

The containment pressure and temperature and suppression pool level instrumentation credited in the strategy are listed in Table 1 in Section 2.4.6.

Contingencies for alternate instrumentation monitoring are provided to the control room team following a BDBEE. Procedural guidance is provided for establishing alternate indications for essential instrumentation.

2.6.6 Thermal-Hydraulic Analyses

Analysis (Reference 3.24) demonstrates that containment response following a postulated ELAP event does not challenge containment design limits until after availability of off-site equipment and implementation of strategies to control pressure and temperature.

MAAP BWR Version 4.0.5 analysis software was utilized for the containment analysis (Reference 3.24). The MAAP BWR Version 4.0.5 analysis software was employed to analyze the specified FLEX scenarios during an ELAP concurrent with LUHS. MAAP4 is an EPRI sponsored computer code that simulates the response of light water nuclear power plants during severe accident sequences, including actions taken as part of the severe accidents. MAAP4 can predict the progression of hypothetical accident sequences from a set of initiating events to either a safe, stable, coolable state or to an impaired containment and depressurization. The guidance provided in the position paper entitled "Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications" (Reference 3.44) as endorsed by the NRC (Reference 3.103) was used to support the performance of ELAP containment analyses

2.6.7 FLEX Pump and Water Supplies

FLEX Pump will provide make-up water to maintain the containment below design limits by cooling the RPV through providing either make-up water for RCIC or via direct injection into the RPV.

2.6.8 Electrical Analysis

Power requirements for the HCVS and containment critical instrumentation is provided by the station batteries. The 600V FLEX DGs are used to repower station battery chargers and to repower ac-powered instrumentation. See additional discussion in Section 2.3.2.

2.7 Characterization of External Hazards

In accordance with NEI 12-06 Sections 4 through 9, the applicable extreme external hazards at HNP Unit 1 and 2 are seismic, high wind, extreme cold with ice, and high temperature (Reference 3.3). These hazards are bounded by the current design basis hazards as described in the FSAR (Reference 3.15 and 3.16) unless otherwise stated.

2.7.1 Seismic

Per the HNP Unit 1 and 2 FSAR (References 3.15 and 3.16), the seismic criteria for HNP include two design basis earthquake spectra: Operating Basis Earthquake (OBE) and the Design Basis Earthquake (DBE). The OBE and the DBE are 0.08g and 0.15g, respectively; these values constitute the design basis of HNP.

For FLEX strategies, the earthquake is assumed to occur without warning and result in damage to non-seismically designed structures and equipment. A debris assessment for the site was performed, including debris generated by seismic events, to determine debris removal tool requirements; see Section 2.9.1 for a discussion of debris removal capability.

2.7.2 External Flooding

HNP is built above the design basis flood level. Per FSAR Chapter 2 the probable maximum flood (PMF) elevation is 105 ft mean sea level (MSL) without wave runup. With wave runup, the water may reach as high as 108.3 ft MSL (Reference 3.16, Section 3.4). Grade elevation of the HNP control buildings, reactor buildings, diesel generator buildings and all safety-related structures is approximately 129 ft MSL, and the grade in the intake structure is 110 ft MSL (Reference 3.16, Section 2.4 and 3.4). The site is not adjacent to a large, encolosed, or partially enclosed body of water (Reference 3.16 Section 2.4).Therefore, in accordance with NEI guidance (Reference 3.3, Section 6.2.1), HNP is considered a "dry" site.

The UHS (Altamaha River) remains accessible for deployment of FLEX pump for all design basis river levels. Measures, such as sandbagging, will be performed in certain key areas in accordance with existing AOP procedural guidance.

2.7.3 Severe Storms with High Wind

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

HNP is located at 31°56'2" N latitude and 82°20'39" W longitude (Reference 3.16, Section 2.1.1.1). The location of HNP is situated between the 160 mph and 170 mph contours shown in Figure 7-1 of NEI 12-06 (Reference); therefore, hurricanes are applicable to HNP. Per Figure 7-2 of NEI 12-06, the recommended tornado design wind speed for the 10^{-6}/yr probability level for the 2 latitude/longitude block where HNP is located is 177 mph. Therefore, tornado hazards are applicable to HNP.

For hurricanes, the HNP FSAR (Reference 3.16, Section 2.3.1.2) indicates that the site is located approximately 80 miles inland from the coast; so the effects from hurricanes or tropical depressions are reduced.

For strong winds, the HNP FSAR (Reference 3.16, Section 2.3.1.3) indicates the frequency of strong winds, 50 knots or greater, has been analyzed for 2° and 1° squares for a 13-year period, 1955 to 1967. For this area, the frequency is 40 per 2° square and 11 for the 1° square over the 13 year period.

Protection of FLEX equipment is guaranteed by ensuring that the characteristics of the storage locations meet the requirements in NEI 12-06. At HNP the storage location is inside the vehicle barrier system (VBS) and in the owner controlled area (OCA). By providing a storage building designed to withstand hurricane and tornado high wind hazards, sufficient FLEX equipment to supply both units is protected from BDBEEs from all high wind hazards including high wind missiles.

Potentially downed trees and flooded roads will have an impact on the deployment time of FLEX equipment. Debris removal capabilities are provided by on-site FLEX equipment (*e.g.*, wheeled loader). The tow vehicles for the FLEX equipment are also stored in the FLEX storage building; see Section 2.9.1 for additional discussion of debris removal capability.

2.7.4 Ice, Snow and Extreme Cold

Per NEI 12-06 Section 8.2.1 guidance, extreme snowfall is not a concern for HNP which is located in the southeastern U.S, below the 35th parallel. Snow is infrequent in the site region and heavy snow is very rare. Based on historical records, the average snowfall is less than 1/2 inch. The maximum snowfall in a 30 year period of record was 4 inches in 1973 (Reference 3.16, Section 2.3.1.2). Thus, even in the unlikely scenario of an ELAP coincident with a maximum probable snowfall, snow removal could be easily accomplished with the normal debris removal equipment (*e.g.*, wheeled loader).

The HNP site is located within the region characterized by EPRI as ice severity level 5 (NEI 12-06, Figure 8-2, Reference 3.3). As such, the HNP site is subject to severe icing conditions that could also cause catastrophic destruction to electrical transmission lines. While freezing rain resulting in heavy ice loading in the HNP site region is considered rare (Reference 3.16, Section 2.3.1.3), NEI guidelines still dictate that the storage and deployment of HNP FLEX equipment must consider the impact of severe icing due to the EPRI study. Thus, the storage of FLEX equipment, including transport equipment, has been designed to protect it from extreme weather. The design criteria for the storage buildings meet the site design basis weather effects in accordance with the requirements of ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures* (Reference 3.104). Debris removal equipment is stored in the FLEX storage building; see Section 2.9.1 for additional discussion of debris removal capability. Because advance warning of freezing weather would be available, actions will be taken per procedural guidance in advance to prepare for adverse conditions (including personnel actions).

The normal daily minimum temperature ranges from 37°F at Macon in January to 71°F in July (Reference 3.16, Section 2.3.2.2). An extreme minimum temperature of 3°F was recorded at Macon in January 1966.

There is no record of the Altamaha River freezing over in the vicinity of HMP (Reference 3.16 Section 2.4.7). Per Reference 3.16, Section 2.4.7, temperature records indicate that icing of ponds and rivers is not a factor to be considered. Therefore, there is no risk of ice blockage, frazil ice, or freezing of the of the Altamaha River (UHS water source).

The storage of FLEX equipment considers the minimum temperature specified by the manufacturers.

The FLEX pump and FLEX generators have special operating requirements when temperatures fall below 32°F (References 3.87 and 3.89). Procedures have been developed and/or changed to ensure that FLEX pumps are freeze protected when not in use to prevent ice buildup when the temperature drops below 32°F. Freeze protection of idle but primed portable pumps and hoses considers the possibility of freezing when conditions warrant action. It should not be necessary to thaw the relatively short connections at the outdoor water tanks due to the large thermal mass of water in the tank.

2.7.5 High Temperatures

The HNP site's normal daily maximum temperature ranges from 59°F in Macon in January to 92°F in July. An extreme maximum of 106°F in Macon was recorded in June 1954. Based on a 9-year period of record, the average number of days in a year on which temperatures of 90°F and above occur is 80 for Macon. Most of these days occur during the summer months (Reference 3.16, Section 2.3.2.2).

The FLEX pumps can operate in hot weather, including the 106°F extreme as documented in the vendor manuals (References 3.87, 3.88

and 3.89). Similarly, the FLEX portable DGs can operate in ambient air up to 113°F based on information from the equipment vendor.

Extreme high temperatures are not expected to impact the ability of personnel to implement the required FLEX strategies. Site industrial safety procedures currently address activities with a potential for heat stress to prevent adverse impacts on personnel (see Section 2.13).

2.8 Protection of FLEX Equipment

FLEX equipment is stored in a single 12,000 ft^2 concrete, tornado-missile protected structure that meets the plant's Design Basis Earthquake (DBE) (Reference 3.59). Additionally, it has a 5,200 ft^2 mezzanine. The HNP FLEX storage building is located outside of the Protected Area but within the Owner Controlled Area (see Figure 4). This location is significantly above the upper-bound flood stage elevation. The FLEX storage building was designed and constructed to prevent water intrusion and built to protect the equipment from the BDBEE hazards identified in Section 2.7.

Large portable FLEX equipment such as pumps and power supplies are secured, as required, inside the FLEX storage building to protect them during a seismic event. The FLEX storage building has tie downs integrated into the floor slab for this purpose. These tie downs are used to secure any equipment that is not considered stable to ensure the stored FLEX equipment remains protected from damage during a seismic event. Additionally, fire piping and ventilation were designed and installed to meet the FLEX storage building specifications (seismic, wind, etc.). The lighting, conduits, electrical, and fire detection components were not seismically installed because they are considered insignificant and not able to damage FLEX equipment and only required functional before the event.

Debris removal equipment is also stored inside the FLEX storage building in order to reasonably protect it from the applicable external events such that the equipment remains functional and deployable to clear obstructions from the pathway between the FLEX equipment's storage location and its deployment location(s). See Section 2.9.1 for additional discussion of debris removal capability.

Deployments of the FLEX and debris removal equipment from the FLEX storage building are not dependent on off-site power.

The logistics of equipment removal after a BDBEE was considered in the design of the building. Two equipment doors are provided and located 180°

around the perimeter of the building from each other. The door opening size provides a minimum clearance for equipment of 14 ft in height and 16 ft in width. The design also includes two personnel entry/exit doors. The doors are designed to design basis tornado and wind loading and be operational after tornado wind pressure loads and tornado-missile loads. Equipment access and personnel access doors have the ability to be operated manually in the case of a loss of power. The ventilation systems are designed to maintain the following indoor conditions: Heating: minimum indoor temperature of 50°F; cooling: maximum indoor temperature of 100°F.

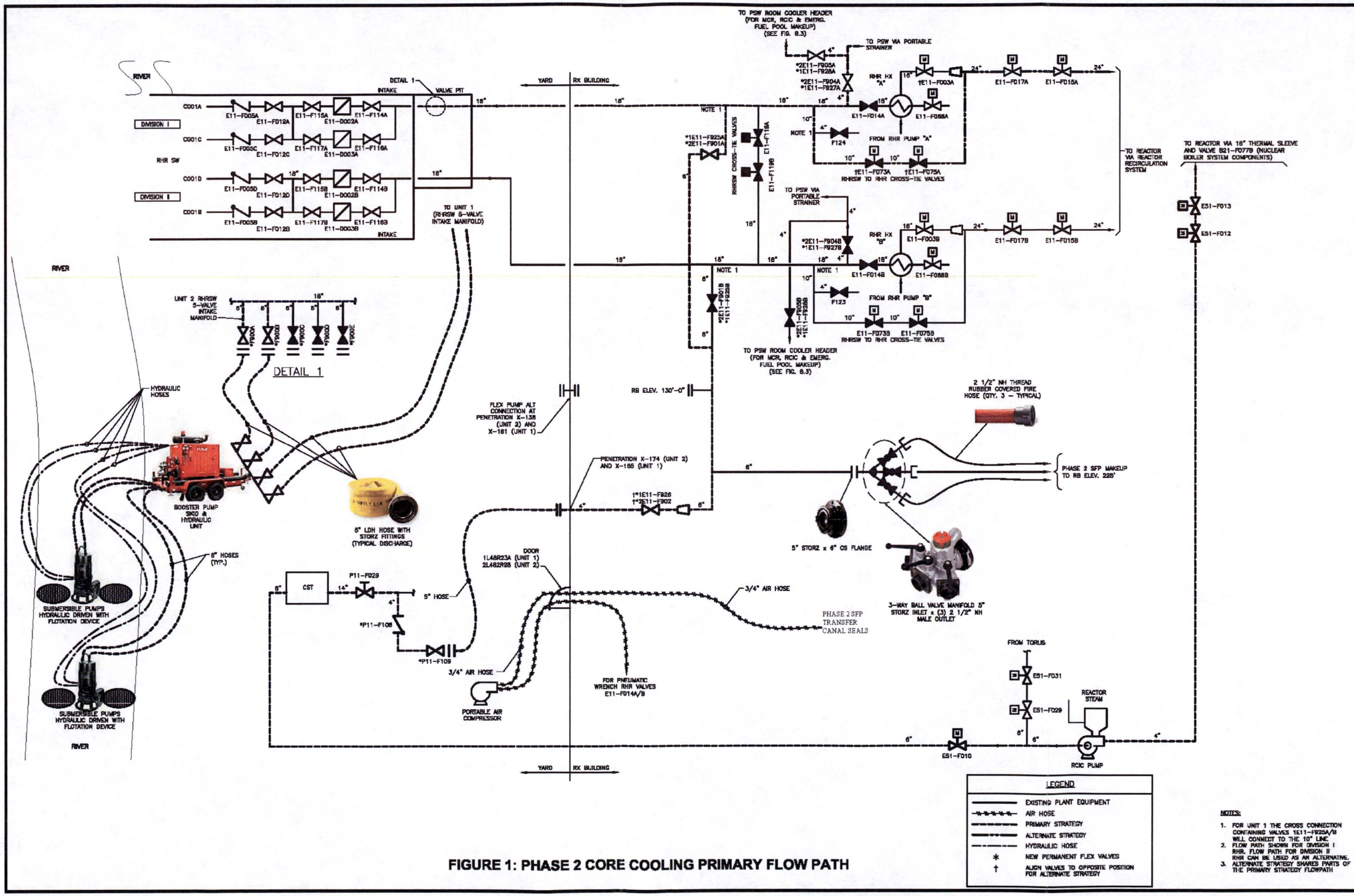


FIGURE 1: PHASE 2 CORE COOLING PRIMARY FLOW PATH

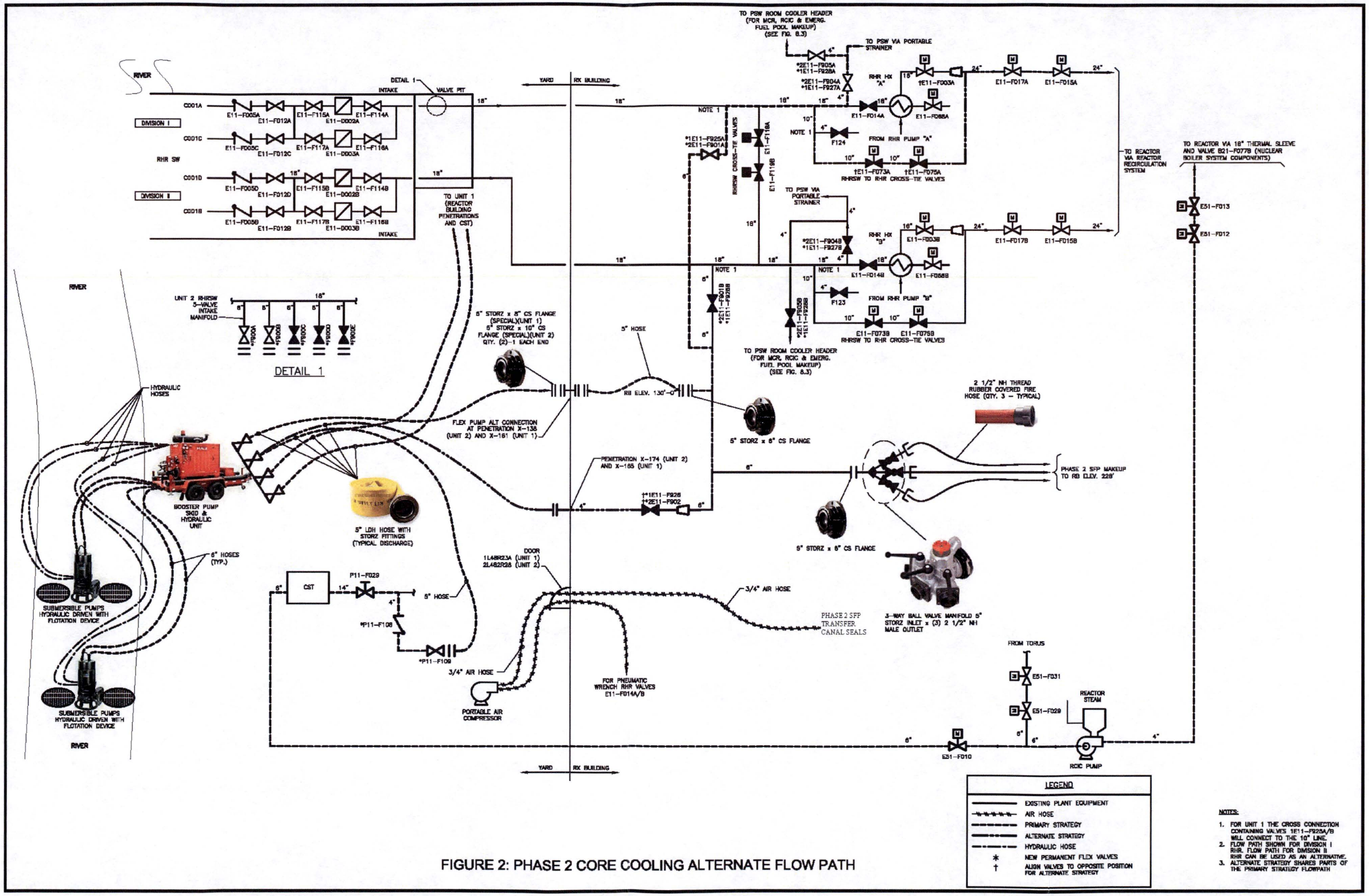
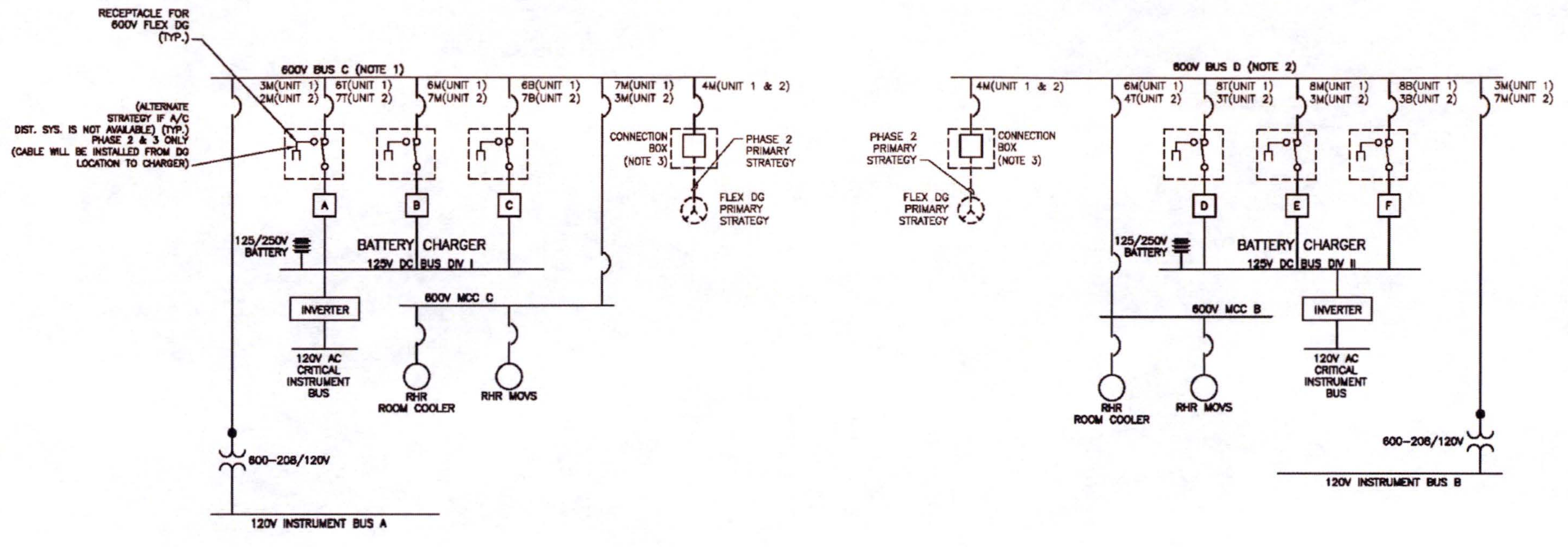


FIGURE 2: PHASE 2 CORE COOLING ALTERNATE FLOW PATH



NOTES:

1. CONFIGURATION TYPICAL FOR CONNECTIONS TO UNIT 1 DIVISION I (TO POWER 600V BUS 1C) AND UNIT 2 DIVISION I (TO POWER 600V BUS 2C). ONE DIESEL GENERATOR WILL BE USED TO POWER BOTH 600V BUS 1C AND 2C.
2. CONFIGURATION TYPICAL FOR CONNECTIONS TO UNIT 1 DIVISION II (TO POWER 600V BUS 1D) AND UNIT 2 DIVISION II (TO POWER 600V BUS 2D). ONE DIESEL GENERATOR WILL BE USED TO POWER BOTH 600V BUS 1D AND 2D.
3. ONE CONNECTION BOX WILL BE AVAILABLE FOR EACH DIVISION IN EACH UNIT TO POWER EACH OF THE FOUR EMERGENCY BUSES (600V BUS 1C, 600V 1D, 600V 2C, AND 600V 2D).
4. EQUIPMENT INSIDE DASHED LINES TO BE INSTALLED PER DCP'S SNC476661 (FOR UNIT 1) AND SNC467474 (FOR UNIT 2).
5. REFER TO DCP'S SNC476661 (FOR UNIT 1) AND SNC467474 (FOR UNIT 2) FOR EQUIPMENT SIZING AND INSTALLATION OF PERMANENT FIELD EQUIPMENT.
6. REFER TO H-13361 FOR A SINGLE LINE OF PERMANENTLY INSTALLED FLEX EQUIPMENT TO SUPPORT UNIT 1 STRATEGIES.
7. REFER TO H-23362 FOR A SINGLE LINE OF PERMANENTLY INSTALLED FLEX EQUIPMENT TO SUPPORT UNIT 2 STRATEGIES.

	125V DC		120V AC BUS		600V AC BUS		4160V AC BUS	
	STRATEGY	METHOD	STRATEGY	METHOD	STRATEGY	METHOD	STRATEGY	METHOD
PHASE I	PROVIDE CRITICAL INSTRUMENTATION RCIC CR LIGHTING	125V DC BUSES SUPPLIED BY STATION BATTERIES DIV I & II	120V AC POWER NOT AVAILABLE	N/A	600V AC POWER NOT AVAILABLE	N/A	4160V AC POWER NOT AVAILABLE	N/A
PHASE II	CHARGE 125V DC BATTERIES CRITICAL INSTRUMENTS RCIC CR EMERGENCY LIGHTING	POWER 600V BUS C & D FROM FLEX DG TO SUPPLY BATTERIES DG TO POWER BOTH DIV BUSES	POWER 120V AC INSTRUMENT POWER BUS POWER PLANT PA	POWER 120V AC INSTRUMENT BUS VIA 600V BUS	POWER 600V BUS C & D POWER BATTERY CHARGERS POWER 600V MCC	POWER 600V BUS C & D VIA FLEX DG	4160V AC POWER NOT AVAILABLE	N/A
PHASE III	CHARGE 125V DC BATTERIES POWER CRITICAL INSTRUMENTS POWER RCIC CR EMERGENCY LIGHTING MISCELLANEOUS LOADS	POWER 600V BUS C & D VIA 4160V BUS	POWER 120V AC INSTRUMENT BUS POWER PLANT PA	POWER 120V AC INSTRUMENT BUS VIA 600V BUS	POWER 600V BUS C & D POWER BATTERY CHARGERS POWER 600V MCC	POWER 600V BUS C & D VIA 4160V BUS	POWER 4160V AC BUS	POWER 4160V AC BUS VIA 4160V FLEX DG DISCONNECT SMALL DG AS POWER TO 4160V AC BUS IS ESTABLISHED

LEGEND

——— PERMANENT PLANT EQUIPMENT

- - - - TEMPORARY FLEX EQUIPMENT (PRIMARY STRATEGY)

FIGURE 3: PHASE 2 ELECTRICAL DIAGRAM

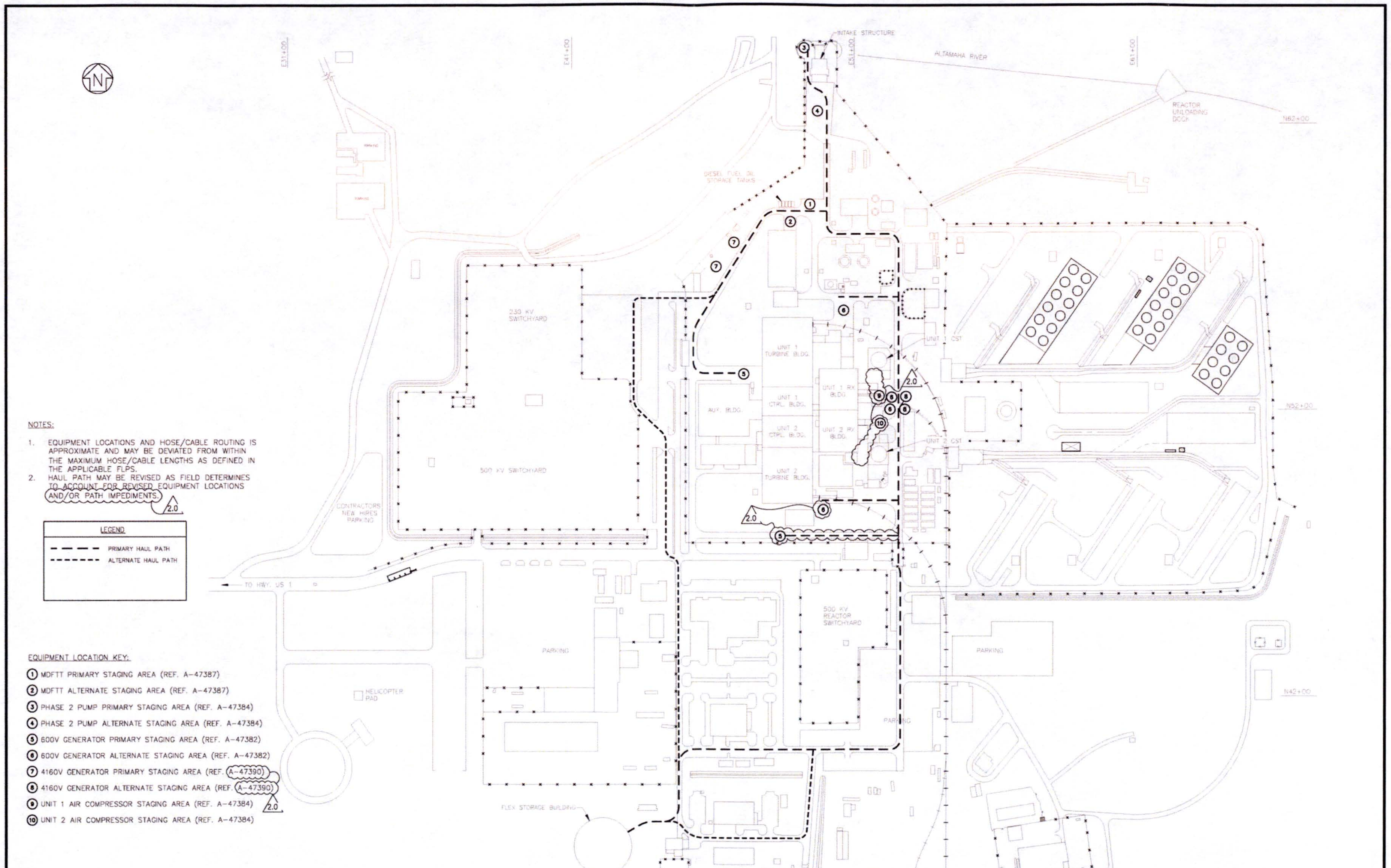


FIGURE 4: SITE PLOT PLAN

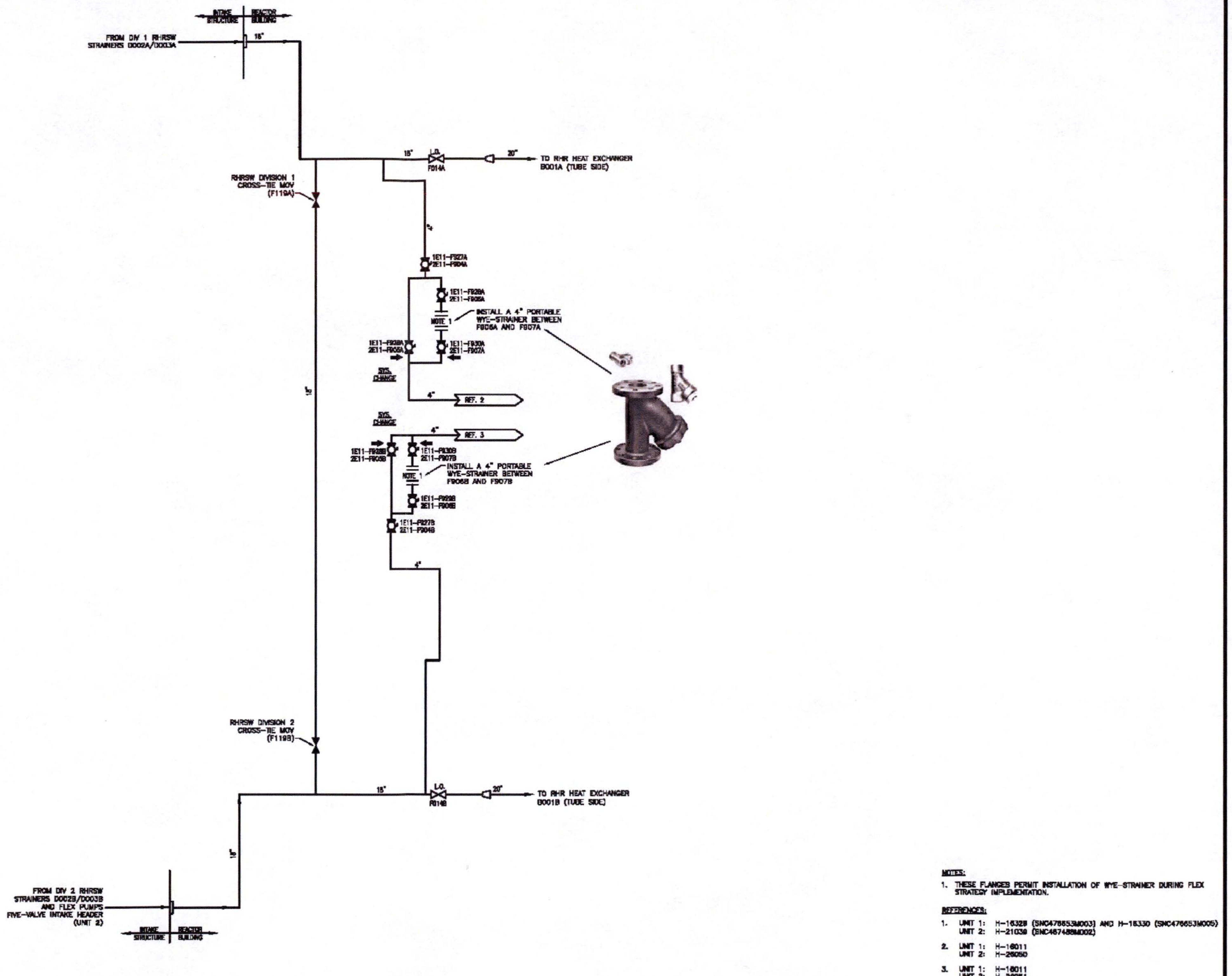


FIGURE 5: **RHR SERVICE WATER CROSSTIE PORTABLE STRAINER FLOW DIAGRAM**

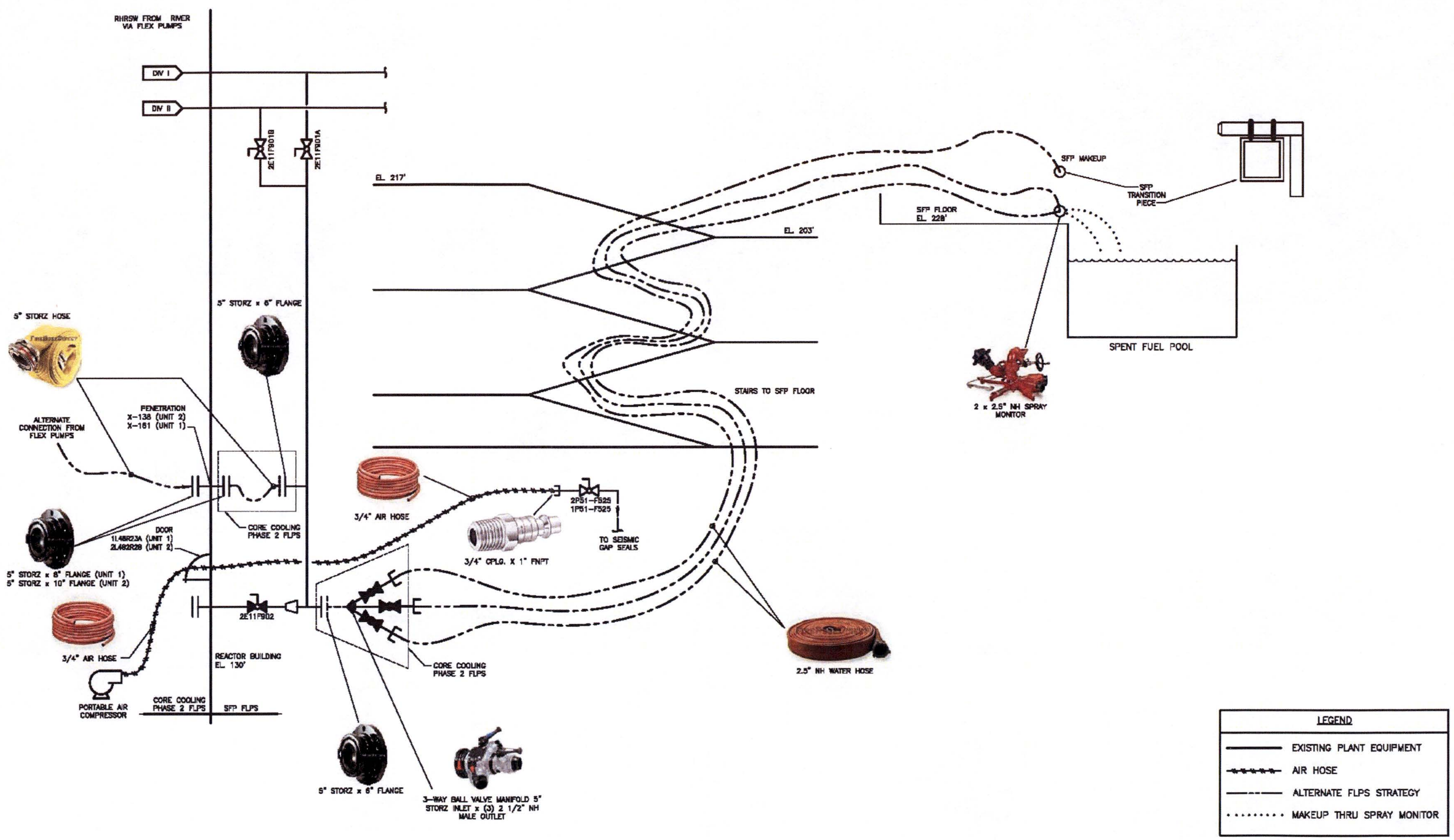


FIGURE 6: FLOW SCHEMATIC: SPENT FUEL POOL MAEKUP - METHOD 1 AND 3 - UNIT 2
NOTE: UNIT 1 FLOW SCHEMATIC IS SIMILAR TO UNIT 2

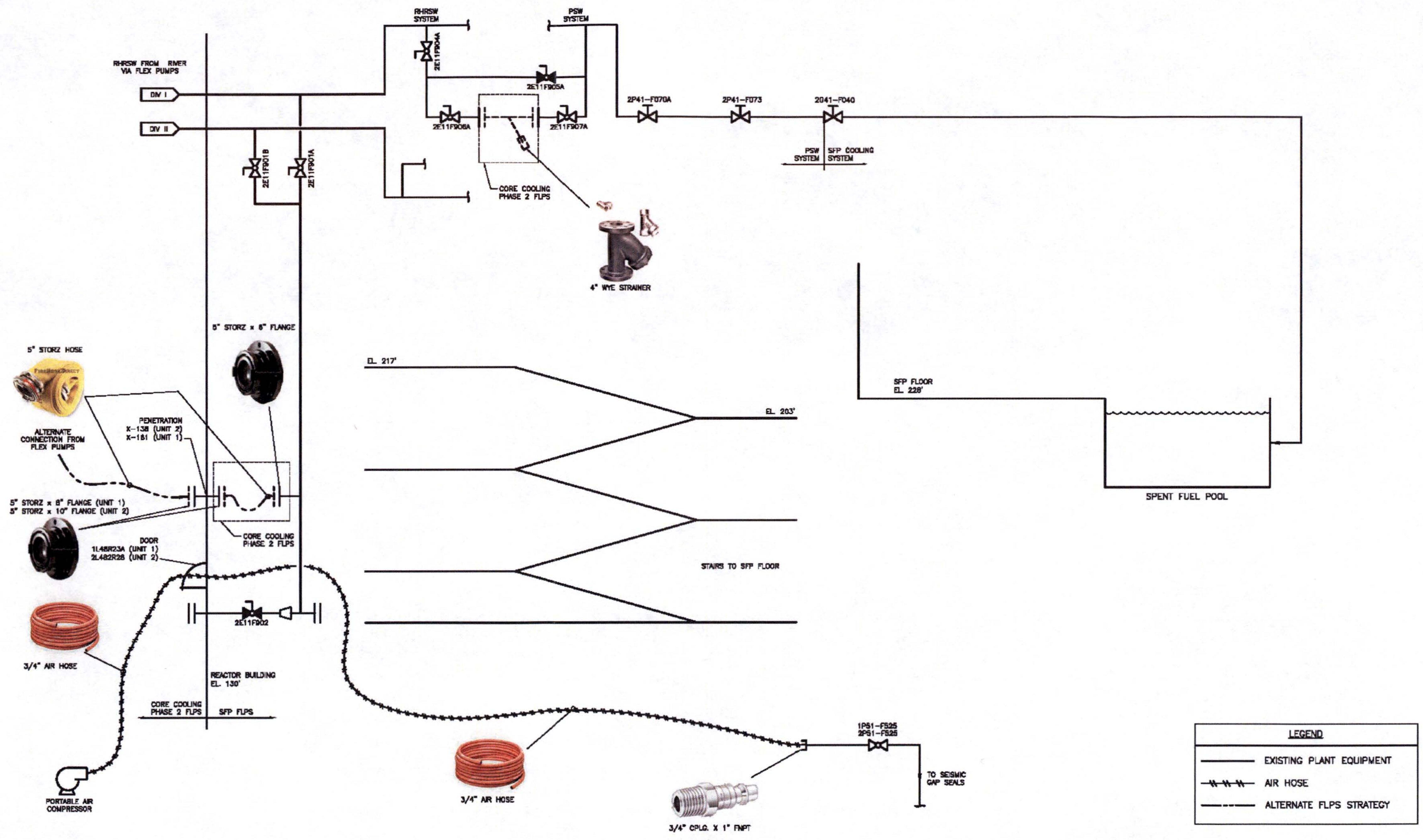


FIGURE 7: FLOW SCHEMATIC SPENT FUEL POOL - METHOD 2 - UNIT 2
NOTE: UNIT 1 FLOW SCHEMATIC IS SIMILAR TO UNIT 2

2.9 Deployment of FLEX Equipment

2.9.1 Haul Paths and Accessibility

Multiple haul routes are available from the FLEX storage building to any staging area. The appropriate haul routes have been evaluated for access per NEI 12-06, Section 5.3.2 (including liquefaction).

The equipment being transported for Phase 2 strategies will be towed by a heavy duty pickup truck or a small semi-tractor. The wheeled loader can also be used to tow equipment. The tires for these vehicles and trailers are designed to withstand small debris punctures and razor wire cuts/penetration (i.e., large commercial/military grade tires). Debris clearing equipment is stored in the FLEX storage building. This will provide the equipment with direct access to the critical travel paths providing timely debris removal. All transmission lines that are brought down by an external hazard are assumed to be electrically charged until verified otherwise. Equipment is available to address downed power lines (v-watch proximity meters, di-electric shoes, high voltage stick/meter).

It was determined through walk downs that all haul paths can support a minimum of two lanes of normal vehicular traffic. This decreases the likelihood of a path being completely blocked, as well as reduce the time it will take to clear any debris adequately to deploy the FLEX equipment. The possibility exists to move off of the roadway to avoid debris along a majority of the deployment route paths. Alternative routes into the power block area are shown in Figure 4.

Based on the results of a liquefaction potential assessment, the overall liquefaction potential at the FLEX storage building and across the designated travel paths is deemed low for the postulated seismic ground motions. The risk of surface displacement due to faulting or lateral spreading is also deemed low (Reference 3.105).

A debris assessment for the site was performed to determine debris removal equipment requirements. It was determined that the debris removal equipment should be capable of moving large debris such as automobiles, trees, pieces of buildings, switchyard structures, and concrete barriers, in addition to general assorted small debris such as limbs. Based on this assessment, it was determined that a medium wheeled loader with appropriate blade and horsepower can move the postulated debris in a single maneuver which simplifies and speeds the debris removal effort.

2.10 Fueling of Equipment

The five underground diesel fuel oil storage tanks (DFOST) at HNP are seismically qualified, protected from missile and have a nominal capacity of 40,000 gallons each.. The HNP Technical Specification 3.8.3 (Reference 3.19) require that each DFOST contain a minimum of 33,320 gallons of fuel. The stored quantity of fuel in any one selected DFOST will meet the fuel demand for all of the diesel-driven FLEX equipment well past 72 hours (Reference 3.61).

The Phase 2 support strategy includes repowering existing DFOST transfer pumps to refill a FLEX fuel tanker from the chosen DFOST. Hoses are connected to the normal DFOST fill valve. Breaker alignments will supply power from a 600V FLEX DG to the selected transfer pump motor. The DFOST fill valve is not missile protected, therefore an alternate option for filling the portable tank/trailer is available by connecting a hose to ½ in. connection points located in the seismic and missile protected emergency diesel generator (EDG) building day tank room. These ½ in. connections come off of the supply line from the DFOST pumps to the EDG day tanks. FLEX tanks/trailers, referred to as mobile diesel fuel transfer tank (MDFTT), are available for use for transporting fuel between the EDG storage tanks to the FLEX diesel-driven equipment..

Five diesel generators day tanks which normally supply fuel oil to the station EDGs are required to contain at least 500 gallons each by Technical Specifications 3.8.3 (Reference 3.19). Each tank is contained in its own enclosed room and has an inlet strainer drain valve.

A FLEX fuel tanker will be towed to each diesel-driven FLEX component that needs refueling. An on board dc powered pump will dispense fuel oil from the tanker. The haul routes for transporting fuel are the same haul routes for deployment of the FLEX equipment, which are evaluated for accessibility following screened in external hazards.

HNP has 3 MDFTTs that can be used to transport diesel fuel from the DFOSTs to the FLEX equipment. As of December 31, 2016, diesel fuel oil stored in the DFOSTs does not meet the ultra low sulfur diesel (ULSD) requirements of Tier 4 equipment. Accordingly, until at least two DFOSTs reach ULSD requirements, two of the MDFTTs have been specifically designated to store the ULSD required for the first 72 hours following a BDBEE. The debris removal equipment and tow vehicles are the only credited FLEX equipment that require ULSD.

2.11 Off-site Resources

2.11.1 National SAFER Response Centers

The industry has established two National SAFER Response Centers (NSRCs) to support utilities during BDBEEs. Southern Nuclear Company (SNC) has established contracts with the Pooled Equipment Inventory Company (PEICo) to participate in the process for support of the NSRCs as required. Each NSRC holds five sets of equipment, four of which will be available for deployment when requested, the fifth set will have equipment in a maintenance cycle. In addition, on-site FLEX equipment hose and cable end fittings are standardized with the equipment supplied from the NSRC. In the event of a BDBEE and subsequent ELAP concurrent with LUHS condition, equipment will be moved from an NSRC to a local staging area established by the Strategic Alliance for FLEX Emergency Response (SAFER) team. FLEX strategy requests to the NSRC are directed by FLEX procedures.

Staging area "C" is the Tattnall County/Reidsville, Georgia Airport. Communications will be established between the HNP 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 in which equipment is delivered is identified in the HNP "SAFER Response Plan."

NSRC personnel will commence delivery of a pre-selected equipment set from the NSRC upon notification. Plans are to deliver equipment from off-site sources via truck or air lift. Typically deliveries will go by truck using preselected routes and with any necessary escort capabilities to ensure timely arrival at the plant site staging area "B" or to staging area "C" approximately 25 miles from the site. The delivery of equipment from the intermediate staging area will use the same methodology. The "B" staging area is a large hard-surfaced area of approximately 2 to 3 acres in size. Helicopter landing considerations are accounted for in selection of the areas. These areas are designed to accommodate the equipment being delivered from the NSRC.

Depending on time constraints, equipment can be flown commercially to a major airport near the plant site and trucked or air lifted from there to the staging areas. The use of helicopter delivery is typically considered when routes to the plant are impassable and time considerations for delivery will not be met with ground transportation. Multiple pre-selected routes are one method to circumvent the effects of seismic events, floods, etc. and these routes will take into account potentially impassible areas such as bridges, rivers, heavily wooded areas and towns. The drivers will have the routes marked and will be in communication with the NSRC to ensure that the equipment arrives on time.

2.11.2 Equipment List

The equipment stored and maintained at the NSRC for transportation to the local assembly area to support the response to a BDBEE at HNP is listed in Table 2.

See Reference 3.95 for descriptions and capabilities of equipment maintained by the NSRC.

Table 2
BWR Portable Equipment From NSRC

Use and (Potential / Flexibility) Diverse Uses										
List Portable Equipment	**Qty Req'd / Unit**	**Qty Provided / Unit**	**Power**	**Core Cool-ing**	**Cont. Cooling/ Integrity**	**Access**	**Instrumen -tation**	**Performance Criteria**		**Notes**
Water Treatment Systems	0	1	Diesel	X					250 gpm	1
Water Treatment Generators	0	1	Diesel	X				480V	150 kW	1
480/600V Step Up Transformer & cable	0	1	N/A	X			X	480V to 600V	1375 kVA	1
Ventilation Fans	0	1	120 V			X			3000 cfm	1
Portable Air Compressor	0	1	Diesel					150 psi	300 scfm	1
Suction Lift Booster Pumps	0	1	Diesel	X				26 ft lift	5000 gpm	1
Medium Voltage Generator	0	2	Turbine	X	X		X	4160 V	1 MW	2,3
Low Voltage Generator	0	1	Turbine	X			X	480V	1100 kW	2
Cable / Electrical	0	Various	N/A	X	X		X	4160 V 480V		2
High Pressure Injection Pump	0	1	Diesel					2000 psi	60 gpm	2
SG/RPV Makeup Pump	0	1	Diesel	X				500 psi	500 gpm	2
Low Pressure / Medium Flow Pump	0	1	Diesel	X				300 psi	2500 gpm	2

Table 2
BWR Portable Equipment From NSRC

Use and (Potential / Flexibility) Diverse Uses										
List Portable Equipment	**Qty Req'd / Unit**	**Qty Provided / Unit**	**Power**	**Core Cool-ing**	**Cont. Cooling/ Integrity**	**Access**	**Instrumen-tation**	**Performance Criteria**		**Notes**
Low Pressure / High Flow Pump	0	1	Diesel		X			150 psi	5000 gpm	2
Hose / Mechanical Connections	0	Various	N/A	X	X			Various	Various	2
Lighting Towers	0	3	Diesel			X		440,000 lumens	(minimum)	2
Diesel Fuel Transfer	0	1	N/A	X	X		X	500 gallon air-lift container		2
Diesel Fuel Transfer Tank	0	1	Motor	X	X		X	264 gallon tank, with mounted ac/dc pumps		2
Portable Fuel Transfer Pump	0	1	Diesel	X	X		X	60 gpm after filtration		2
Electrical Distribution System	0	1	N/A	X	X		X	4160 V	250 MVA, 1200 A	2

Note 1 - NSRC Non-Generic Equipment –Provided as Defense-in-Depth (Reference 3.95, Table 9-1).
Note 2 - NSRC Generic Equipment –Provided as Defense-in-Depth (Reference 3.95, Table 7-1).
Note 3 - 1 MW is the individual generator output, and 2 MW is the total standard output to be supplied by the Phase 3 MV generators to satisfy identified load demands. The total output is created by connection of several smaller generators in parallel (Reference 3.95, Table 7-1)

2.12 Habitability and Operations

2.12.1 Equipment Operating Conditions

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

The key areas identified for all phases of execution of the FLEX strategy activities are the MCR, RCIC pump room, battery and switchgear rooms on the 130' control building.

2.12.1.1 Main Control Room

Accessibility in the MCR must be maintained for the duration of the ELAP. During the ELAP, some control room vital electronics, instrumentation and emergency lighting remain energized from emergency dc power sources. At 75 minutes, extended load shedding is complete and some instrumentation are de-energized. An ELAP event disables all trains of control room HVAC for both units simultaneously.

Under ELAP conditions with no mitigating actions taken, the analysis determined the control room would surpass 110°F (the assumed maximum temperature for efficient human performance as described in NUMARC 87-00 (Reference 3.66)) in a time of approximately 9 hours (Reference 3.67). This indicated that mitigating actions were necessary in order to maintain control room habitability. The Phase 1 FLEX strategy mitigating actions involve blocking open the entrance air lock at the stairwell to the MCR and the lower stairwell doors coupled with the opening of the outside freight elevator doors and doors from MCR to the turbine building at or before

3 hours following the BDBEE initiation. This establishes a path from the control building (and outside) 130' elevation to the MCR. In addition, the turbine building tornado roof vent hatches can be opened to allow hot air from the turbine building to escape. Allowing hot air to escape from the turbine building will aid in slowing the MCR heatup since the turbine building design air temperature is 110°F.

During cold weather, the ventilation flow can be limited to keep the MCR at a habitable temperature. If the outside temperature is above 96°F, then the MCR doors will not be opened until the MCR temperature is in excess of the outside temperature. Note that on the infrequent days when the peak daily outside temperature is above 98°F, this temperature is normally only exceeded for a limited time during the early afternoon hours. In addition, there is on average a 23.8°F difference between the daily high and low temperatures (Reference 3.16, Table 2.3-2).

For Phase 2, the primary strategy for maintaining the environment of the MCR is to power one division of the MCR chillers and air handling units when the 600 VAC switchgear is energized with the 600V FLEX DG and to provide a jumper from RHRSW to the PSW piping that supplies cooling water to the MCR air conditioning coolers no later than 13 hours following the BDBEE. The MCR air conditioning units are common to both units, and cooling water is supplied to each MCR from both units. The FLEX connection and piping coming off of the 18 in. RHRSW line provides the means to supply a total of 120 gpm each to two of the MCR air conditioning coolers from both units. Valve manipulations are required to properly route the cooling water to the air conditioning units. The alternate strategy for Phase 2 is to power the opposite division of the MCR Coolers and air handling units.

The Phase 3 strategy for MCR cooling is to continue the Phase 2 strategy supplemented by portable equipment delivered from off-site. See Table 2 for a list of equipment that will be delivered to the site by the NSRC after notification by the plant; refer to Section 2.11 for a discussion on NSRC supplied equipment.

As resources become available, actions can be taken to transition away from extended Phase 2 coping strategies. Since no time sensitive Phase 3 actions have been identified, instructions for connection and utilization of NSRC equipment for long term coping or recovery will be provided by TSC personnel who will have assessed the condition of the plant and infrastructure, plant accessibility, and additional available off-site resources (both equipment and personnel) following the BDBEE.

2.12.1.2 RCIC Pump Room

During operation, there will be a considerable heat load within the room from the steam turbine and associated piping. Operation of RCIC without forced ventilation was evaluated for the ELAP concurrent with LUHS condition (Reference 3.68). This conservative calculation determined that with no supplemental ventilation, the room would remain below 148°F during the initial 72 hours.

The design area temperature limit for equipment qualification is 295°F as listed in FSAR Tables 7.16-7 for Unit-1 and Table 3.11-1 for Unit-2 (References 3.15 and 3.16). For long term operation (6 months), the safety-related components of the RCIC room are designed to operate with area temperatures of 148 °F as discussed in the FSAR Section 10.18.5 (Reference 3.16). Since RCIC operation is accomplished from the MCR, continuous habitability will not be required in the RCIC pump room. The acceptance criteria for personal habitability for short intervals of exposure is 150°F, which is derived from an aero medical laboratory report titled "Human Tolerance for Short Exposures to Heat" (Serial No. TSEAL-3-695-49A) (Reference 3.106).

If personnel entry is required into the RCIC room then personal protective measures such as donning of ice vests will be taken. Site industrial safety procedures currently address activities with a potential for heat stress to prevent adverse impacts on personnel.

Cooling of the RCIC pump room beyond 72 hours is accomplished as necessary by repowering the RCIC pump room coolers and by providing cooling water via the RHRSW to PSW crosstie (Section 2.4.5.2).

Since no time sensitive Phase 3 actions have been identified, instructions for connection and utilization of NSRC equipment for long term coping or recovery will be provided by TSC personnel who will have assessed the condition of the plant and infrastructure, plant accessibility, and additional available off-site resources (both equipment and personnel) following the BDBEE.

2.12.1.3 Battery and Switchgear Rooms

During the ELAP event, the 125V dc and inverter-fed 120 V ac electrical distributions are energized and maintain power to instrumentation and controls for core cooling, containment, and SFP cooling functions.

Analysis (Reference 3.69) determined that the maximum temperature for the station battery rooms (1A, 1B, 2A, and 2B) after a BDBEE does not exceed the acceptance criteria of 122°F for a period of 72 hours.

During battery charging operations in Phases 2 and 3, in support of maintaining power to instrumentation and controls for core cooling, containment and SFP cooling functions, ventilation is required in the main battery rooms for cooling the rooms and venting hydrogen released from the batteries during charging. The calculation of main battery room hydrogen generation (Reference 3.70) concluded that the earliest time to accumulate a 2% hydrogen concentration in any one of the battery rooms is approximately 73 hours and the latest time is 99 hours. The primary ventilation strategy is to repower the existing emergency exhaust fans which are connected to the emergency power bus. This will occur after a 600V FLEX DG has been connected to power the 600 V bus. The alternate strategy is to prop open doors and set up portable fans within 72 hours.

Since no time sensitive Phase 3 actions have been identified, instructions for connection and utilization of NSRC equipment for long term coping or recovery will be provided by TSC personnel who will have assessed the condition of the plant and infrastructure, plant accessibility, and additional available off-site resources (both equipment and personnel) following the BDBEE.

In Phase 2, following the energization of some of the 600 VAC switchgear by the 600V FLEX DGs, the rooms begin to heat up. Analysis determined that opening doors and operating fans is adequate to maintain the room temperatures below 122°F to support continued operation of the equipment for FLEX coping (Reference 3.71). NUMARC 87-00 indicates that certain classes of electrical equipment (such as those in the dc equipment rooms at HNP) will likely remain operable in thermal environments of 150°F to 300°F for up to 8 hours (Reference 3.66).

Thus, the electrical equipment rooms are evaluated at 150°F (Reference 3.71). For the specific rooms where the inverters are installed the room temperature limit is 122°F. The results of this calculation determined that the maximum temperature reached in any of the rooms where the inverters are installed does not exceed 122°F. The rest of the switchgear rooms, the results determined that the maximum temperature remains well below 150°F when the following mitigations actions are performed:

- Doors C37, C90, C33, C28, C21, and C22 are opened at 3 hours to establish ventilation pathways from the Unit 1 and Unit 2 switchgear rooms to the east cableway that leads to the turbine building.
- The freight elevator outer and inner doors are opened at 3 hours to permit mixing of outside air.
- Five fans are deployed at 10 hours. A 15,000 CFM fan is staged in the doorway from the control building to the east cableway in door C21 to exhaust hot air from control building El. 130' to the turbine building. Four smaller 8,000 CFM fans are staged in the doorways of the Unit 2 Switchgear rooms (doors 6, 7, 9, and 10) to exhaust hot air from the switchgear rooms to the passageway and out to the hallway.

2.12.1.4 Containment

Containment conditions during the event are below the design limits of the containment. Per the 0 to 72 hour MAAP run the temperature rises to 260°F. It is expected that drywell temperature will remain below the containment design basis temperatures for beyond 72 hours via actions of venting, injection of cool water from the river and drywell sprays via FLEX pumps.

A limited number of instruments in containment are required to remain operable for post-accident monitoring as specified in Technical Specification 3.3.3, Post Accident Monitoring Instrumentation (Reference 3.19). These instruments meet Regulatory Guide 1.97 Category I design and qualification requirements for seismic and environmental qualification, single failure criterion, utilization of emergency standby power, immediately accessible display, continuous readout, and recording of display (Reference 3.107). Additionally refer to NTTF Tier 3 item closure plan for Instrument Enhancements for BDB Events (white paper, Joint steering committee presentation 10/20/2015, and SECY-15-0187, Notation Vote Request on Tier 2&3 Plans). Containment entry is not required following an ELAP; therefore, personnel habitability/accessibility is not applicable.

HNP has 11 solenoid operated SRVs, but just 1 SRV is necessary to control the pressure gradient after the first few hours of the event. The SRV solenoids were tested per Target Rock Qualification Test Report 5074 (S-59638) under the following conditions 355°F, 68 psig, 3 hours; 335°F, 50 psig, 3 hours; 265°F 44 psig, 18 hours; 215°F 11 psig, 101.8 days. This test program at elevated temperatures along with the redundancy of the 11 SRVs reasonable assurance is provided that pressure control function will be supplied for an extended period of time.

While it is not anticipated that SRVs will malfunction, as defense in depth, the operators will make decisions on use of RPV depressurization, use of additional FLEX pump capacity for Drywell Spray and use of NSRC large capacity pumps to reduce the Drywell temperatures.

Since no time sensitive Phase 3 actions have been identified, instructions for connection and utilization of NSRC equipment for long term containment cooling will be provided by TSC personnel who will have assessed the condition of the plant and infrastructure, plant accessibility, and additional available off-site resources (both equipment and personnel) following the BDBEE.

2.12.2 Heat Tracing

For the HNP site, the normal daily minimum temperature ranges from 37°F at Macon in January to 71°F in July (Reference 3.16). An extreme minimum temperature of 3°F was recorded at Macon in January 1966. About 42 days per year have minimum temperatures below freezing (Reference 3.16, Table 2.3-2). Therefore, extreme cold is not considered to be a significant concern for the site. Heat tracing has been provided to the five 6 in. FLEX ball valves (on each unit) (Figure 1) located at the intake structure.

The CST will be the initial source of water and the need for a backup supply is not anticipated prior to 19 hours into the BDBEE due to the capacity of the CST (see Table 3). When heat tracing is lost during cold weather events, it should not be necessary to thaw any of the FLEX connection in the relatively short length of time prior to connecting the FLEX pump. Heat tracing is not required to be maintained following a BDBEE.

The storage of FLEX equipment considers the minimum temperature specified by the manufacturers (see Section 2.8). The FLEX pumps and generators have special operating requirements when temperatures fall below 32°F. Freeze protection of idle but primed portable pumps and hoses considers the possibility of freezing.

2.13 Personnel Habitability

Operators are trained on recognizing the symptoms of heat stress and on proper hydration methods to combat heat stress. Guidance derived from current site industrial safety procedures and passive cooling technologies already used by response personnel will be applied as deemed necessary to minimize impacts of heat stress. Continued accessibility will be assured by evaluation of room environments, application of heat stress countermeasures, and rotation of personnel to the extent feasible.

Personnel habitability for MCR was evaluated in Section 2.12.1 and determined to be acceptable.

2.14 Lighting

Flashlights are the primary means of lighting to accomplish FLEX actions. All operators are required to have flashlights. In addition, the MCR and Maintenance Shop include a stock of flashlights and batteries to further assist the staff responding to a BDBEE event during low light conditions.

The majority of areas for ingress/egress and deployment of FLEX strategies contain emergency lighting fixtures (Appendix "R" lighting) consisting of a battery, battery charger and associated light fixtures. These emergency lights are designed and periodically tested to insure the battery pack will provide a minimum of 8 hours of lighting with no external ac power sources. Therefore, these currently installed emergency lighting fixtures provide lighting to light pathways for 8 hours. Prior to the depletion of the Appendix "R" lighting, portable battery powered lighting could be deployed to support the FLEX strategy tasks, but are not required for compliance.

There are no emergency lighting fixtures in the yard outside of the protected area to provide necessary lighting in those areas where portable FLEX equipment is to be deployed. Therefore, while not credited, the large FLEX pumps and diesel generators are outfitted with lights that can be powered from either their respective diesel generators or batteries in order to support connection and operation. In addition to the lights installed on the FLEX equipment, portable light plants are available to be deployed from the FLEX storage building as needed to support night time operations.

Analysis indicates that execution of specified load shed actions directed in plant procedures ensures a continued reliable source of MCR illumination for a minimum of 14 hours until the 600V FLEX DG will be available to repower the battery charger that supplies the station service batteries which powers the MCR lighting (References 3.30 thru 3.33).

2.15 Communications

The plant Public Address (PA) system will assist with initial notifications and directions to on-site personnel, the on-shift Emergency Response Organization (ERO) personnel, and in-plant response personnel. Battery operated handheld satellite phones will assist with initial notifications and directions to off-site ERO personnel and other personnel.

As discussed in the HNP communications assessment (Reference 3.64), provisions have been made for battery backup for the plant public address system to perform in plant notification functions. A rapidly deployable communications kit (RAPIDCASE) and a mobile communications system (RAPIDCOM) will be utilized to support satellite communications for the ERO (MCR and TSC). The RAPIDCOM is self-powered via a generator located on board and it can also support radio communications for operations and security personnel. The RAPIDCASE is a defense-in-depth component. RAPIDCASE is able to provide satellite communications to the TSC until the RAPIDCOM is deployed.

The required FLEX communications equipment is stored in the FLEX storage building or another robust structure.

2.16 Water sources

2.16.1 Secondary Water Sources

Table 3 provides an expanded list of on-site water sources considered for core cooling and SFP cooling coping strategies. This table considers each source's design robustness with respect to seismic events, floods, high winds, and associated missiles. The CSTs and Altamaha River meet the qualification guidelines of NEI 12-06 for an injection source that can be credited for the ELAP concurrent with LUHS event. Other tanks and basins are included in the table to provide a comprehensive list of site water sources. These non-creditable water sources may be available for injection, depending on the cause of the event, and although these are not credited, they could be considered for use during an actual event.

Table 3 - On-site Makeup Water Sources			
Makeup Water Source	**Min. Normal Volume (gals.)**	**Water Chemistry[4]**	**Source Qualification[1]**
Condensate Storage Tank (Reference 3.16, Section 9.2.6)	100,000 (credited) (1 per unit)	Clean	Seismically Qualified[2]
Suppression pool (Reference 3.90)	655,000 (1 per unit)	Clean	Seismic Category I
Demineralized Water Storage Tank (Reference 3.16, Section 9.2.3)	100,000	Clean	Non-seismic
Condenser Hotwell (Reference 3.16, Section 15.3.8, 10.4.1)	189,000 (1 per unit)	Clean	Seismic Category II
Fire Protection System (Reference 3.16, Section 10.4.5)	600,000 (2 x 300,000 gal tanks)	Unclean	Non-seismic
UHS (Altamaha River) (Reference 3.16, Section 2.5)	Continuous Source	Unclean	Undefined[3]
Circulating Water Flume (Reference 3.16, Section 10.4.5)	~5,000,000 gal (1 per unit)	Unclean	Non-seismic
Filtered Water Storage Tank (Reference 3.16, Section 9.2.4)	100,000	Unclean	Non-seismic
Sanitary Water Storage Tank (Reference 3.16, Section 9.2.4)	20,000	Unclean	Non-seismic

Notes:

1. All Seismic Category I structures and components are designed for protection from wind/tornado loadings, flooding, and missiles according to Reference 3.16 sections 3.3, 3.4, and 3.5, respectively.
2. According to Reference 3.16 section 9.2.6.2, the CST is surrounded by a 20' tall Seismic Category I and missile-proof retaining wall
3. The Altamaha River is not defined as Seismic or non-seismic, however the intake structure is Seismic Category I
4. Clean water sources include those that are chemically treated for injection to the reactor

2.17 Shutdown and Refueling Analysis

HNP abides by the Nuclear Energy Institute position paper entitled "Shutdown/Refueling Modes" (Reference 3.65) addressing mitigating strategies in shutdown and refueling Modes. This paper has been endorsed by the NRC Staff (Reference 3.10).

HNP has site-specific procedures for implementation of FLEX in shutdown MODES. The applicable procedure addresses all plant configurations expected in MODES 4 & 5. The strategy for core cooling for Modes 4 and 5 are, in general, similar to those for Modes 1-3.

HNP has also incorporated guidance from the BWROG technical paper BWROG-TP-15-019 (Reference 3.108).

2.17.1 FLEX Mode 4

The primary and alternate strategies for Mode 4 are the same as those for Modes 1 – 3 as discussed for core cooling (Sections 2.4.1 through 2.4.3). If an ELAP occurs during Mode 4 (cold shutdown), water in the vessel will heat up. When temperature reaches 212°F, (Mode 3, hot shutdown) the vessel will begin to pressurize. The turbine driven systems (RCIC and HPCI) are generally available for emergency use at the beginning and end of an outage, thus during the pressure rise RCIC can be returned to service with suction from the CST to provide injection flow. When pressure rises to the SRV setpoints then pressure will be controlled by SRVs. It should be noted that the heatup from cold shutdown conditions through vessel pressurization will provide a significant amount of time to obtain FLEX water sources for makeup and cooling and DG for electrical power.

2.17.2 FLEX Mode 5

During Mode 5, many variables exist which impact the ability to cool the core. To accommodate the activities of vessel disassembly and refueling, water levels in the reactor vessel and the reactor cavity are often changed. The most limiting condition is the case in which the reactor head is detensioned and water level in the vessel is at or below the reactor vessel flange. If an ELAP concurrent with LUHS occurs during this condition then (depending on the time after shutdown) boiling in the core occurs quite rapidly. As indicated in procedure 34AB-E11-001-1(2) (Reference 3.72), if the event occurs at 1 day after shutdown, boiling will occur in less than 1 hour with fuel uncovering in less than 6 hours.

To mitigate the consequences of this scenario, a pump and hose trailer will be pre-staged near one of the cooling tower flumes or at the river near the discharge structure to provide necessary makeup. Hoses would be routed similar to the alternate flow path using the connection points in the Reactor Building as described in Section 2.4.5.6. The pre-staged pump would provide the water for core cooling while the FLEX pump is being staged.

With the reactor head removed and SFP gates removed in Mode 5, makeup to the RPV can also be accomplished via the SFP makeup strategy utilizing the FLEX pump.

Modes 4 and 5 SFP Cooling Strategy

For SFP considerations refer to Section 2.5.

Modes 4 and 5 Containment Strategies

Except for the specific containment closure requirements of Technical Specifications, equipment hatches and airlocks are often opened during outages. Each breach of containment integrity is administratively controlled. While the containment may not initially be isolated in operating Modes 4 and 5, plant operating procedures require that containment be manually isolated following the ELAP event. If the penetrations are closed then the Phase 1 and 2 FLEX strategy will be employed (i.e. use of HCVS) should containment limits be approached. The coping strategy for maintaining containment integrity includes monitoring containment pressure.

2.18 Sequence of Events

Table 4 below presents a sequence of events timeline for an ELAP concurrent with LUHS event at HNP. Validation of each of the FLEX time constraint actions has been completed in accordance with the FLEX Validation Process document issued by NEI (Ref. 3.96) and includes consideration for staffing (Reference 3.96). Time to clear debris to allow equipment deployment is to be up to 4 hours (Reference 3.97). This time is conservative based on site reviews and the location of the FLEX storage building. Debris removal equipment is stored in the FLEX storage building.

Additional technical basis details regarding the identified time critical actions (i.e., actions which have a "Y" in the ELAP time constraint column) is provided after the table.

Table 4 Sequence of Events Timeline

Action Number	Elapsed Time	Action	ELAP Time Constraint Y/N [1]	Remarks
	0	**Event Starts**	N	Plant @100% power
1	60 sec	RCIC/HPCI starts	N	Reactor operator initiates or verifies initiation of reactor water level restoration with steam driven high pressure injection. Manual operation capability of RCIC is proceduralized.
2	3 min	HPCI secured	N	Time sensitive at 4 minutes. HPCI will trip automatically when reactor level reaches the high level setpoint
3	25 min	Operators override the auto-swap of RCIC suction valves in accordance with EOPs to maintain suction from the CST	Y	Time sensitive at the point when suppression pool water level reaches the high level setpoint (approximately 35 minutes) which would initiate the automatic swap of the RCIC suction from the CST to the suppression pool. Swap must be overridden to keep suction on CST as required by EOPs.
4	32 min	Attempts to start EDGs have been unsuccessful. Enter ELAP Procedure	Y	Time sensitive at 48 minutes. Entry into ELAP provides guidance to operators to perform ELAP actions.
5	71 min	dc Load shed complete	Y	Time sensitive at 1 hour 15 minutes. dc buses are readily available for operator access and breakers on the 130' elevation will be appropriately identified (labeled) to show which are required to be opened.
6	1 hr 6 min	Using manual control of SRVs depressurize the RPV in accordance with EOPs (to approximately 380 – 480 psig) to keep in the safe region of the HCTL curve remaining within the cooldown limitation of ≤100°F/hr per Technical Specifications.	Y	Time sensitive at the point of approaching the unsafe region of the HCTL curve (Approximately 3 hours 19 minutes). EOPs require operators to keep reactor pressure and temperature from causing entry into unsafe region of HCTL curve. Elapsed time assumes the action will be initiated after 1 hour after the event.
6A	2 hr 20 min	Open passageway doors C37, C90, C33, C28, C21 and C22 on 130' elevation of control building to provide flowpath for natural convection airflow from the inverter areas and switchgear rooms through the chemistry counting room and into the east cableway and Turbine Building.	Y	Time sensitive at 3 hours. The inverters are rated for normal long-term operation at 122°F. The inverters cause the areas to heat up and area temperatures will exceed the safety limits for personnel habitability. This area is required for passage and short duration mitigation actions. The elapsed time assumes starting action after 2 hours.

[1] Instructions: Provide justification in Remarks column if "N" (No). If "Y" (Yes), include technical basis discussion as required by NEI 12-06 section 3.2.1.7

Action Number	Elapsed Time	Action	ELAP Time Constraint Y/N [1]	Remarks
7	2 hr 47 min	Open MCR, stairwell, and freight elevator doors to establish path for natural convection airflow to the MCR from the 130' elevation –	Y	Time sensitive after 3 hours. Doors must be opened any time prior to 3 hours to prevent temperature from exceeding 110°F in the MCR. The freight elevator doors will be opened in accordance with station procedures which will include the necessary tools (if required) and preplanned actions. Elapsed time assumes starting action after 2 hours.
7A	2 hr 10 min	Manual cooldown of RPV to 150 psig	Y	Time sensitive at 4.5 hours. Operators manually cooldown the RPV to 150 psig by opening one SRV and maintain pressure between 150 – 300 psig by cycling one SRV
8	4 hr 11 min	Initiate use of hardened containment vent to maintain containment parameters and HCTL within limits	Y	Time sensitive at 5.1 hours. The HCTL is approached. The wetwell vent valve is opened. The suppression pool temperature does not exceed 230°F. HCVS is seismic and powered by dc buses with nitrogen supplied from the accumulators or temporary nitrogen bottles to operate the HCVS valves
9	6 hr 3 min	When CST inventory is near depletion, swap RCIC suction from CST to suppression pool to preserve RCIC availability	Y	Time sensitive at 6.8 hours. To maintain RCIC operating, the suction must be swapped to a suction source that contains available inventory, i.e. the suppression pool.
10	9 hr 44 min	Transition from Phase 1 to Phase 2 for core cooling function by placing FLEX pump in service to make up to the CST and MCR cooling	Y	Time sensitive for MCR HVAC at 13 hours. FLEX pump will be staged beginning at approximately 5 hours time frame. Combined CST and suppression pool volume is estimated to be sufficient out to 19 hours.
11	9 hr 21 min	Power up the station battery chargers using FLEX 600 V DGs to supply power to the buses C and D	Y	Time sensitive after 14 hours. Batteries durations are calculated to last greater than 14 hours.
11A	8 hr 59 min	Deploy the portable fans on 130' elevation of control building. Place one 15,000 cfm fan at door C21 and four 8,000 cfm fans in doorways of Unit 2 switchgear rooms to exhaust hot air from the switchgear rooms to the hallway and into the Turbine Building	Y	Time sensitive at 10 hours. When the switchgear is reenergized from the FLEX generator the switchgear rooms will have a larger heat load. Deploying these portable fans (and a FLEX miscellaneous generator to power them) will establish forced air flow from the outside (via the freight elevator doors) and from the switchgear rooms to the hallways and out to the Turbine Building to provide ventilation/cooling to the switchgear rooms and annunciator/inverter rooms
11B	11 hr 5 min	Initiate MCR ventilation/cooling using the MCR HVAC system	Y	Time sensitive at 13 hours. Repower MCR HVAC required to maintain MCR temperatures.

Action Number	Elapsed Time	Action	ELAP Time Constraint Y/N [1]	Remarks
12	11 hr 10 min	Begin makeup to SFP as necessary to maintain adequate level in the SFP. (Boiling under design basis conditions begins at 12 hours and requires 24 gpm makeup). Vent the refuel floor to prevent pressurization during pool boiling by opening the reactor building roof vents	N	Boil-off rate is slow with a large volume of water in the SFP. Action starting at 10 hours.
13	10 hr 3 min	Swap RCIC suction from the suppression pool to the CST when suppression pool level impacts RCIC required NPSH (between 146 in. and 102 in.) or before suppression pool level reaches 102 in.	Y	Time sensitive at 19 hours when the reduction in suppression pool level begins to impact RCIC required NPSH or when 102 in. is reached (102 in. is the limiting level to maintain coverage over the SRV tailpipe quenchers and the RCIC exhaust).

Discussion of time constraints identified in Table 4.

- Table 4 Action Number 3:

  25 minutes - Operators override the auto-swap of RCIC suction valves in accordance with EOPs to maintain suction from the CST - Time sensitive at the point when suppression pool water level reaches the high level setpoint (approximately 35 minutes) which would initiate the automatic swap of the RCIC suction from the CST to the suppression pool. It is desirable to maintain suction from the CST because it is a source of higher quality water and is also a step directed by EOPs (Reference 3.73).

- Table 4 Action Number 4:

  32 minutes - Enter ELAP procedure – Time sensitive at 48 minutes is a reasonable assumption for system operators to perform initial evaluation of the EDGs. Entry into ELAP provides guidance to operators to perform ELAP actions.

- Table 4 Action Number 5:

  71 minutes - dc load shed complete - Time sensitive at 75 minutes. To ensure that safety-related station batteries can maintain dc bus voltages above minimum required voltage for a minimum of 14 hours following a loss of ac power, dc extended load shed is required to be completed by

75 minutes after loss of ac power. The dc buses are located in switchgear rooms in the control building and are readily accessible to the operator. Load stripping consists of opening no breakers in Unit 1 and 5 breakers in Unit 2 DC switchgears (Reference 3.2930, 3.31, 3.32, 3.33). As an operator aid, the breakers have been appropriately identified (labeled) to show which are required to be opened to facilitate an extended load shed (Reference 3.29).

- Table 4 Action Number 6:

  1 hour and 6 minutes - Reactor pressure control to keep from entering unsafe region of the HCTL curve - Using manual control of SRVs, depressurize the RPV IAW EOPs (to approximately 380 – 480 psig) to keep in the safe region of the HCTL curve (Reference 3.14). Manual control of depressurization will ensure that reactor temperatures will be maintained within the cooldown limitation of ≤100°F/hr per Technical Specifications (Reference 3.19). Time sensitive at the point of approaching the unsafe region of the HCTL curve (Approximately 3 hours 19 minutes per MAAP analysis (Reference 3.24)). SRV control is maintained from the control room with sufficient dc power and pneumatic pressure to operate the SRVs throughout Phase 1 (Reference 3.29).

- Table 4 Action Number 6A:

  2 hours and 20 minutes - Open passageway doors on 130 foot elevation of Control Building to provide flowpath for natural convection airflow from the inverter areas and switchgear rooms through the chemistry counting room and into the east cableway and Turbine Building. Time sensitive at 3 hours. Analysis has determined that opening the doors by 3 hours provides sufficient ventilation and cooling prior to use for passage and short duration mitigation actions such as load shedding.

- Table 4 Action Number 7:

  2 hours and 47 minutes - Open MCR, stairwell, and freight elevator doors to establish path for natural convection airflow to the MCR from the 130 foot (grade) elevation – Time sensitive after 3 hours. Analysis has shown that doors must be opened any time prior to 3 hours to prevent temperature from exceeding 110°F in the MCR. During cold weather, the ventilation flow can be limited to keep the MCR at a habitable temperature. If the outside temperature is above 98°F, then

the MCR doors will not be opened until the MCR temperature is in excess of the outside temperature.

- Table 4 Action Number 7A:

  2 hours and 10 minutes - Manual cooldown of RPV to 150 psig – Time sensitive at 4.5 hours. Operators manually cooldown the RPV to 150 psig by opening one SRV and maintain pressure between 150 – 300 psig by cycling one SRV.

- Table 4 Action Number 8:

  4 hours and 11 minutes - Wetwell vent valve is opened prior to excedding the HCTL curve. Time sensitive at 5 hours 4 minutes. The suppression pool temperature does not exceed 230°F. In addition, at this time, the use of HCVS per EOPs is initiated to maintain containment parameters below design limits and within the limits that allow continued use of RCIC. - The reliable operation of HCVS is met because HCVS is seismic and are powered by dc buses with motive force supplied to HCVS valves from installed accumulators and portable nitrogen storage bottles. Setup/lineup of HCVS (blowing rupture disk, valve lineup, etc.) can occur after ELAP is declared, between 1 and 7.5 hours. Critical HCVS controls and instruments associated with containment are dc powered and operated from the MCR or a remote operating station on each unit (Reference 3.19). The dc power for HCVS will be available as long as the HCVS is required. Station batteries will provide power for greater than 14 hours with the 600V FLEX DG supplying power before battery life is exhausted.

- Table 4 Action Number 9:

  6 hours and 3 minutes - When CST inventory is near depletion, swap RCIC suction from CST to suppression pool to preserve RCIC availability – Time sensitive at 6.8 hours. CST inventory is estimated to last approximately 6.8 hours (References 3.25 and 3.24). To maintain RCIC operating the suction must be swapped to a suction source that contains available inventory (i.e., the suppression pool).

- Table 4 Action Number 10:

  9 hours and 44 minutes - Transition from Phase 1 to Phase 2 for core cooling function by placing FLEX pump in service to make up to the CST - Time sensitive after 13 hours for MCR cooling. For core cooling,

the combined CST and suppression pool credited volume is estimated to be sufficient out to approximately 19 hours (References 3.29 and 3.24). Thus the FLEX pump will be available to be placed in service at any point after 10 hours as required to makeup to the CST. The FLEX pump will be maintained in the on-site FLEX storage building. The FLEX pump will be transferred and staged via haul routes and staging areas evaluated for impact from BDBEE hazards.

- Table 4 Action Number 11:

  9 hours and 21 minutes - Power up both divisions of station Class 1E battery chargers using FLEX 600 V DGs to supply power to both divisions of Class 1E emergency 600 V buses C and D - Time sensitive after 14 hours. Battery durations are calculated to be greater than 14 hours. The on-site 600V FLEX DG will be deployed and in service to power the battery chargers. The on-site 600V FLEX DGs will be maintained in the on-site FLEX storage building. The on-site FLEX DGs will be transferred and staged via haul routes and staging areas evaluated for impact from BDBEE hazards.

- Table 4 Action Number 11A:

  8 hours and 59 minutes - Initiate forced ventilation with portable fans on the 130 foot elevation of the control building. These actions will provide ventilation/cooling to the switchgear rooms and the hallways on the 130 foot elevation of the control building. Time sensitive at 10 hours. Hot air will be exhausted to the Turbine Building. This action is time sensitive after repowering the switchgear due to the extra heat load in these areas, which needs to be exhausted (Reference 3.71). These areas are readily accessible at the ground floor elevation of the control building. The fans are portable and will be powered by the FLEX miscellaneous generator, which will be deployed nearby on the west side of the control building.

- Table 4 Action Number 11B:

  11 hours 5 minutes - Initiate MCR ventilation/cooling using the MCR HVAC system. After the 600V FLEX DGs are placed in service, power is available to the MCR HVAC system. Cooling water flow is available to the MCR HVAC system via the FLEX pump and system cross-connects

to the PSW system, which provides cooling water flow to the MCR HVAC system. Time sensitive at 13 hours.

- Table 4 Action Number 13:

  10 hours 3 minutes - Swap RCIC suction from the suppression pool to the CST when suppression pool level impacts RCIC required NPSH (between 146 in. and 102 in.) or before suppression pool level reaches 102 inches. - Time sensitive at approximately 19 hours when the reduction in suppression pool level begins to impact RCIC required NPSH or when 102 inches is reached (102 inches is the limiting level to maintain coverage over the RCIC exhaust).

2.19 Programmatic Elements

2.19.1 Overall Program Document

Southern Nuclear Operating Company's (SNC) program for FLEX in response to a BDBEE is described in two documents; the program description - for common elements applicable to all SNC sites (NMP-GM-038, Reference 3.74), and a program document specific for each of the SNC sites (NMP-GM-038-002 for HNP, Reference 3.75). Together, the two documents describe the FLEX program for HNP.

Key elements of the HNP FLEX program include:

- A summary of FLEX strategies including validation methods
- A description of FLEX equipment including:
  - Quality attributes
  - Maintenance and testing
  - Availability tracking
  - Storage
  - Requirements for deployment
- A description of SNC's FLEX procedure development including:
  - The interface between design basis and beyond design basis procedures
  - Procedure maintenance

- Application of procedures during emergencies

- Plant configuration control:
  - Changes to FLEX strategies
  - Configuration management
  - Activities that potentially affect FLEX strategies
  - Plant configuration control processes during emergencies
- A summary of personnel related items including staffing and training

2.19.2 Procedural Guidance

The overall plant response to an ELAP concurrent with LUHS is accomplished through normal plant command and control procedures and practices. The inability to predict plant conditions following an extreme external event has prompted the creation of a new set of procedures. These procedures, FLEX Support Guidelines (FSGs), provide guidance for deployment of FLEX equipment. FSGs are written such that they can be implemented during a variety of post event conditions. When the use of FLEX equipment is required for response to a FLEX stylized BDBEE, EOPs or AOPs will direct the entry into and exit from the appropriate FSG. This procedure approach conforms to NEI 12-06, Section 11.4 guidance for the relationship between FLEX procedures and other relevant plant procedures.

FSGs at HNP were developed to provide pre-planned strategies for accomplishing specific tasks associated with implementation of FLEX strategies. Strategy Implementation Guides (SIGs) were developed to have operator actions in the field included in a separate "operator friendly" procedure format. The FSGs and SIGs together are equivalent to the generic FSGs.

Changes to plant procedures including FSGs and SIGs are screened using existing procedural guidance which incorporates the aspects of NEI 96-07, Revision 1 (Reference 3.76), and NEI 97-04, Revision 1 (Reference 3.77).

2.19.3 Staffing

Using the methodology of NEI 12-01, Guideline for Assessing beyond Design Basis Accident Response Staffing and Communications Capabilities (Reference 3.78), assessments of the capability of the HNP 1 & 2 on-shift staff and ERO to respond to a BDBEE were performed for Phase 1 and for Phase 2 staffing studies (References 3.109 and 3.97).

2.19.4 Training

Training has been developed and delivered to the target populations (operations, maintenance, engineering, security, and ERO staff) using the systematic approach to training (SAT) process. The training conducted by SNC satisfies the requirements of NEI 12-06, Section 11.6.

The SNC general population is trained using NANTeL courses provided by the Emergency Response Training Development (ERTD) Working Group (INPO facilitated). The ERTD conducted a job analysis to identify common training topics and coordinated the design and development of common training materials.

SNC staff responsible for the implementation of the FSGs also complete additional NANTeL training provided by the ERTD working group.

ERO decision makers receive additional training on directing actions and implementing strategies following a BDBEE.

2.19.5 FLEX Equipment List

The equipment necessary for the implementation of the FLEX strategies in response to a BDBEE at HNP is listed in Table 5. The table includes the quantity and equipment performance criteria for the required FLEX equipment. FLEX equipment is primarily stored in the FLEX storage building. Some equipment (for SFP makeup) is stored near its staging area in the reactor building and some FLEX communications equipment is stored in the control building.

2.19.6 N+1 Equipment Requirement

NEI 12-06 invokes an N+1 requirement for the FLEX equipment that directly performs a FLEX mitigation strategy for core cooling, containment, or SFP cooling in order to assure reliability and availability of the FLEX equipment required to meet the FLEX strategies. Sufficient equipment is available to address all functions at all units on-site, plus one additional spare, i.e., an N+1 capability, where "N" is the number of equipment required by FLEX strategies for all units on-site. Where a single resource is sized to support the required function of both units a second resource is available to meet the +1 capability. In addition, where multiple strategies to accomplish a function have been developed, the equipment associated with each strategy does not require N+1 capability. Plant Hatch provided additional hose or cable equivalent to 10% of the total length of each type/size of hose or cable necessary for the "N" capability as described in NEI 12-06, Revision 2, Section 3.2.2 to establish the quantities of N+1 hose and cable. Plant unavailability tracking guideline provides the quantity details for each type of hose and cable.

The N+1 requirement does not apply to the FLEX support equipment, vehicles, and tools. However, these items are subject to inventory checks, requirements, and any associated maintenance and testing.

Table 5: On-site Major FLEX Equipment		
FLEX Equipment	**Performance Criteria**	**Qty Required w/ one Storage location**
FLEX Pump Package for pumping from UHS to CST, SFP, and RPV (200% capacity).	Pump Package includes 2 submersible booster pumps with integrated strainers. The FLEX pump is sized for 3,000 gpm @ 150 psi	2
4 in. Wye Strainer	Cast steel 300# flanged ends, 1/16 in. mesh	3
Portable Spray Monitors	800 gpm @ 200 psia	3
Flow Tube w/ 2.5 in. couplings	30-850 gpm	3
Vehicle	With sufficient rating to tow FLEX pumps, DGs, etc.	2
Portable Air Compressor – Diesel	Rated for a 100 psig at 185 CFM. Minimum pressure required to operate E11-F014A.	3
Diesel Generator	For Division I and II 600V safety buses and battery chargers	3
Diesel Generator	Sufficient to power miscellaneous loads such as ventilation fans	1
Portable FLEX Fan	For ventilation of each Switchgear Room to the hallway. Fans are rated for 8,000 CFM, wheel mounted	4
Portable FLEX Fan	For ventilation of the Switchgear Rooms from the hallway to the Turbine Building. Fan is rated for 15,000 CFM, wheel mounted	1
Portable FLEX Fan	For ventilation of the Battery Rooms. Fans are rated for up to 780 CFM at 25 Pa. Door frame assembly to seal fan within door.	4
Trailer	Means to store and transport hoses, strainers, cables, and miscellaneous equipment.	4 Cable Trailers 2 Hose Trailers
Trailer with Fuel Tank, Portable Fuel Containers, hoses and adapter	528 gallon. Provides diesel fuel to FLEX equipment. Adapter is for ½ in. alternate fill connections	3
Monitor Spray Nozzles for SFP Spray and required hoses	Sprays 250 gpm of makeup water	3
Rapidly Deployable Communications Kit	RAPIDCASE	1
Rapidly Deployable Communications Kit	RAPIDCOM mobile communications trailer	1

2.19.7 Equipment Maintenance and Testing

FLEX equipment (including support equipment) is subjected to initial acceptance testing and to periodic maintenance and testing utilizing the guidance provided in INPO AP 913, Equipment Reliability Process (Reference 3.93), to verify proper function.

The standard EPRI industry PM process (similar to the Preventive Maintenance Basis Database) is used to establish the maintenance and testing actions for FLEX equipment. This provides assurance that stored or pre-staged FLEX equipment is being properly maintained and tested.

EPRI FLEX maintenance templates (where provided) were used to develop the specific maintenance and testing guidance for the associated FLEX equipment. In the absence of an EPRI FLEX template, existing maintenance templates (where available) were used to develop the specific maintenance and testing guidance. For all other equipment not covered by a maintenance template, manufacturer OEM or industry standards were used to determine the recommended maintenance and testing.

The PM Templates include activities such as:

- Functional Test and Inspection
- Fluid Filter Replacement
- Fluid Analysis
- Generator Load Test
- Component Operational Inspection
- Standby Walkdown

2.19.8 FLEX Equipment Unavailability Tracking

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

The unavailability of FLEX portable equipment, connections and FLEX installed equipment is controlled using the tracking application in the Shift Operations Management System (eSOMS) per NMP-OS-019-013, Beyond Design Basis Equipment Unavailability Tracking (Reference 3.82).

FLEX equipment and connections will not normally be used for purposes other than emergency response. It is permissible, however, to pre stage and/or use FLEX equipment and connections provided the following requirements are met:

- Permission is received from the Shift Manager or Emergency Director.
- The proper action to restore the equipment to an available status is determined and the status of the affected equipment and/or connection is tracked per NMP-OS-019-013.

FLEX equipment and resources may be allocated when requested to support a beyond design basis emergency event at another nuclear site provided the following requirements are met:

- Permission is received from the Site Duty Manager per NMP-EP-002, Duty Manager (Reference 3.83)
- The status of the allocated equipment is tracked and unavailability actions implemented per NMP-OS-019-013 (Reference 3.82).

3. References

3.1 SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," dated July 12, 2012 (ADAMS Accession No. ML11186A950)

3.2 NRC Order Number EA-12-049, Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for BDBEEs, dated March 12, 2012 (ADAMS Accession No. ML12056A045)

3.3 Nuclear Energy Institute (NEI) 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, Revision 0, dated August 2012 (ADAMS Accession No. ML12242A378)

3.4 NRC Interim Staff Guidance JLD-ISG-2012-01, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for BDBEEs, Revision 0, dated August 29, 2012 (ADAMS Accession No. ML12229A174)

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

3.6 Nuclear Energy Institute (NEI) 12-02, Industry Guidance for Compliance with NRC Order EA-12-051, To Modify Licenses with Regard to Reliable SFP Instrumentation, Revision 1, dated August 2012 (ADAMS Accession No. ML12240A307)

3.7 NRC Interim Staff Guidance JLD-ISG-2012-03, Compliance with Order EA-12-051, Reliable SFP Instrumentation, Revision 0, dated August 29, 2012 (ADAMS Accession No. ML12221A339)

3.8 NUMARC 87-00, Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors, Revision 1

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