Entergy

Entergy Operations, Inc.
P.O. Box 756
Port Gibson, MS 39150

Kevin Mulligan
Site Vice President
Grand Gulf Nuclear Station
Tel. (601) 437-7500

GNRO-2016/00006

May 24, 2016

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

SUBJECT: Notification of Full Compliance with NRC Order EA-12-049 Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)
Grand Gulf Nuclear Station, Unit 1
Docket No. 50-416
License No. NPF-29

REFERENCES:

1. NRC Order Number EA-12-049, *Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events*, dated March 12, 2012 (ML12054A735)
2. Entergy Letter to NRC, *Overall Integrated Plan in Response to March 12, 2012, Commission Order Modifying License with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)*, dated February 27, 2013 (GNRO-2013/00015, ML13059A316)
3. NRC Letter to Entergy, Grand Gulf Nuclear Station, Unit 1 – *Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies)(TAC No. MF0954),* dated February 19, 2014
4. NRC Letter to Entergy, Grand Gulf Nuclear Station, Unit 1 – *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. MF0954 and MF0955)*, dated November 24, 2015 (ML15308A298)

Dear Sir or Madam:

The purpose of this letter is to notify the Nuclear Regulatory Commission (NRC) that Entergy Operations, Inc. (Entergy) is in compliance with Order EA-12-049 for Grand Gulf Nuclear Station (GGNS), Unit 1. On March 12, 2012, the NRC issued Order EA-12-049 (Reference

1), *Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (BDBEEs)* to Entergy. Reference 1 was immediately effective and directed Entergy to develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities in the event of a beyond-design-basis external event. GGNS submitted the Overall Integrated Plan (OIP) to the NRC on February 27, 2013 (Reference 2). Changes to the OIP have been submitted pursuant to Section IV, Condition C.2. of Reference1, with the issuance of six-month status reports.

In Reference 3, the NRC issued an interim staff evaluation (ISE) for Order EA-12-049, which identified open and confirmatory items requiring resolution by Entergy.

In Reference 4, The NRC issued a report for an audit conducted at GGNS regarding implementation of mitigating strategies and reliable SFP instrumentation related to Orders EA-12-049 and EA-12-051, *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*. The audit included a review and closure of Entergy's responses for GGNS to the ISE open and confirmatory items as documented in Reference 4 and Attachment 4 to this submittal.

Order EA-12-049, Section IV.A.2, requires full implementation no later than two refueling cycles after submittal of the OIP or December 31, 2016, whichever comes first. In addition, Section IV.C.3 of Order EA-12-049 requires that licensees report to the NRC when full compliance is achieved. On March 25, 2016 Grand Gulf entered Mode 2 (startup) at which time GGNS was in full compliance with Order EA-12-049.

This letter contains no new regulatory commitments. Should you have any questions regarding this submittal, please contact Mr. James J. Nadeau, Regulatory Assurance Manager, at (601) 437-2103.

I declare under penalty of perjury that the foregoing is true and correct; executed on May 24, 2016.

Sincerely,

for KJM

KJM/sas

Attachments:
1. Compliance with Order EA-12-049
2. Order EA-12-049 Compliance Elements Summary
3. Audit Open Item Response
4. ISE Open and Confirmatory Item Responses
5. Final Integrated Plan

cc: U.S. Nuclear Regulatory Commission
ATTN: Mr. Jim Kim, NRR/DORL (w/2)
Mail Stop OWFN 8 B1
Rockville, MD 20852-2738

U.S. Nuclear Regulatory Commission
ATTN: Mr. Marc Dapas (w/2)
Regional Administrator, Region IV
1600 East Lamar Boulevard
Arlington, TX 76011-4511

Mr. B. J. Smith
Director, Division of Radiological Health
Mississippi State Department of Health
Division of Radiological Health
3150 Lawson Street
Jackson, MS 39213

NRC Senior Resident Inspector
Grand Gulf Nuclear Station
Port Gibson, MS 39150

Attachment 1 to GNRO-2016/00006

Compliance with Order EA-12-049

Compliance with Order EA-12-049

On March 12, 2012, the NRC issued Order EA-12-049, *Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (BDBEEs)*. This Order was effective immediately and directed sites to develop and implement strategies and guidance to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities in the event of a BDBEE.

Grand Gulf Nuclear Station (GGNS) developed a Final Integrated Plan (Attachment 5), documenting the diverse and flexible strategies (FLEX), in response to NRC Order EA-12-049. The information provided herein documents full compliance with the Order for Grand Gulf Nuclear Station, Unit 1.

GGNS has a finalized response to the Audit Report Open Item which is summarized in Attachment 3.

Milestone	Completion Date
Submit 60 Day Status Report	Oct 2012
Submit Overall Integrated Plan	Feb 2013
Submit Six-Month Updates:	
Report 1	Aug 2013
Report 2	Feb 2014
Report 3	Aug 2014
Report 4	Feb 2015
Report 5	Aug 2015
Report 6	Feb 2016
Report 7	Deleted
Perform Staffing Analysis	Oct 2015
Modifications	Mar 2016
On-site FLEX Equipment	Dec 2015
Off-site FLEX Equipment	Sept 2015
Procedures	Mar 2016
Training	Feb 2016

Attachment 2 to GNRO-2016/00006

Order EA-12-049 Compliance Elements Summary

Order EA-12-049 Compliance Elements Summary

The elements identified below are included in the Grand Gulf Nuclear Station Final Integrated Plan (FIP) (Attachment 5) and demonstrate compliance with Order EA-12-049.

Strategies – Complete

GGNS strategies are in compliance with Order EA-12-049 and are documented in the FIP.

Staffing - Complete

The staffing study for GGNS has been completed in accordance with 10 CFR 50.54(f), "Request for Information Pursuant to Title 10 of the Code of Federal Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force review of Insights from the Fukushima Dai-ichi Accident," Recommendation 9.3, dated March 12, 2012. GGNS submitted the Phase 2 staffing assessment in response to the 50.54(f) letter on October 21, 2015 (GNRO-2015/00054).

Modifications – Complete

The modifications required to support the diverse and flexible strategies (FLEX) strategies documented in the FIP for GGNS have been implemented in accordance with the station design control process.

Equipment – Procured and Maintenance & Testing – Complete

The equipment required to implement the FLEX strategies for GGNS was procured in accordance with Nuclear Energy Institute (NEI) 12-06, Sections 11.1, *Quality Attributes*, and 11.2, *Equipment Design*, initially tested/performance verified in accordance with NEI 12-06, Section 11.5, *Maintenance and Testing*, and is available for use.

As discussed in the FIP, maintenance and testing is conducted through the use of the GGNS preventive maintenance program such that equipment reliability is achieved.

Protected Storage – Complete

The storage facilities required to implement the FLEX strategies for GGNS have been completed and provide protection from the applicable site hazards, as discussed in the FIP. The equipment required in order to implement the FLEX strategies for GGNS is stored in its protected configurations.

Procedures – Complete

FLEX Support Guidelines (FSGs) for GGNS have been developed, and integrated with existing procedures. The FSGs and procedures have been validated per NEI 12-06, Section 11.4.3, *Development Guidance for FSGs*, and have been issued for use in accordance with the site procedure control program.

Training – Complete

Initial compliance training has been completed in accordance with an accepted training process as recommended in NEI 12-06, Section 11.6, *Training.*

National SAFER Response Centers - Complete

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

Validation - Complete

Entergy has completed performance of validation activities in accordance with industry developed guidance to assure required tasks and manual actions for FLEX strategies are feasible and may be executed within the constraints identified in the FIP (Attachment 5) for Order EA-12-049.

FLEX Program Document – Established

The GGNS FLEX program document, EN-OP-201-02, "Diverse and Flexible Coping Strategies (FLEX) Fleet Program Document," has been developed and issued in accordance with the requirements of NEI 12-06.

Attachment 3 to GNRO-2016/00006

Audit Open Item Response

Audit Open Item

GGNS Storage Building Seismic Design – Response to NRC Open Item ISE CI 3.1.1.1.A

Licensee Input Needed:

The NRC staff request that the licensee make available an evaluation of the ability of the FSBs to survive a safe shutdown earthquake.

Audit Open Item Response:

The Grand Gulf Nuclear Station (GGNS) FLEX storage buildings were designed via the 2012 International Building Code (IBC). IBC invokes ASCE 7-10 throughout the document. The seismic design input spectra was obtained from ASCE 7-10 which is in accordance with NEI 12-06 Section 5.3.1.1.b. ASCE 7-10 provides a spectra with lower spectral accelerations than the GGNS safe shutdown earthquake (SSE). At the request of the NRC, the ability of the structure to resist plant SSE accelerations was evaluated. The ASCE 7-10 based seismic reactions obtained from the FLEX storage building vendor were increased accordingly for this evaluation. In order to determine the acceptability of the existing design to the higher accelerations, these higher seismic reactions were then compared to the wind reactions.

The design input wind speed of 165 mph significantly exceeds the ASCE 7-10 requirements. A thorough review of the design determined that the reactions from the excess wind speed govern over SSE loading. The existing design is therefore acceptable.

The table below summarizes the governing design element (Braces) ratios between wind and SSE reactions. Note that the individual building frames and end wall members also have margin over SSE reactions beyond what is shown below. Per GGNS UFSAR, section 2.5.2.5, due to the conservatism of the SSE design spectrum with the peak acceleration characterized for the soil column, no additional analysis to take account for the site soil column is necessary.

Table 1: Wind and Seismic SSE Comparison for Governing Design Element

	Wind Reactions (kip)		**SSE Reactions (kip)**		**Wind capacity over SSE forces (Wind reaction/SSE reaction)**	
	Horiz.	**Vert.**	**Horiz.**	**Vert.**	**Horiz.**	**Vert.**
GGNS North & South Storage Buildings	12.9	9.7	5.2	4.1	2.5	2.4

Attachment 4 to GNRO-2016/00006

ISE Open and Confirmatory Item Responses

Interim Staff Evaluation Open Item and Confirmatory Item Responses

On February 19, 2014, the NRC issued the Interim Staff Evaluation (ISE) for Grand Gulf Nuclear Station (GGNS) Unit 1 (ML 14007A718). In that document, one open item and seventeen confirmatory items were identified. A NRC onsite audit was conducted at GGNS during the week of October 19, 2015, during which all of the confirmatory and open items were closed, with the exception of the item discussed in Attachment 3, as documented in the audit report. Listed below are the Entergy responses to the ISE open and confirmatory items in addition to the one provided in Attachment 3. These responses were provided to the NRC before and during the onsite audit.

ISE Open Item 3.1.2.A

Since the GGNS Probable Maximum Precipitation is greater than the grade elevation and sandbags are needed to protect against flooding, it is unclear how GGNS can be designated as a "dry" site. Since the licensee identified GGNS as a dry site, licensee information related to NEI 12-06 guidelines identified in this report, Sections 3.1.2.1, 3.1.2.2, and 3.1.2.3 (storage, deployment, and procedural interfaces, respectively) are not discussed. If the resolution of this Open Item results in GGNS not being categorized as a "dry" site, the guidelines of the NEI 12-06 Sections related to these report sections will need to be addressed by the licensee as part of that resolution.

GGNS Response:

See section 4 of Entergy's Second Six-Month Status Report in Feb 2014 (ML14059A080):

The external flood hazard assessment for GGNS is discussed on OIP page 1 of 69. The site was originally designated as a dry site for FLEX because the GGNS UFSAR, in Appendix 3A, identified the plant as a dry site based on the plant grade elevation being 30 feet greater than the probable maximum flood (PMF) level. However, after consideration of the updated flood level due to probable maximum precipitation (PMP), the need for flood barriers for PMP, and the guidance of NEI 12-06, Entergy has determined that GGNS will be classified as a wet site for beyond design basis events. As such, the GGNS FLEX strategy incorporates, as applicable, the guidance of NE12-06, Revision 0, sections 6.2.2 and 6.2.3 (including sub-sections 6.2.3.1 through 6.2.3.4). EC50287, Revision 0, "FLEX Storage Buildings" section 3.6.2 and calculation CC-N1FLEX-14002, Rev. 0, section 2.0, document that due to the 6" curb installed on the FLEX Storage Buildings (FSBs), they are protected from bounding flooding due to local intense precipitation (LIP). The "effective top-of-slab" elevation of 163.5 feet for the North FSB (Site 1) and 133.7 feet for the South FSB (Site 4) are both above the projected maximum flood elevations at the building locations due to local intense precipitation (LIP) of 163.2 feet and 133.5 feet, respectively.

Deployment Paths:

The deployment path from the North FSB (Site 1) dips to 6 ft below the Stream A maximum reevaluated probable maximum flood level of 132.5 feet (including wind-wave effects) documented in ML13071A457 preventing the deployment of the FLEX equipment from the North FSB for this specific flooding scenario. For the timeline of this predictable initiating event the South FSB deployment path remains accessible allowing deployment of the FLEX equipment. Similarly, for the projected maximum flood elevation along the deployment path from the South FSB due to LIP, the deployment path could experience a transient maximum water depth of 1.5 ft. ML13071A457 documents that this maximum flood level drops significantly (to about one-half max) within 2 hours and FLEX equipment deployment would not be needed until about 6 hours. Therefore, for the GGNS flooding initiating events documented in ML13071A457 the South FSB is provided and remains accessible with a full complement of FLEX equipment to implement the mitigating strategies.

ISE Confirmatory Item 3.1.1.1.A

Confirm that the storage facilities and plans will conform to the guidance in NEI 12-06, Section 5.3.1, for protection from seismic events.

GGNS Response:

See section 4 of Entergy's Second Six-Month Status Report in Feb 2014 update (ML14059A080) and Attachment 3 to this submittal:

While onsite, NRC staff reviewed the Grand Gulf Nuclear Station (GGNS) strategy for protecting FLEX equipment from seismic hazards. EC50287, Revision 0, “FLEX Storage Buildings” section 3.6.1 installed two pre-engineered metal buildings which are designed for seismic loads per NEI 12-06, Revision 0, section 5.3.1.1.b (ASCE 7-10 and local building codes). Soil borings have been taken along the primary travel path from each building to the deployment (staging) locations to ensure that at least one pathway will not be susceptible to soil liquefaction, which satisfies NEI 12-06, Section 5.3.2.1 for soil liquefaction.

ISE Confirmatory Item 3.1.3.1.A

Confirm that at least one of the two FLEX equipment storage buildings would not be damaged by tornado missiles, based on the guidance in NEI 12-06, Section 7.3.1.

GGNS Response:

See section 4 of Entergy's Second Six-Month Status Report in Feb 2014 update (ML14059A080) and Engineering Report GGNS-SA-14-00004, Revision 1:

While onsite, the NRC staff reviewed the GGNS strategy for protecting FLEX equipment form high wind and tornado missile hazards. EC50287, Revision 0, “FLEX Storage Buildings” section 3.6.3 documents that GGNS has two pre-engineered metal buildings which are designed in accordance with NEI 12-06, Revision 0, section 7.3.1.1.c (ASCE 7-10 and local building codes) to address high wind design criteria. Specifically, the storage buildings locations are separated to provide reasonable assurance that at least one of the storage buildings would not be damaged by tornado winds and tornado-generated missiles. A tornado separation evaluation for the two storage buildings has been completed (GGNS-SA-14-00004, Revision 1). Based on this evaluation, the licensee concluded that 90th percentile tornado is 990 feet wide and travels from the southwest to northeast direction. The FLEX storage buildings are located over 1500 feet apart on this southwest to northeast axis to ensure adequate separation.

ISE Confirmatory Item 3.1.3.2.A

Confirm that procedures address UHS usability when wind generated debris is present in the UHS.

GGNS Response:

While onsite, the NRC staff reviewed the GGNS strategy for addressing wind-generated debris in the ultimate heat sink (UHS). To preclude ingestion and transport of large debris into the RPV or SFP, EC50275, Revision 2, "FLEX Basis Engineering Change (EC)", section 3.1.40 and the GGNS FLEX Support Guidelines (05-S-01-FSG-005, Revision 0 and 05-S-01-FSG-003, Revision 0) document that the GGNS strategy includes use of a suction debris strainer for the Phase 2 FLEX pump. Small debris and dissolved material has been evaluated to not impede cooling by the BWROG in BWROG-TP-14-006. The GGNS strategy follows the recommendation in BWROG-TP-14-006 to inject water into the core shroud region.

ISE Confirmatory Item 3.2.1.1.A

Confirm that the final Modular Accident Analysis Program Revision 4 (MAAP4) analysis of the RCS response conforms to the NEI position paper dated June 2013, entitled "Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications" (ADAMS Accession Number ML 13190A201) and the MAAP4 limitations of the NRC endorsement letter, dated October 3, 2013 (ADAMS Accession No. ML 13275A318).

GGNS Response:

The MAAP4 analysis contained in Case B of Appendix 9 of calculation XC-Q1111-14005, Revision 0, "Grand Gulf Core and Containment Analysis of FLEX Strategies" determines the conditions in the GGNS containment, drywell, and reactor vessel following a beyond design basis external event (BDBEE) resulting in an extended loss of A/C power (ELAP). The Modular Accident Analysis Program (MAAP) Version 4.0.6 BWR (Boiling Water Reactor) is used for this analysis. This calculation was developed consistent with the guidelines contained in the 2013 EPRI Technical Report 3002001785 (ML13190A201), with regards to the use of MAAP4 in support of post-Fukushima applications. Appendix 5 of the calculation contains a GGNS response to the letter of October 3, 2013 from Jack Davis (NRR) to Joe Pollock (NEI) (ML13275A318) regarding use of MAAP4 in simulating ELAP events for BWRs, addressing each one of the limitations stated on the NRC endorsement letter.

ISE Confirmatory Item 3.2.1.2.A

Confirm that the MAAP4 analysis includes appropriate recirculation pump seal leakage.

GGNS Response

Recirculation pump seal leakage is included in section 5.0 of the MAAP4 analysis contained in Case B of Appendix 9 of calculation XC-Q1111-14005, Revision 0, "Grand Gulf Core and Containment Analysis of FLEX Strategies". The initial GGNS recirculation pump seal leakage in Case B is 18 gallons per minute (gpm) per pump seal and 30 gpm allowed Technical Specification pressure boundary leakage for a total leakage of 66 gpm at normal operating reactor pressure. Primary system leakage is modeled to start at time zero and varies with reactor pressure. The RPV leakage location is set at the reactor recirculation pump suction nozzle elevation to simulate leakage from the recirculation pump seals. Additionally, to determine the impact of increased seal leakage on RPV Level; drywell and containment temperature; and drywell and containment pressure; Case F of Appendix 9 of calculation XC-Q1111-14005, Revision 0, also analyzes the FLEX strategy of Case B of Appendix 9 with an initial increased seal leakage between 100 gpm to 184 gpm prior to RPV injection with the FLEX pump. Primary system leakage and pressure are included in the evaluation of the FLEX make-up pump requirements when RPV depressurization is performed.

ISE Confirmatory Item 3.2.1.3.A

Confirm that the final Sequence of Events (SOE) reflects the results of the final MAAP4 analysis of the RCS response and the licensee provides reasonable assurance by some means (e.g. by walkthrough) that the timing of the actions in the SOE is achievable.

GGNS Response:

The final SOE of Appendix 9, Case B of calculation XC-Q1111-14005, Revision 0 is included in the Table 3-4 timeline in Section 3.1.8 of EC50275, Revision 2, "FLEX Basis EC" and the SOE Timeline in Attachment 1 to transmittal CIN2016-00023. CIN2016-00023 documents that the timeline has been validated in accordance with the elements of Appendix E to NEI 12-06, Revision 1, "Validation Guidance" and includes consideration of the required staffing documented in transmittal CIN2016-00031, "GGNS NEI 12-01 Phase 2 Staffing Assessment (Revision 1)".

ISE Confirmatory Item 3.2.1.4.A

Confirm that operation with the suppression pool temperature at its calculated maximum temperature will not impact the mitigation strategies, especially RCIC operation and structural integrity of the suppression pool.

GGNS Response:

While onsite, the staff reviewed the GGNS MAAP4 containment analysis, XC-Q1111-14005, Revision 0, (specifically Case B of Appendix 9). Section 1.0(1) of Appendix 9 to the analysis, GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-7, Revision 0, "Extended Loss of AC Power (ELAP)", and the GGNS FLEX Support Guideline (05-S-01-FSG-002, Revision 0, "Alternate RCIC Suction Source") confirm the GGNS strategy to manually realign the Reactor Core Isolation Cooling (RCIC) system pump suction from the Suppression Pool (SP) to the Upper Containment Pool (UCP) when the SP temperature reaches 170°F. This is well in advance of any RCIC pump net positive suction head (NPSH) concerns as further documented in section 2.0 and Attachment 2 of calculation MC-Q1111-14001, Revision 0, "GGNS RCIC NPSH Available for a BDBEE". The SP and UCP temperatures are modelled to initially be at the maximum Technical Specification allowable values of 95°F and 125°F, respectively, at the time of the initiating event. Therefore, the increasing temperatures in the SP and UCP do not impact RCIC operation.

Case B of Appendix 9 of the GGNS containment analysis for the mitigating strategies, XC-Q1111-14005, shows that drywell temperature, drywell pressure, containment pressure, core temperature, and RPV water level all remain within acceptable design values. The analysis showed that the peak containment temperature of 233F and the peak SP water temperature of 226F are limited to slightly above their design values of 215°F by 18°F and 11°F, respectively. GGNS confirmed continued containment integrity at these temperatures in GGNS calculation CC-Q1M10-14001, Revision 0, "Evaluation of Containment Wall for FLEX Strategy" and in EC50275, Revision 2, "FLEX Basis EC".

ISE Confirmatory Item 3.2.1.8.A

Confirm that the hydraulic calculations for the FLEX pumps demonstrate that the required flow rates can be achieved.

GGNS Response:

Calculations MC-Q1111-14008, Revision 0, "GGNS FLEX Phase 2 Pump Sizing" and MC-Q1111-14007, Revision 0, "GGNS FLEX Pump NPSHA", along with the FIP (GNRO2016-00006 Attachment 5) and XC-Q1111-14005, Revision 0, "Grand Gulf Core and Containment Analysis of FLEX Strategies" provide the portable / FLEX pump head / flow characteristics, suction and discharge losses, system backpressure, elevation differences, piping losses, and the required water flow rates to support the mitigating strategies.

While onsite, the NRC staff reviewed the GGNS hydraulic analysis of the FLEX pumping system which provides cooling and makeup water to the RPV and SFP. Calculation MC-Q1111-14008 determines the minimum capability needed for the Phase 2 FLEX pump to simultaneously provide the required flow rates of the strategy for both RPV makeup and SFP spray. The results of this analysis show that a pump capable of delivering 500 gpm (250 gpm for RPV makeup and 250 gpm for SFP spray) at a total dynamic head of 337 ft (146 psi) is required to provide makeup to the RPV and SFP. EC50275, Revision 2, "FLEX Basis EC", confirms the head / flow characteristics of the specified Hale Model IPH1250/175DJ-TC pump meet these requirements.

GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-7, Revision 0, "Extended Loss of AC Power (ELAP)" and GGNS FLEX Support Guidelines (05-S-01-FSG-003, Revision 0, "Alternate Reactor Vessel Cooling", 05-S-01-FSG-005, Revision 0, "Initial Assessment and FLEX Equipment Staging", and 05-S-01-FSG-011, Revision 0, "Alternate Spent Fuel Makeup and Cooling") provide the procedural controls for the GGNS strategy to simultaneously provide the required bounding flow rates for both RPV makeup and SFP spray.

ISE Confirmatory Item 3.2.2.A

Confirm that the SFP area ventilation calculation demonstrates that portable ventilation is not required in the SFP area, or that the licensee provides a strategy to use portable ventilation.

GGNS Response:

Prior to SFP boiling (approximately 5 hours for a full core offload and approximately 12 hours for a design basis heat load), GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-7, Revision 0, "Extended Loss of AC Power (ELAP)", and GGNS FLEX Support Guideline 05-S-01-FSG-005, Revision 0, "Initial Assessment and FLEX Equipment Staging" establish a vent pathway to minimize condensation of steam in the Auxiliary Building from the boiling SFP. Local Auxiliary Building interior door 1A601 (located at the ~208 ft elevation of the SFP) and exterior door 1A605 (located at the 229 ft roof elevation) are opened to vent the SFP area through stairwell 1A10 to the

atmosphere. An evaluation was performed in EC50275, Revision 2, "FLEX Basis EC", section 3.1.30 that confirms the selected vent path for the SFP area provides a flow capacity that exceeds the SFP boil off rate with no reliance on additional portable ventilation equipment.
In ONEP 05-1-02-I-7 an operator is directed to open these doors to create the SFP area vent pathway at 4 hours. For the design basis heat load the SFP is not expected to start boiling until 12 hours after the initiating event. Thus there is sufficient amount of conservatism in the timeframe in which operators can complete this action.

ISE Confirmatory Item 3.2.3.A

Confirm that the licensee's strategy for maintaining containment capabilities considers the results of the final MAAP4 analysis for RCS leakage and the containment venting strategy.

GGNS Response:

While onsite, the staff reviewed the GGNS MAAP4 containment analysis, XC-Q1111-14005, Revision 0, "Core and Containment Analysis of FLEX Strategies" (specifically Case B of Appendix 9). Case B of section 2.0 of Appendix 9 to the analysis, the GGNS Off-Normal Event Procedure 05-1-02-I-7, Revision 0, "Extended Loss of AC Power (ELAP)", and the GGNS FLEX Support Guideline (05-S-01-FSG-012, Revision 0, "Alternate Containment Cooling and Hydrogen Control") confirm and support the capability of the GGNS containment venting strategy to maintain containment integrity including consideration of the reactor coolant system (RCS) leakage of section 5.0 of Appendix 9 to the analysis (also see the GGNS Response to ISE Confirmatory Items 3.2.1.2.A and 3.2.1.3.A of this submittal).

The GGNS final containment analysis, XC-Q1111-14005, Revision 0, "Core and Containment Analysis of FLEX Strategies", documents the MAAP4 calculations performed to evaluate the containment pressure and temperature response for 240 hours during an ELAP event. Case B of Appendix 9 is the specific MAAP run that represents the GGNS ELAP scenario as described in section 2.5 and the Sequence of Event (SOE) Table 6 of section 2.17 of the final integrated plan (FIP) (GNRO2016-00006 Attachment 5).

Appendix 9 (Case B) of calculation XC-Q1111-14005, Revision 0, specifically documents the inputs and assumptions used in the analysis to develop the mitigating strategies containment performance response. The results of the containment analysis show that the drywell and containment pressures remain well below the design values of 30 psig and 15 psig, respectively. The drywell temperature also remains well below its design value of 330°F. The results of the containment analysis show the containment temperature increase is limited to 18.1°F above the design value of 215°F and the suppression pool temperature increase is limited to 10.8°F above the design value of 215°F (also see the GGNS Response to ISE Confirmatory Item 3.2.1.4.A). GGNS confirmed continued containment integrity at these temperatures in GGNS calculation CC-Q1M10-14001, Revision 0, "Evaluation of Containment Wall for FLEX Strategy" and in EC50275, Revision 2, "FLEX Basis EC".

ISE Confirmatory Item 3.2.4.2.A

Confirm that the RCIC room heat up calculation for ELAP uses appropriate heat loads and shows an acceptable room temperature.

GGNS Response:

While onsite, the staff reviewed GGNS calculation, XC-Q1111-14003, Revision 0, "GGNS RCIC Pump Room Heat-up for ELAP". Figure 1 for Case 1 of section 2.0 of the analysis, GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-7, Revision 0, "Extended Loss of AC Power (ELAP)", and GGNS FLEX Support Guideline 05-S-01-FSG-004, Revision 0, "ELAP DC Bus Load Shed and Management" confirm and support the capability of the GGNS FLEX strategy to maintain an acceptable RCIC room temperature including consideration of the room heat load due to the SBO required operator response in GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-4, Revision 50, "Loss of AC Power" to load shed the DC power supply to the RCIC steam turbine gland seal compressor to conserve battery power.

GGNS performed GOTHIC calculation, XC-Q1111-14003, Revision 0, "GGNS RCIC Pump Room Heat-up for Extended Loss of AC Power," to determine the temperature in the RCIC pump room for 120 hours following an ELAP. This calculation incorporates applicable heat loads including the steam leakage heat load from the station blackout (SBO) required operator response to initially load shed the DC power supply to the RCIC steam turbine gland seal compressor. The analysis shows the RCIC room temperature approaches 193°F at 11 hours after the initiating event for Case 1, at which time the RCIC room temperature drops and remains below 150°F due to the Operator restoration of gland seal air to the RCIC turbine when the station battery chargers are reenergized by the 480 VAC 300 kW battery charger portable diesel generator. Additionally, because the equivalent leakage rate of 0.5 gpm from the gland seals is small and of limited duration, the gland seal leakage will not cause adverse flooding as evaluated in Section 3.1.28 of EC50275, Revision 2, "FLEX Basis EC".

The GGNS analysis demonstrates that the FLEX strategy maintains the RCIC room temperature below the established SBO acceptance criteria of 212°F during the time that RCIC is credited in the FLEX strategy (less than 72 hours) and beyond.

Although not precluded as indicated in section 3.2.5 and Attachment 1 of the GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-7, Revision 0, "Extended Loss of AC Power (ELAP)", no local operator actions are required inside the RCIC room for the FLEX mitigating strategy, thus personnel habitability is not an issue with DC power available.

ISE Confirmatory Item 3.2.4.4.A

Confirm that any required upgrades to the site's communications systems have been completed, as noted in the NRC's review of the GGNS communications assessment (ADAMS Accession No. ML13129A132).

GGNS Response:

EC50711, Revision 0, "EP Communications System Enhancements to Comply with NEI 12-01" Section 1.3 documents the required upgrades to the site's communications systems for compliance with the requirements of NEI 12-01, as noted in the NRC's review of the GGNS communications assessment (ML13129A132). Per EC50711 the required upgrades to the site's EP communication systems ensure that the credited EP Communication equipment associated with two (2) Radio Channels, handheld radios, and satellite phones has the necessary power and connectivity to remain operational following a BDBEE. Section 3.2 of the NRC's review of the GGNS communications assessment (ML13129A132), provides the guidance that prior NRC approval is not required for subsequent changes to the upgrades to the site's communications systems for compliance with NEI 12-01 as described in Attachment 1, paragraph 4.12 and Table 3 of GNRO2012/00131(ML12306A245) and GNRO2013/00014 (ML13053A091). Per EC50711 Revision 0, the required upgrades to the site's communication systems are complete.

ISE Confirmatory Item 3.2.4.8.A

Confirm that the licensee's analyses for size and loading of FLEX generators shows acceptable results.

GGNS Response:

While onsite, the staff reviewed GGNS calculation, EC-Q1111-14002, Revision 0, "FLEX Strategy – Portable Diesel Generator System Sizing". Section 6 of calculation EC-Q1111-14002; Sections 3.1.4.1, 3.1.4.5, and 3.1.4.7 of EC50275, Revision 2, "FLEX Basis EC"; Section 3.1.2.5 of EC50711, Revision 0, "EP Communications System Enhancements to Comply with NEI 12-01"; GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-7, Revision 0, "Extended Loss of AC Power (ELAP)"; and GGNS FLEX Support Guidelines (05-S-01-FSG-004, Revision 0, "ELAP DC Bus Load Shed and Management", 05-S-01-FSG-005, Revision 0, "Initial Assessment and FLEX Equipment Staging", 05-S-01-FSG-007, Revision 0, "Loss of Control / Instrumentation Power", 05-S-01-FSG-001, Revision 0, "Long Term Reactor Cooling", and 05-S-01-FSG-101, Revision 1, "Emergency Communication for BDBEEs") confirm and support the size and loading capability of each of the following portable diesel generators (PDGs) utilized for the GGNS FLEX and GGNS EP communication strategies:

- 480 VAC 300 kW generators selected to power the Division 1 and Division 2 battery chargers and a battery room exhaust fan (EC-Q1111-14002),
- 240 VAC 15 kW generators selected to power either division of hydrogen igniters (EC50275),
- 240/120 VAC 6 kW generators selected to power the portable FLEX control room ventilation fans (EC-Q1111-14002),
- 4160 VAC 1 MW National SAFER Response Center (NSRC) generators (EC-Q1111-14002), and
- 120 VAC 7.5 kW generators selected to power EP communications equipment (EC50711).

The FLEX electrical guidance and strategies supporting the maintenance or restoration of core cooling, containment integrity, and spent fuel pool (SFP) cooling capabilities are detailed further in section 2.3.11 and throughout the final integrated plan (FIP) (GNRO2016-00006 Attachment 5). Specific loads supported by the each of the portable diesel generators (PDGs) utilized for the GGNS FLEX and GGNS EP communication strategies follow:

One 480 VAC 300 kW portable diesel generator is used to repower Class 1E Load Centers 15BA6 and 16BB6 as shown on the one line diagram of drawing E1020, Revision 11. A dedicated breaker (52-15605) is installed on Division I 480 VAC Load Center 15BA6 to re-power battery charger 1DA4 and Battery Room Exhaust Fan 1Z77C001A; a dedicated breaker (52-16605) is installed on Division II 480 VAC Load Center 16BB6 to re-power battery charger 1DB4; and a new dedicated fused disconnect (89-171102A) is installed for repowering the HPCS DG Fuel Oil Storage Tank

Transfer Pump in accordance with GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-7, Revision 0, "Extended Loss of AC Power (ELAP)" and GGNS FLEX Support Guideline (05-S-01-FSG-004, Revision 0, "ELAP DC Bus Load Shed and Management". There is also a 120 VAC receptacle available at the auxiliary panel of the 300 kW portable DG for repowering the Phase 2 Containment Vent Uninterruptible Power Supply (UPS) (1M41PS01) shown on drawing E1213-040, Revision 0, "FLEX M41 Vent Path Control" in accordance with GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-7, Revision 0, "Extended Loss of AC Power (ELAP)" and GGNS FLEX Support Guideline (05-S-01-FSG-004, Revision 0, "ELAP DC Bus Load Shed and Management". A total of two 480 VAC, 300 kW portable diesel generators are stored and available for deployment, one in each of the FLEX storage buildings.

One 240 VAC 15 kW portable diesel generator is used to repower one train of hydrogen igniters in accordance with GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-7, Revision 0, "Extended Loss of AC Power (ELAP)" and GGNS FLEX Support Guideline (05-S-01-FSG-012, Revision 0, "Alternate Containment Cooling and Hydrogen Control". A total of two 240 VAC 15 kW PDGs are stored and available for deployment, one in each of the FLEX storage buildings.

One 240 VAC 6 kW portable diesel generator is used to power two portable MCR ventilation fans in accordance with GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-7, Revision 0, "Extended Loss of AC Power (ELAP)" and GGNS FLEX Support Guideline (05-S-01-FSG-005, Revision 0, "Initial Assessment and FLEX Equipment Staging". A total of two 240 VAC 15 kW PDGs are stored and available for deployment, one in each of the FLEX storage buildings.

Two 4160 VAC 1 MW National SAFER Response Center (NSRC) portable diesel generators will be used to repower the "B" RHR Pump (Q1E12C002B-B) and Room Cooler (Q1T51B004); "B" FPCC PUMP (Q1G41C001B-B) and Room Cooler (Q1T51B007B); Battery Charger 1DB4, MCC 16B31, SSW "B" fans (1P41C003C and 1P41C003D), 1B and 2B ESF Coolers (1T46B001B and 1T46B002B), CR A/C compressors (QSZ51B002B), CR A/C fans (QSZ51B002B), CR A/C auxiliaries (QSZ51B002B), CR standby fresh air system fans (QSZ51D002B), and CR standby fresh air system heating coils (QSZ51D002B) in accordance with GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-7, Revision 0, "Extended Loss of AC Power (ELAP)" and GGNS FLEX Support Guideline (05-S-01-FSG-001, Revision 1, "Long Term Reactor Vessel Cooling".

Three 120 VAC 7.5 kW portable diesel generators are used to repower EP communications equipment in accordance with GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-7, Revision 0, "Extended Loss of AC Power (ELAP)" Attachment 2 and GGNS FLEX Support Guideline (05-S-01-FSG-101, Revision 1, "Emergency Communication for BDBEEs". A total of six 120 VAC 7.5 kW PDGs are stored and available for deployment, three in each of the FLEX storage buildings.

<u>ISE Confirmatory Item 3.2.4.8.B</u>

Confirm that the licensee's final proposed connections of FLEX Phase 2 and 3 electrical equipment to the permanent plant equipment are acceptable.

<u>GGNS Response:</u>

The final integrated plan (FIP) (GNRO2016-00006 Attachment 5) defined connections of "FLEX Phase 2 and 3 electrical equipment to the permanent plant equipment" are addressed by the design documents of EC50283, Revision 0, "FLEX Electrical EC" and EC50275, Revision 2, "FLEX Basis EC".

The FIP designs for the facility modifications outlined in the initial submittal of the overall integrated plan (OIP) have been implemented as amended by the six month status reports. The facility design changes were screened to document that there is clear basis that there is no adverse effect on an Updated Final Safety Analysis Report (UFSAR) / Cask Final Safety Analysis Report (CFSAR) described design function and the design changes do not require a detailed 10 CFR 50.59 evaluation, 10 CFR 72.48 Evaluation, or a license amendment. The modifications made to the facility as defined in the FIP do not impair the safety functions of plant structures, systems and components that are designated for the mitigation of anticipated operational occurrences and postulated accidents currently in the licensed design basis.

The FLEX electrical guidance and strategies supporting the maintenance or restoration of core cooling, containment integrity, and spent fuel pool (SFP) cooling capabilities are detailed throughout the FIP. For the specific connection of loads supported by the each of the portable diesel generators (PDGs) utilized for the FIP GGNS FLEX and GGNS EP communication strategies see the GGNS Response to ISE Confirmatory Items 3.2.4.8.A of this submittal:

ISE Confirmatory Item 3.2.4.9.A

Confirm that the licensee has plans to refuel FLEX equipment based on the fuel oil consumption rates.

GGNS Response:

While onsite, the NRC staff reviewed the GGNS FLEX equipment refueling strategy documented in Attachment 6.005 of EC50275. Section 3.1.26 and Attachment 6.005 of EC50275, Revision 2, "FLEX Basis EC"; Section 3.1.2.5 of EC50711, Revision 0, "EP Communications System Enhancements to Comply with NEI 12-01"; GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-7, Revision 0, "Extended Loss of AC Power (ELAP)"; and GGNS FLEX Support Guidelines (05-S-01-FSG-005, Revision 0, "Initial Assessment and FLEX Equipment Staging" and 05-S-01-FSG-001, Revision 1, "Long Term Reactor Vessel Cooling") confirm and support the FLEX equipment refueling strategy.

The FLEX equipment refueling guidance and strategy supporting the maintenance or restoration of core cooling, containment integrity, and spent fuel pool (SFP) cooling capabilities is detailed further in section 2.9.4 of the final integrated plan (FIP) (GNRO2016-00006 Attachment 5).

EC50275, Revision 2, Attachment 6.005 documents the evaluation performed to develop the strategy for refueling portable, diesel-driven FLEX equipment following the declaration of an ELAP. To ensure adequate fuel exists to meet the strategy, all diesel-driven FLEX equipment stored in the FLEX storage buildings is maintained with a full tank of diesel fuel. Fuel oil gravity drained from the HPCS DG Day Tank (1P81A002), as necessary and additional fuel oil from the HPCS DG fuel oil storage tank (1P81A001) is available when accessed by repowering the HPCS DG fuel oil storage tank pump (1P81C001). When repowered the pump transfers diesel fuel from the storage tank to a portable 500 gallon fuel trailer via flexible 1.5" diameter hose connected to drain line 1"-HBD-558. The 500 gallon fuel trailer is towed to the various equipment staging locations to refill the fuel tanks as outlined in Attachment 6.005 of EC50275 Revision 2. A DC motor-driven fuel pump on the 500 gallon trailer-mounted tank is used to pump fuel from the trailer-mounted tank to FLEX equipment fuel tanks.

In Attachment 6.005, "Diesel Fuel Strategy Evaluation" to EC50275, Revision 2, the fuel oil evaluation is conservatively based on the commercially available fuel consumption rates of the FLEX equipment, assumes conservative loading, and assumes conservative start times for the Phase 2 diesel-driven equipment. The 480 VAC 300 kW battery charger PDG, the Phase 2 portable diesel driven pump, and the 240 VAC 15 kW hydrogen igniter PDG are each assumed to start 11 hours after the event. For the Phase 2 portable diesel driven pump this is approximately 9 hours earlier than analyzed / required. The 120 VAC 7.5 kW EP communication diesel generators are conservatively assumed to start 8 hours after the event which is approximately 16 hours earlier than expected / needed.

The 240/120 VAC 6 kW Main Control Room (MCR) portable fans portable diesel generator, which is assumed to start at 10 hours after the initiating event, has a small fuel tank and is the first equipment that requires refilling approximately 5.9 hours after it starts operating. The refueling equipment in each FLEX storage building, which includes four portable 28 gallon cart tanks and one 500 gallon portable tank are suitable for ensuring all diesel driven equipment remains fueled throughout the event.

Attachment 6.005 of EC50275, Revision 2, documents that the FLEX equipment is evaluated to consume approximately 51.75 gallons of diesel fuel per hour, or about 1,242 gallons per day, when all equipment is running post-BDBEE. The minimum required diesel fuel oil storage capacity of the HPCS diesel generator fuel oil storage tank 1P81A001 is 44,616 gallons (GGNS UFSAR Section 9.5.4.2, March 2014, and MC-Q1P81-90188, Revision 3, "Diesel Fuel Storage Requirement for the Division III Diesel Generator"). The HPCS DG fuel oil storage tank is the primary source of diesel fuel for the FLEX equipment and contains sufficient fuel to run the diesel driven FLEX equipment for approximately 35.9 days following a BDBEE, based on the fuel consumption rate of 1,242 gallons per day. GGNS uses its existing fuel oil vendor to supply an indefinite supply of fuel beyond 35 days.

ISE Confirmatory Item 3.2.4.10.A

Confirm the acceptability of RCIC operation without the gland seal compressor (de-energized 30 minutes after loss of all ac power).

GGNS Response:

While onsite, the staff reviewed GGNS calculation, XC-Q1111-14003, Revision 0, "GGNS RCIC Pump Room Heat-up for ELAP". Figure 1 for Case 1 of section 2.0 of the analysis, GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-7, Revision 0, "Extended Loss of AC Power (ELAP)", and GGNS FLEX Support Guideline 05-S-01-FSG-004, Revision 0, "ELAP DC Bus Load Shed and Management" confirm and support the capability of the GGNS FLEX strategy to maintain an acceptable RCIC room temperature including consideration of the room heat load due to the SBO required operator response in GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-4, Revision 50, "Loss of AC Power" to load shed the DC power supply to the RCIC steam turbine gland seal compressor to conserve battery power (also see the GGNS Response to ISE Confirmatory Items 3.2.4.2.A of this submittal).

GGNS performed GOTHIC calculation, XC-Q1111-14003, Revision 0, "GGNS RCIC Pump Room Heat-up for Extended Loss of AC Power," to determine the temperature in the RCIC pump room for 120 hours following an ELAP. This calculation incorporates applicable heat loads including the steam leakage heat load from the station blackout (SBO) required operator response to initially load shed the DC power supply to the RCIC steam turbine gland seal compressor. The analysis shows the RCIC room temperature approaches 193°F at 11 hours after the initiating event for Case 1, at which time the RCIC room temperature drops and remains below 150°F due to the Operator restoration of gland seal air to the RCIC turbine when the station battery chargers are reenergized by the 480 VAC 300 kW battery charger portable diesel generator. Additionally, because the equivalent leakage rate of 0.5 gpm from the gland seals is small and of limited duration, the gland seal leakage will not cause adverse flooding as evaluated in Section 3.1.28 of EC50275, Revision 2, "FLEX Basis EC".

The GGNS analysis demonstrates that the FLEX strategy maintains the RCIC room temperature below the established SBO acceptance criteria of 212°F during the time that RCIC is credited in the FLEX strategy (less than 72 hours) and beyond.

ISE Confirmatory Item 3.2.4.10.B

Confirm that the calculations regarding battery sizing which show that Vital Batteries can provide required loads for at least 11 hours (considering load shedding) are acceptable.

GGNS Response:

While onsite, the staff reviewed GGNS calculation, EC-Q1111-14001, Revision 0, "Station Division I Battery 1A3 and Division II Battery 1B3 Discharge Capacity during ELAP". Section 7 of the analysis, GGNS Off-Normal Event Procedure (ONEP) 05-1-02-I-7, Revision 0, "Extended Loss of AC Power (ELAP)", and GGNS FLEX Support Guidelines (05-S-01-FSG-004, Revision 0, "ELAP DC Bus Load Shed and Management" and 05-S-01-FSG-005, Revision 0, "Initial Assessment and FLEX Equipment Staging") confirm and support the capability of DC load shedding in accordance with the GGNS FLEX Support Guidelines to extend the discharge capacity of the Division I battery 1A3 to 12 hours and to extend the discharge capacity of the Division II battery 1B3 to 14 hours. The 480 VAC 300 kW battery charger PDG is deployed, connected, and placed into service at or before 11 hours to supply the required loads and to begin recharging the Division I and Division II batteries. Based on the load shed and FLEX equipment deployment actions that are reflected in 05-S-01-FSG-004, 05-S-01-FSG-005, and ONEP 05-1-02-I-7, slightly greater than 1 hour of margin is provided between the 1A3 minimum battery discharge capacity of 12 hours and re-powering the divisional battery charger 1DA4 at or prior to 11 hours after the initiating event.

The FLEX electrical guidance and strategies supporting the maintenance or restoration of core cooling, containment integrity, and spent fuel pool (SFP) cooling capabilities are detailed further in section 2.3.11 and throughout the final integrated plan (FIP) (GNRO2016-00006 Attachment 5).

Attachment 5 to GNRO-2016/00006

Final Integrated Plan

FINAL
INTEGRATED
PLAN
DOCUMENT

GRAND GULF NUCLEAR STATION

April 2016

Table of Contents

1. Background

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

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

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

1. Licensees shall develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities following a beyond-design-basis external event.

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

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

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

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

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

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

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

The Nuclear Energy Institute (NEI) developed NEI 12-06 (Reference 3.3), which provides guidelines for nuclear stations to assess extreme external event hazards and implement the mitigation strategies specified in NRC Order EA-12-049. The NRC issued Interim Staff Guidance JLD-ISG-2012-01 (Reference 3.4), dated August 29, 2012, which endorsed NEI 12-06 with clarifications on determining baseline coping capability and equipment quality.

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

NEI 12-02 (Reference 3.6) provides guidance for compliance with Order EA-12-051 and 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.

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

2.1 General Elements

2.1.1 Assumptions

The assumptions used for the evaluations of a Grand Gulf Nuclear Station (GGNS) ELAP/Loss of Ultimate Heat Sink (LUHS) event and the development of diverse and flexible coping (FLEX) strategies are stated below.

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

- Flood and seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 (Reference 3.8) have been completed and therefore considered. Where appropriate, results have been incorporated into the modifications implementing the FLEX strategies.
- The following conditions exist for the baseline case:
  - Seismically designed direct current (DC) battery banks are available.
  - Seismically designed alternating current (AC) and DC distribution systems are available.
  - Plant initial response is the same as a Station Black-Out (SBO) event.
  - Best estimate analysis and decay heat is used to establish operator time and action.
  - No single failure of systems, structures, or components (SSCs) is assumed except those in the base assumptions of the event (i.e., emergency diesel generator (EDG) operation, and motive force of the Ultimate Heat Sink (UHS) pumps). Therefore, the Reactor Core Isolation Cooling (RCIC) system will perform either via automatic control or with manual operation capability per the guidance in NEI 12-06.
- The designed hardened connections are protected against applicable external events or are established at multiple and diverse locations.
- FLEX components are designed to be capable of performing in response to "screened in" hazards in accordance with NEI 12-06. Portable FLEX components are procured commercially and under augmented quality requirements for testing where appropriate.

- Margin is inherent in nuclear design processes such that FLEX components and hard connection points have margin to anticipate possible future additional requirements if flooding and seismic re-evaluation warrants. Interim flooding and seismic re-evaluation impacts on the FLEX strategies have been performed with no adverse impacts identified.

- All Phase 2 FLEX components are stored at the site and will be protected against the "screened in" hazards in accordance with NEI 12-06. At least N sets of FLEX equipment that directly supports maintenance of a key safety function will be available after the event they were designed to mitigate.. Non-credited backup / replacement Phase 2 FLEX equipment will be available from a National SAFER Response Center (NSRC).

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

- Phase 3 FLEX equipment will be provided by a NSRC.

- Additional staff resources are expected to begin arriving at 6 hours and the site will be fully staffed 24 hours after the event (References 3.83 and 3.88).

- Maximum environmental room temperatures for habitability / accessibility or equipment availability is based on NUMARC 87-00 (Reference 3.9) guidance if other design basis information or industry guidance is not available. Extreme high temperatures are not expected to impact the utilization of off-site resources or the ability of personnel to implement the required FLEX strategies.

- This plan defines strategies capable of mitigating a simultaneous loss of all alternating current (ac) power and loss of normal access to the ultimate heat sink (characterized as a loss of motive force of the Ultimate Heat Sink (UHS) pumps) resulting from a beyond design basis external event (BDBEE) by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities at all units on the site. 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 have been integrated with the unit emergency operating procedures (EOP) in accordance with established EOP change processes and the facility modifications required to support these strategies are evaluated under 10 CFR 50.59 for impact on the design basis of the unit.

- The plant Technical Specifications contain the limiting conditions for normal unit operations to ensure that design safety features are available to respond to a design basis accident and direct the required actions to be taken when the limiting conditions are not met. The result of the beyond-design-basis event may place the plant in a condition where it cannot comply with certain Technical Specifications and / or with its Security Plan, and, as such, may warrant invocation of 10 CFR 50.54(x) and/or 10 CFR 73.55(p). (Reference 3.10)

- The assumptions listed in NEI 12-06 (Reference 3.3), Section 3.2.1, General Criteria and Baseline Assumptions, are applicable to the strategies developed for GGNS.

2.2 Strategies

The objective of the FLEX Strategies is to establish an indefinite coping capability in order to 1) prevent damage to the fuel in the reactor, 2) maintain the containment functional integrity and 3) prevent damage to fuel in the spent fuel pool (SFP) using installed equipment, on-site portable equipment, and off-site resources. This indefinite coping capability will address an extended loss of all ac power (ELAP) – loss of off-site power, emergency diesel generators and any alternate ac source (as defined in 10 CFR 50.2) but not the loss of ac power to buses fed by station batteries through inverters – with a simultaneous loss of access to the ultimate heat sink (LUHS) (characterized as a loss of motive force of the Ultimate Heat Sink (UHS) pumps).

The plant indefinite coping capability is attained through the implementation of pre-determined strategies (FLEX strategies) that are focused on maintaining or restoring key plant safety functions. The FLEX strategies are not tied to any specific damage state or mechanistic assessment of external events. Rather, the strategies are developed to maintain the key plant safety functions based on the evaluation of plant response to the coincident ELAP/LUHS event. A safety function-based approach provides consistency with, and allows coordination with, existing plant emergency operating procedures (EOPs), off-normal event procedures (ONEPs), and alternate strategy (B.5.b) procedures. FLEX strategies are implemented in support of EOPs and ONEPs using FLEX Support Guidelines (FSGs).

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

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

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

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

2.3 Reactor Core Cooling Strategy

Immediately after a shutdown caused by the BDEEE, the reactor remains isolated and pressurized. To mitigate the postulated ELAP event GGNS will initially remove core decay heat by using the DC powered Reactor Core Isolation Cooling (RCIC) system. The steam-driven RCIC pump will initially supply water to the reactor from the condensate storage tank (CST) or, if the CST is not available due to the BDBEE, the RCIC suction will automatically transfer to the suppression pool on DC powered instrumentation, valves and control logic.

Operators take action to reduce load on the station batteries by shedding non-critical electrical loads with actions completed in 2 hours after the initial BDBEE.

Steam from the reactor pressure vessel (RPV) will drive the RCIC turbine and will be discharged through the inverter supplied AC powered, air assisted main steam safety relief valves (SRVs) to the suppression pool to remove decay heat. Operators will depressurize the RPV to maintain operation in the safe region of the heat capacity temperature limit (HCTL) curve. RPV depressurization will be stopped at a pressure of about 200 to 400 pounds per square inch gauge (psig) to maintain sufficient steam pressure for continued RCIC operation.

When the suppression pool temperature reaches approximately 170°F (in about 3 hours after the initial BDBEE) the RCIC suction will be locally manually aligned to the upper containment pool (UCP) in order to maintain a cool source of cooling water supply to the RCIC pump and turbine as well as to maintain net positive suction head for the RCIC pump. Prior to depletion of the UCP inventory supporting RCIC injection (in about 20 hours after the initial BDBEE) RPV depressurization will continue to allow initiation of RPV injection with the FLEX pump for decay heat removal.

As described in the GGNS containment integrity strategy below, before the suppression pool temperature exceeds approximately 190°F, (in about 4 hours after the initial BDBEE) the suppression pool / containment will be vented to the atmosphere via the modified 20" EOP containment vent path to limit containment pressurization and minimize the containment temperature increase.

Following FLEX pump (1FLEXC001 or 1FLEXC002) deployment from either respective onsite storage building, completion of local manual valve alignments, and with the FLEX pump capable of injection with suction aligned to a standby service water (SSW) cooling tower basin (the ultimate heat sink [UHS]), the FLEX pump will be available (in about 11 hours after the initial BDBEE) to inject water into the RPV to maintain RPV level. An additional suction strainer is provided for each FLEX pump to allow for swapping out of strainers.

A FLEX generator (1FLEXS009 or 1FLEXS010) initially deployed from either respective onsite storage building will be used to reenergize the installed battery chargers (in about 11 hours after the initial BDBEE versus the approximate 12 hours of battery availability with no charging) to keep the necessary DC buses energized, which will keep important inverter supplied 120 volt AC equipment and instruments energized and available.

The FLEX pump, with suction from a SSW basin, will continue to provide core cooling well past 72 hours without basin makeup. Prior to depletion of the SSW basin inventory, offsite supplied pumps and / or water transportation equipment will provide water from the Mississippi River via public access roads from the Port of Port Gibson, from Grand Gulf Military Park, or from the owner controlled access road from the site barge slip. Optionally, the NSRC equipment may be utilized, as necessary, for the long term water makeup to the ultimate heat sink. This optional strategy requires deployment of approximately 9900 ft of offsite supplied flexible hose from the river to the SSW Basin.

As resources become available, recovery actions will be taken to transition to the NSRC supplied equipment to establish shutdown cooling for the RPV. The NSRC 4160 volt AC generators, 4160 volt distribution, and NSRC pumps will be used to energize and cool a residual heat removal (RHR) pump, UHS cooling tower fans, plant valves, support systems, etc. needed to transfer decay heat to the UHS and from the UHS to the environment using the installed RHR heat exchanger and UHS cooling tower fans without reliance on the installed SSW pumps.

A description of the sequence of events for required operator actions is provided in Section 2.17 and the major portable equipment required to support the FLEX coping strategies is provided in Section 2.18.5.

2.3.1 Phase 1 Reactor Core Cooling Strategy

The Phase 1 strategy for reactor core cooling is to use the RCIC system pump to provide cooling water flow to the reactor vessel and to use the RCIC system turbine to assist in depressurization of the RPV. Normal alignment for RCIC suction is from the non-seismic / non-missile protected CST. If prior to or during the initiating events the CST inventory becomes unavailable, the RCIC suction is automatically transferred to the suppression pool via the use of qualified dc-powered instrumentation in the Auxiliary Building. The automatic transfer function is a safety related function; no modifications are necessary to achieve the suction swap to the suppression pool (Reference 3.11) during an ELAP due to a BDBEE. Until manually bypassed, all required RCIC trips, interlocks, and associated equipment (fed by battery chargers, per Reference 3.12) will remain functional during an ELAP event and the associated DC load shed. Necessary trip and interlocks requiring bypass early in the SBO prior to declaration of an ELAP, to allow continued operation of RCIC during Phase 1 (e.g., Low RCIC Steam Supply Pressure), will be completed in accordance with current off normal event procedures. The DC powered air assisted SRVs control reactor pressure in accordance with the low-low set mode of SRV operation (Reference 3.13). The SRVs have adequate air and DC power to maintain this function as documented in Reference 3.21, Section 3.1.4.8. As the ELAP progresses, the suppression pool heats up due to RCIC injection, RCIC turbine exhaust, normal primary system leakage, and SRV cycling.

At approximately two hours after the event, the heat capacity temperature limit (HCTL) curve is reached (Reference 3.13). At this point, reactor pressure is reduced to and maintained in a range between 200 and 400 psig (to maintain RCIC operation) by SRV operation from the MCR while maintaining the technical specification 100°F/hr cool down limit.

Based on avoidance of RCIC NPSH and durability margin concerns with a high temperature suction source, the RCIC suction will be swapped to the UCP which is a cooler suction source and is at a higher elevation than the suppression pool (Reference 3.13). The core and containment analysis (Reference 3.13, Case B), determined that approximately three hours after the event, the suppression pool temperature reaches 170°F. Justification for using up to 170°F suppression pool water for the RCIC system is provided in BWROG-TP-14-018 (Reference 3.15), SDC E51 Section 4.12 and 4.13 (Reference 3.11), and GGNS-SA-14-00003 (Reference 3.16) while justification for Phase 1 RCIC functionality and Phase 2 mitigating action for increased room temperature is provided in XC-Q1111-14003 (Reference 3.17).

When the UCP to RCIC flow path is opened at approximately 3 hours after event initiation, RPV water level is not challenged and the UCP volume will continue to provide an adequate RCIC suction source for approximately 17 additional hours (Reference 3.13). Similarly, during this time period and following completion of a DC load shed approximately 2 hours after the event, the station batteries and installed Class 1E DC distribution system continues to provide power for RCIC system operation and monitoring instrumentation (Reference 3.12). The installed batteries maintain voltage above minimum requirements for greater than 12 hours following the event (Reference 3.12), prior to which, a Phase 2 diesel generator (1FLEXS009 or 1FLEXS010) will be deployed and connected to recharge the Division I and Division II batteries as discussed in Section 2.3.2 below.

To allow the RCIC pump to use the UCP as a suction source for BDBEE mitigation, two modifications were required and implemented. For BDBEE mitigation only, one modification replaced the existing manual operator on UCP drain inboard containment isolation valve 1G41F201 with a battery powered DC motor-operator that is controlled from a new panel (1H22P003) installed in Auxiliary Building room 1A318 (Electrical Penetration Room) located on elevation 139'-0". To maintain licensing basis regulatory compliance, operation of 1G41F201 will continue to be via manual means for all design basis functions. The second modification provided the necessary piping configurations for the FLEX mitigating strategies for core cooling, including the piping installed to allow BDBEE alignment of the RCIC pump suction to the UCP drain line. The flow path from the UCP to RCIC has been evaluated to ensure sufficient NPSH exists for continued RCIC operation during Phase 1 for approximately 20 hours (Reference 3.13) following the event. The flow path and pressure boundary for the UCP to RCIC suction for RPV makeup are shown in Figure 1.

Based on the MAAP4 core and containment analysis performed in XC-Q1111-14005 (Reference 3.13), the minimum RPV water level for the postulated event is approximately 2.9 ft. above the top of active fuel shortly after RPV depressurization for Phase 2 core makeup approximately 20 hours following the event.

The Boiling Water Reactor Owners Group (BWROG) issued Revision 3 of the BWROG Emergency Procedure and Severe Accident Guidelines. The revised BWROG guidance allows operators to remain at mid-range pressures, such as directed in the GGNS FLEX strategy, without performing emergency depressurization (Reference 3.86). Based on the BWROG new guidance, emergency depressurization is not appropriate if adequate core cooling will not be maintained as a result (e.g. if depressurization would result in loss of injection required for core cooling provided by the steam turbine driven RCIC pump). This new guidance has been incorporated into the latest revision of the GGNS EOPs.

At approximately 20 hours after the start of the event, the UCP supply available for RCIC suction is depleted (with no operator actions taken to manually maintain RPV water level below level 8) due to RPV makeup with automatic control of the RCIC injection valve between Level 2 and level 8 and the automatic operation of the RCIC minimum flow control valve. Prior to depletion of the UCP inventory after ~20 hours and after confirmation that the portable FLEX pump (1FLEXC001 or 1FLEXC002) is available (the FLEX pump is deployed, able to function in the SFP makeup mode as discussed in Section 2.4 [at ~11 hours], and connected hoses to the primary or alternate RPV injection connections in the Auxiliary Building are vented and pressurized), two SRVs are opened to depressurize the reactor and RCIC is secured. The reactor will be depressurized to less than 100 psig to initiate RPV injection with the portable FLEX pump (1FLEXC001 or 1FLEXC002).

Electrical / Instrumentation – Load shedding of non-essential loads is completed within 2 hours after the occurrence of an ELAP/LUHS. With this load shedding, the usable station Class 1E battery life is extended beyond twelve (12) hours and the Phase 2 diesel generator (1FLEXS009 or 1FLEXS010) will have repowered the DC Battery Chargers within that timeframe, before the batteries are depleted to a capacity where they can no longer sustain the supported loads. (See Section 2.3.11).

2.3.2 Phase 2 Reactor Core Cooling Strategy

Primary Strategy Core Cooling

For continued RCIC operation, a Phase 2 FLEX diesel generator (1FLEXS009 or 1FLEXS010) is deployed to repower load centers 15BA6 and 16BB6. These load centers repower the battery chargers to ensure that both the RCIC system and the critical instrumentation continue to have adequate DC power. Division I and II, battery chargers 1DA4 and 1DB4, respectively, will be repowered as part of the strategy. Additionally, Battery Room Exhaust Fan 1Z77C001A will be repowered via load center 15BA6.

Following manual transfer of the RCIC suction from the suppression pool, core cooling will be maintained using RCIC from the UCP with the operator adjusting the RCIC flow controller to maintain level. Prior to the depletion of the volume in the UCP available for RCIC suction, a portable, diesel driven FLEX pump (1FLEXC001 or 1FLEXC002) will be deployed to either SSW Basin A (primary) or B (alternate). This pump will be deployed early in the event (~ 11 hours) for the SFP makeup capability prior to when it will be required for reactor core cooling (~20 hours [with no operator actions taken to manually maintain RPV water level below level 8]). A suction hose and strainer will be lowered into the basin to provide suction to the portable FLEX pump (1FLEXC001 or 1FLEXC002). An additional suction strainer is provided for each FLEX pump to allow for swapping out of strainers.

Diverse connection points for the portable pump are provided to establish the capability to inject through two separate systems; RHR C (primary) and low pressure core spray (LPCS) (alternate) using a combination of installed piping and hoses described below. Based on initial conditions assumed at the time of the event initiation, the low pressure core spray and residual heat removal flow paths into the core are open and are not subject to being isolated based on plant conditions.

The primary strategy for Phase 2 reactor core cooling is via a new hose and a hose connection on the HPCS Service Water (SW) system return line in the Standby Service Water Basin "A" valve room. With the portable, diesel driven FLEX pump (1FLEXC001 or 1FLEXC002) deployed and connected via the hose connection in the valve room, the safety related underground piping between the Basin "A" valve room and a new hose connection in the HPCS Diesel Generator Room will be used to deliver water to either of the new RHR C or LPCS systems hose connections in the Auxiliary Building via deployed flexible hose.

The flexible hose from the HPCS SW return line in the HPCS Diesel Generator Room will be routed to a hose connection on the Condensate and Refueling Water Storage and Transfer (CRWST) system piping upstream of valve 1E12F063C. This permanent tie in allows RPV injection via the RHR "C" system. The flow path and pressure boundaries for the primary core cooling makeup path to the RHR loop "C" injection line are shown in Figure 1. The hoses, pipes, and valves that provide the primary flow path and pressure boundary have been evaluated to confirm they are designed for the discharge pressure of the Phase 2 FLEX pump (1FLEXC001 or 1FLEXC002).

Implementation of this Phase 2 strategy requires deployment of approximately 225 ft of flexible, 5" hose. This includes two 50 ft hose sections from the pump staging location to the SSW Basin "A" valve room hose connection, two 50 ft hose sections from the hose connection in the HPCS DG Room into the Auxiliary Building, and one 25 ft hose section to either the primary (RHR C) or alternate (LPCS) core cooling hose connection location. Calculation MC-Q1111-14008 (Reference 3.18; see Section 2.3.10.1 for summary) evaluated these flow paths to ensure the selected Phase 2 pump is capable of providing adequate pressure and flow to the RPV.

Additionally, implementation of the Phase 2 strategy will require that a portable nitrogen bottle(s) be deployed from either FLEX storage building and connected at approximately 40 hours after event initiation to replenish the automatic depressurization system (ADS) safety relief valve (SRV) air accumulators and receivers in accordance with existing plant procedures to maintain ADS and low-low set SRVs functionality. Replenishment is based on the initial opening of the SRVs as the reactor scrams at the initiation of the event, the use of the low-low set function of the SRVs to control RPV pressure, and the use of two SRVs to depressurize the RPV for Phase 2 makeup with the diesel driven FLEX pump for a total of 79 SRV actuations (References 3.13 and 3.14). This analysis is based on utilizing both "trains" of accumulators / receivers. During the event, as is current practice to rotate SRVs to allow even heating of the suppression pool, operators ensure that SRVs are rotated such that a single train of accumulators / receivers is not drained of air before the other. Nitrogen bottles for the SRVs for off-normal and emergency response are stored in a rack behind the Unit 1 warehouse (Chemical Storage Facility). Four (4) nitrogen bottles equivalent to (or larger than) the existing bottles will be stored in each FLEX storage building (1FLEXZ001 and 1FLEXZ002) to ensure adequate SRV air supply. The tools and pressure regulators necessary to perform this strategy are contained in a seismically restrained tool box on elevation 139', Area 9 inside the safety related Auxiliary Building.

During Phase 2, the inventory of water within the SSW Basins will be utilized to maintain reactor core cooling. See Section 2.3.10 and 2.15 for discussion of utilization of the SSW basin water for reactor core cooling.

Alternate Strategy Core Cooling

An alternate flow path for Phase 2 reactor core cooling is a tie-in location upstream of 1E21F025 also in the CRWST System. This tie-in allows RPV injection via the LPCS system. The flow path and pressure boundaries for the alternate core cooling makeup path to the LPCS injection line are shown in Figure 1. The hoses, pipes, and valves that provide the alternate flow path and pressure boundary have been evaluated to confirm they are designed for the discharge pressure of the Phase 2 FLEX pump (1FLEXC001 or 1FLEXC002).

An additional alternate strategy considers that if the HPCS SW system piping between the SSW basins and the HPCS DG Building is unavailable, 700 feet of flexible hose stored in each storage building will be routed from either service water basin directly to either connection point for the RHR C or LPCS hose connections on the CRWST System piping in the Auxiliary Building.

Phase 2 Strategy to Repower Battery Chargers

One portable diesel generator (1FLEXS009 or 1FLEXS010) will be used to repower Class 1E Load Centers 15BA6 and 16BB6. A new, dedicated breaker has been installed on Division I 480 V Load Center 15BA6 to re-power battery charger 1DA4 and Battery Room Exhaust Fan 1Z77C001A, a new, dedicated breaker has been installed on Division II 480 V Load Center 16BB6 to re-power battery charger 1DB4, and a new dedicated fused disconnect has been installed for repowering the HPCS DG Fuel Oil Storage Tank Transfer Pump. There are also 120 V receptacles available at the portable DG auxiliary panel for repowering the Phase 2 Containment Vent Uninterruptible Power Supply (UPS) (1M41PS01) discussed in Section 2.3.11. A total of two 480 VAC, 300 kW portable diesel generators (1FLEXS009 or 1FLEXS010) will be stored and available for deployment, one in each of the FLEX storage buildings, in order to meet the NEI 12-06 requirements of N+1 sets of equipment.

Phase 2 FLEX Portable Diesel Generator Deployment Strategy

Transition from Phase 1 (reliance on station batteries) to Phase 2 (re-powering station battery chargers) will be made using a FLEX portable 480V DG (1FLEXS009 or 1FLEXS010). Although the decision to deploy the FLEX portable 480V DG will be made during the initial response phase, with load shedding the station battery durations are calculated to last beyond 12 hours.

During the initial response phase, the operator is directed to take steps to begin minimizing the load on the station batteries by shedding unnecessary loads in accordance with the station SBO procedure (Reference 3.19). Additional load shedding is completed within 2 hours. This ensures the station batteries will have greater than 12 hours capability and will be available until the FLEX 480V DG is placed in service on or before 11 hours. The two (2) required (N+1) FLEX 480V 300 kW DGs will be maintained in on-site FLEX storage buildings (1FLEXZ001 and 1FLEXZ002). For the single BWR 6 reactor sited at GGNS, N equals one [1].

With the deployment and connection of the FLEX portable 480V DG (1FLEXS009 or 1FLEXS010), the battery chargers 1DA4 and 1DB4 are repowered to support the connected loads and to start recharging the station batteries 1A3 and 1B3. A single 300 kW generator is capable of repowering the two 125V battery chargers, the HPCS DG fuel oil storage tank transfer pump (1P81C001), the Containment Vent UPS (1M41PS01), and a battery room exhaust fan (Q1Z77C001A).

Once inside the PA, the portable 480V DG will be deployed to either the primary or alternate staging location. The primary staging location for the 480V DG (1FLEXS009 and 1FLEXS010) is at grade level, just west of the Control Building. The alternate staging location is at grade level on the southwest corner of the Unit 1 Auxiliary Building. The staging locations for the FLEX DGs are shown in Figure 2.

The FLEX portable 480V 300 kW DG (1FLEXS009 or 1FLEXS010) will be transferred from a storage building and deployed via specific haul paths / pre-defined routes (see Figure 2 and Figure 3) evaluated for impact of external hazards. Removal of debris along the primary and alternate deployment routes has been evaluated. The debris removal assessment concluded that a front-end loader would be sufficient to remove any debris by 6 hours after the event. Therefore, the front-end loader stored in each FLEX Storage Building (1FLEXE001 or 1FLEXE002) will be sufficient to meet the deployment timeline.

Figure 4 shows a block diagram for the primary and alternate connections points for the FLEX portable 480V 300 kW DG (1FLEXS009 or 1FLEXS010). This configuration permits the powering of Division I Battery Charger 1DA4, Division II Battery Charger 1DB4, and Battery Room Exhaust Fan 1Z77C001A from new Breakers 52-15605 and 52-16605 in load centers 15BA6 and 16BB6, respectively. The breakers will be back-fed from the FLEX diesel generator (1FLEXS009 or 1FLEXS010). Division I Battery Charger 1DA4 is powered directly from Load Center 15BA6 Breaker 52-15602, Division II Battery Charger 1DB4 is directly powered from Load Center 16BB6 Breaker 52-16602, and the Switchgear and Battery Room Exhaust Fan 1Z77C001A is powered from MCC 15B61 Breaker 20 (52-156120) downstream of Load Center 15BA6. Normally one Switchgear and Battery Room Exhaust Fan operates to ventilate both battery rooms.

2.3.3 Phase 3 Reactor Core Cooling Strategy

Primary Strategy Core Cooling

The strategy for Phase 3 reactor core cooling will be continued use of the Phase 2 strategy with additional capabilities provided by offsite equipment. Without replenishment, after approximately 99 hours (Reference 3.20), the level in the SSW Basin will decrease such that the NPSHa of the Phase 2 FLEX pump (1FLEXC001 or 1FLEXC002) will no longer be sufficient to provide RPV makeup. Any method to provide basin makeup is acceptable provided at least 23,000 gallons per hour can be provided by 99 hours after event initiation (Reference 3.21). Offsite supplied pumps and / or water transportation equipment will provide water from the Mississippi River via public access roads from the Port of Port Gibson, from Grand Gulf Military Park, or from the owner controlled access road from the site barge slip. Additionally, the NSRC supplied SSW basin makeup pump and submersible pump can be deployed to the river to provide makeup to the SSW Basin for indefinite core cooling. This strategy requires deployment of approximately 9900 ft of offsite supplied flexible hose from the river to the SSW Basins. An evaluation has determined that these optional NSRC supplied pumps are adequate to provide a bounding flow of 500 gpm for RPV makeup and SFP spray.

Alternate Phase 3 Reactor Core Cooling Strategy

As resources become available, recovery actions can be taken to transition away from extended Phase 2 coping. A NSRC supplied SSW basin makeup pump (NSRC PO 201307), submersible pump (NSRC PO 201320), low pressure / high flow pump (NSRC PO 201308), 4160V generator(s) (NSRC PO 201310), and 4160V distribution (NSRC PO 201349), as necessary, can be utilized to regain flow through service water piping along with repowering RHR Pump B and necessary Motor Operated Valves (MOVs) for RHR operation. The connection location for the NSRC 4160V generator to the installed 4160V distribution system is discussed in Sections 2.3.11 and 2.10. The NSRC supplied, 2500 gpm SSW basin makeup pump and 1000 gpm submersible pump would be deployed to provide makeup to the SSW basin such that the 5000 gpm NSRC pump could provide cooling flow to site heat loads via the Standby Service Water loop "B" system piping (Reference 3.22). A flanged adapter is required to connect the discharge of the NSRC high flow pump to the SSW piping; the fabricated adapter consists of a 24" carbon steel flanged containing six 5" Storz connections. The design of the adapter facilitates it being bolted to the location where the Unit 2 SSW pump was to be located since construction of Unit 2 was not completed. Following the BDBEE and if the alternate strategy is required, the adapter would be bolted into place. Since the onsite water supply is available for approximately 99 hours prior to requiring replenishment, there is sufficient time to fabricate the adapter after the event. Alternatively, each storage building could store one of these fabricated flanged adapters. In addition, a spool piece would be bolted in to the location on the Unit 2 Division 2 service water cross tie piping (20"-HBC-172) in between the bolted flanges and the Unit 1 Division 2 service water piping. Calculation MC-Q1111-14010 (Reference 3.23) determined the pump discharge head and Net Positive Suction Head available (NPSHa) for the NSRC Phase 3 high flow pump.

2.3.4 Systems, Structures, Components

2.3.4.1 Reactor Core Isolation Cooling (RCIC)

The Reactor Core Isolation Cooling (RCIC) system consists of a turbine, pump, pipinq, valves, accessories, and instrumentation designed to ensure that sufficient reactor water inventory is maintained in the reactor vessel to permit adequate core cooling to take place during the following conditions (Reference 3.24, Section 5.4.6.2.1.1):

- Should the vessel be isolated and maintained in the hot standby condition;
- Should the vessel be isolated and accompanied by loss of coolant flow from the reactor feedwater system; or
- Should a complete plant shutdown, under conditions of a loss of normal feedwater flow, be started before the reactor is depressurized to a level where the RHR system shutdown cooling mode can be placed into operation.

Refer to GGNS UFSAR (Reference 3.24) Section 5.4.6 for a description and discussion of capabilities of the RCIC pump.

The RCIC Pump and Turbine are safety related, Seismic Category I components located in the Auxiliary Building which is a Seismic Category I tornado-resistant structure (Reference 3.24, Table 3.2-1 and Table 3.3-1).

2.3.4.2 Standby Service Water Cooling Tower Basins

The two (2) Standby Service Water (SSW) cooling tower basins consist of (Reference 3.24, Section 3.8.4.1.1.4):

- A makeup water storage basin
- A pumphouse
- Pipe and valve room
- Mechanical draft SSW cooling towers
- Natural draft cooling towers (HPCS SSW only)

Refer to GGNS UFSAR (Reference 3.24) Section 9.2.1 for a description of the SSW system and basins.

The SSW cooling tower basins are Seismic Category I tornado-resistant structures (Reference 3.24, Table 3.2-1 and Table 3.3-1).

2.3.4.3 Standby Service Water System

The SSW system, containing the plant ultimate heat sink, is an essential auxiliary supporting system which is designed to remove heat from plant auxiliaries that are required for a safe reactor shutdown. All safety-related components requiring an external source of cooling water are served by the SSW system. The SSW system is divided into three loops based on Emergency Core Cooling System (ECCS) divisional separation requirements. SSW loop C is designed to support only the HPCS system and the HPCS diesel generator. (Reference 3.24, Section 9.2.1).

Refer to GGNS UFSAR (Reference 3.24) Section 9.2.1 for a description of the SSW system.

The SSW system is a safety-related, Seismic Category I system (Reference 3.24, Table 3.2-1 and Table 3.3-1).

2.3.4.4 Automatic Depressurization System

The automatic depressurization system (ADS) is a safety related system and utilizes selected safety/relief valves for depressurization of the reactor. Each of the safety/relief valves utilized for automatic depressurization is equipped with two air accumulators and associated inlet check valves. Two air receivers are utilized to recharge each division of air accumulators. Power from the 125 VDC system is used to operate the SRV solenoid valves. The air receivers / air accumulators can be recharged by utilizing compressed air and the test connection provided outside the containment in the Auxiliary Building on the instrument air supply penetration piping (Reference 3.24, Section 5.2.2.4 and Reference 3.25).

Refer to GGNS UFSAR (Reference 3.24) Section 5.2.2 and 7.3.1.1.1.4 for a description of the automatic depressurization system.

The safety/relief valves are designed and constructed to the requirements of ASME Section III, Class 1, are Seismic Category I and tornado missile protected. The air receivers, air accumulators, interconnecting piping, and associated valving are designed to the requirements of ASME Section III, Class 3, are Seismic Category I and tornado missile protected (Reference 3.24, Table 3.2-1 and Table 3.3-1).

2.3.4.5 Condensate and Refueling Water Storage and Transfer System

The Condensate and Refueling Water Storage and Transfer (CRWST) system is designed to pump and store condensate for the RCIC and HPCS systems, maintain the level of condensate in the condenser hotwell, and provide condensate to other plant systems, where required. The condensate storage and transfer subsystem consists of a stainless steel storage tank with a capacity of 300,000 gallons, two condensate transfer pumps, and necessary piping, valves, and instrumentation (Reference 3.24, Section 9.2.6). The CRWST system also connects the upper containment pool (UCP) with the Condensate Storage Tank (CST).

2.3.4.6 AC Power Distribution System

The Class 1E AC power distribution system is the power source used in (or associated with) shutting down the reactor and preventing the release of radioactive material following a design basis event (Reference 3.24, Section 8.3.1). The system is divided into three independent divisions. The delineation of Class 1E AC power system divisions and the associated engineered safety features switchgears, load centers, and motor control centers are shown on UFSAR Figure 8.1-1 (Reference 3.24). The equipment utilized in the FLEX strategies is Seismic Category I and is located in tornado-resistant Seismic Category I structures (Reference 3.24 Tables 3.2-1 and 3.3-1).

2.3.4.7 Division I Battery Charger 1DA4 and Division II Battery Charger 1DB4

The Class 1E 480V AC system normally powers the 125V DC system battery chargers including chargers 1DA4 and 1DB4 (Reference 3.24, Section 8.3.2 and Reference 3.26). The Class 1E 125V DC batteries are provided with two chargers. Each 125V DC battery is separately housed in a ventilated room apart from its charger and distribution center. Each battery is in a separate battery room. All components of the Class 1E 125V DC systems are housed in seismic Category I structures and tornado-resistant enclosures (Reference 3.24 Tables 3.2-1 and 3.3-1).

2.3.4.8 Safeguard Switchgear & Battery Room Ventilation System

The safeguard switchgear and battery room ventilation system is a safety related Seismic Category I system and housed in seismic Category I and tornado-resistant enclosures (Reference 3.24, Tables 3.2-1 and 3.3-1). The system contains four 50% capacity exhaust fans (sized for 2 units) in the Control Building (Reference 3.24, Section 9.4.5 and Reference 3.27, Section 4.17). One fan can operate at 100% capacity in order to remove heat and hydrogen from the individual areas of one unit (Reference 3.27, Section 4.17). The switchgear and battery room air is not recirculated but is exhausted by one of two redundant fans from each room to the outside. The exhaust system maintains the hydrogen concentration level in the battery rooms well below the explosive limits during battery charging. Automatic dampers are provided at the inlet and outlet of the air-handling units and exhaust fans to facilitate the isolation of the units when necessary. These dampers fail open upon loss of air or power (Reference 3.27, Section 4.21.1).

2.3.4.9 Suppression Pool

The suppression pool is a concentric open container of water with a stainless steel liner that is located inside and at the bottom of the primary containment. The suppression pool is designed to absorb the decay heat and sensible heat released during a reactor blowdown from safety/relief valve discharges or from a loss of coolant accident (LOCA). The suppression pool must also condense steam from the Reactor Core Isolation Cooling System turbine exhaust and provides the main emergency water supply source for the reactor vessel (Reference 3.28, TS Bases 3.6.2.1). The suppression pool volume ranges between 135,291 ft^3 at the low water level limit of 18 ft 4-1/12 inches and 138,701 ft^3 at the high water level limit of 18 ft 9-3/4 inches (Reference 3.28, TS Bases 3.6.2.2).

2.3.4.10 Ultimate Heat Sink

The UHS is part of the SSW system and consists of two cooling towers with two required fan cells per tower, each with a concrete makeup water cooling tower basin. These two cooling tower basins are interconnected by a siphon line (to transfer water between them) and together constitute the UHS basin. The combined UHS basin volume is sized such that sufficient water inventory is available for all SSW System post LOCA cooling requirements for a 30 day period with no external makeup water source available. Normal makeup for each cooling tower basin is provided automatically by the Plant Service Water System (Reference 3.28, TS Bases 3.7.1).

2.3.4.11 Upper Containment Pool

Spent fuel is stored in the Auxiliary Building spent fuel pool and in the upper containment pool (UCP) during outages. No fuel is stored in the UCP during plant operation (Reference 3.24, Section 3.1.2.6.2). The UCP is also used as a water source for the suppression pool following a LOCA (Reference 3.24, Section 6.2.7)

2.3.5 FLEX Connections

2.3.5.1 Primary Core Cooling Phase 2 Connection Point

A 6" suction hose and strainer will be lowered into a service water basin to provide suction to the portable FLEX pump (1FLEXC001 or 1FLEXC002). FLEX pump discharge fittings allow connection of a 5" flexible hose to a hose connection on the HPCS SW return line at valve 1P41F397. The hose connection is located in the SSW Basin A valve room. To minimize flexible hose length and deployment time, the primary strategies for core cooling and SFP rely upon the installed, protected (underground) return piping of the safety related HPCS SW system as the flow path from the hose connection in the valve room to the DG Building, where a 5" hose connection and isolation valve are installed. From the DG building hose connection at valve 1P41F400, 5" flexible hose will be routed to the Corridor, then up a 6 foot flight of stairs and into the Auxiliary Building. Once inside the Auxiliary Building, the hose will be fitted with a gated wye to allow diversion of flow for core cooling and SFP cooling.

The primary and alternate connection locations for reactor core cooling are located inside the RPV Instrument Test Room in the Auxiliary Building. A 5" flexible hose will be connected to one of the two hose connections on the gated wye and then connected to either the primary (1P11F438) or alternate (1P11F445) core cooling hose connection valve locations located approximately 25 feet from the gated wye. The primary core cooling connection allows RPV injection via the RHR "C" system through 1E12F063C at the hose connection valve 1P11F438. The flow path and pressure boundaries for the primary core cooling makeup path to the RHR loop "C" injection line are shown in Figure 1.

2.3.5.2 Alternate Core Cooling Phase 2 Connection Point

The alternate path for Phase 2 reactor core cooling is a tie-in location upstream of 1E21F025 also in the CRWST System at the hose connection valve 1P11F445. This tie-in allows RPV injection via the LPCS system. The flow path and pressure boundaries for the alternate core cooling makeup path to the LPCS injection line are shown in Figure 1.

2.3.5.3 Primary Electrical Connection

The primary Phase 2 Portable Diesel Generator (PDG) (1FLEXS009 or 1FLEXS010) staging location is west of the Control Building. Figure 2 shows the staging area for this PDG. A primary 480 V PDG Connection Cabinet (1R20P016) is installed inside the Control Building. Figure 4 shows a block diagram for the primary connections points for the FLEX diesel generator.

A combination of onsite portable (FLEX) cable and permanent cable / conduit is provided to allow connections to be made between the FLEX PDG (1FLEXS009 or 1FLEXS010 at the staging area), the primary 480 VAC FLEX Connection Cabinet (Panel 1R20P016), and the divisional 480 VAC Load Centers 15BA6 and 16BB6. This will repower the 480 VAC Load Centers and Motor Control Centers (specifically, two battery chargers, one battery room exhaust fan, and the HPCS DG Fuel Oil Storage Tank fuel oil transfer pump) that are utilized during Phase 2 of a BDBEE.

The primary strategy for Phase 2 utilizes a new, dedicated breaker on Division I 480 V Load Center 15BA6 to re-power battery charger 1DA4 and Battery Room Exhaust Fan 1Z77C001A. The primary strategy for Phase 2 also utilizes a new, dedicated breaker on Division II 480 V Load Center 16BB6 to re-power battery charger 1DB4. A new, dedicated fused disconnect has also been utilized to repower the HPCS DG Fuel Oil Storage Tank Pump. Power is provided from a single FLEX PDG (1FLEXS009 or 1FLEXS010).

To maintain design basis divisional separation during non-BDBEEs, portable FLEX cables must be used during BDBEEs to connect two of the new FLEX connection cabinets (panels) (1R20P018 and 1R20P019) to provide FLEX PDG power to the Division II LC during deployment of the FLEX PDG to either only the primary or alternate staging location.

Permanent connections are provided to allow FLEX portable diesel generators (1FLEXS009 or 1FLEXS010) to be connected to the FLEX loads required to be operational following a BDBEE. The following modifications were made to provide the connections:

- Installation of a primary FLEX connection cabinet (1R20P016) on the west wall in the northwest corner of the Control Building Division II Switchgear Area, a FLEX connection cabinet (1R20P019) on the south wall in the southwest corner of the Control Building Division II Switchgear Area, a FLEX connection cabinet (1R20P018) on east wall in the southeast corner of the Control Building Division I Switchgear Area, and cables / conduits in the Control Building at Elevation 111' to allow cable / conduit connections to Load Centers 16BB6 and 15BA6.

- Installation of an alternate FLEX connection cabinet (1R20P017) on the north wall in the Auxiliary Building Misc. Equipment Area at Elevation 119'.
- Installation of FLEX cable storage chests in the Control Building at Elevation 111' (1FLEXD001 through 1FLEXD003) and in the Auxiliary Building at Elevations 119' (1FLEXD004 through 1FLEXD007).
- Installation of conduits and termination of cables to 480V Load Center Bus 15BA6 through new Breaker 52-15605.
- Installation of conduits and termination of cables to 480V Load Center Bus 16BB6 through new Breaker 52-16605.
- Installation of conduit and cables through an existing penetration from Auxiliary Building Elevation 119' to Control Building Elevation 111'

2.3.5.4 Alternate Electrical Connection

The alternative strategy to re-power the FLEX required loads is to use the FLEX PDG (1FLEXS009 or 1FLEXS010) in the alternate staging area south-west of the Auxiliary Building (see Figure 2) to connect to the alternate FLEX connection cabinet (panel 1R20P017) in the Auxiliary Building using onsite portable FLEX cables. Figure 4 shows a block diagram for the alternate connections points for the FLEX diesel generator.

See discussion in Section 2.3.5.3 above regarding the details of the alternate and common connections.

2.3.6 Key Parameters

The following critical reactor parameters will be monitored throughout the event:

- Reactor Pressure Vessel water level
- Reactor Pressure Vessel pressure
- Suppression Pool water level
- Suppression Pool temperature

The instruments and their associated power supplies for monitoring the critical reactor parameters (NEI 12-06, Section 3.2.1.10) above are presented in Table 1. Instruments for alternate monitoring (NEI 12-06, Section 5.3.3, Item 1) are noted in Table 1 with an asterisk (*).

Table 1

Function	Instrument	Transmitter	Power Supplies
RPV Level	B21-UR-R623A Wide Range	B21-LT-N091A*	Loop: 11DA; 72-11A18 Recorder: 1Y89; 08-1Y89-06
	B21-UR-R623B Wide Range	B21-LT-N091B*	Loop: 11DB; 72-11B14 Recorder: 1Y84; 08-1Y84-06
	B21-UR-R615A Shutdown Range	B21-LT-N027A	Loop: 11DA; 72-11A29 Recorder: 1Y89; 08-1Y89-06
	B21-UR-R615B Shutdown Range	B21-LT-N027B	Loop: 11DB; 72-11B32 Recorder: 1Y84; 08-1Y84-06
	B21-UR-R615A Fuel Range	B21-LT-N044C	Loop: 11DA; 72-11A29 Recorder: 1Y89; 08-1Y89-06
	B21-UR-R615B Fuel Range	B21-LT-N044D	Loop: 11DB; 72-11B32 Recorder: 1Y84; 08-1Y84-06
RPV Pressure	B21-UR-R623A	B21-PT-N062A*	Loop: 11DA; 72-11A18 Recorder: 1Y89; 08-1Y89-06
	B21-UR-R623B	B21-PT-N062B*	Loop: 11DB; 72-11B14 Recorder: 1Y84; 08-1Y84-06
SP Level	E30-LR-R600A	E30-LT-N003C*	Loop: 11DA; 72-11A29 Recorder: 11DA; 72-11A29
	E30-LR-R600B	E30-LT-N003D*	Loop: 11DB; 72-11B32 Recorder: 11DB; 72-11B32
SP Temperature	M71-TR-R605A M71-TR-R605C	M71-TE-N012A* M71-TE-N022A* M71-TE-N023A* M71-TE-N024A* M71-TE-N025A* M71-TE-N026A*	Recorders A & C: 11DA; 72-11A29 Temp sensors: 1Y89; 08-1Y89-15
	M71-TR-R605B M71-TR-R605D	M71-TE-N012B* M71-TE-N022B* M71-TE-N023B* M71-TE-N024B* M71-TE-N025B* M71-TE-N026B*	Recorders B & D: 11DB; 72-11B32 Temp sensors: 1Y84; 08-1Y84-15

The above instrumentation is available prior to and after load shedding of the dc buses during Phase 1. Continued availability during Phases 2 and 3 is maintained by repowering the 125 VDC battery chargers for the station 125 VDC batteries using either FLEX Portable Diesel Generator (1FLEXS009 or 1FLEXS010).

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

FLEX support guidelines are provided for alternate monitoring of the critical parameters locally in accordance with the guidelines of NEI 12-06 Section 5.3.3.1.

2.3.7 <u>Thermal Hydraulic Analyses</u>

The GGNS FLEX Strategy Timeline is supported by the results of a plant specific MAAP4 core and containment analysis performed in XC-Q1111-14005 (Reference 3.13) and various other calculations.

Case B of Appendix 9 of the MAAP4 analysis (Reference 3.13) represents the optimal method for controlling reactor water level which represents the scenario utilized in the development of the GGNS FLEX Strategy.

The analysis contained in calculation XC-Q1111-14005 (Reference 3.13) is conservative with respect to the parameters of interest in developing the coping timeline (i.e., UCP inventory and battery capacity). The analysis models RCIC to provide the design basis flow of 800 gpm when aligned to the vessel. At this flow rate, reactor vessel level quickly reaches Level 8, at which point RCIC discharge is diverted to the suppression pool at a rate of 163 gpm. This flow rate is the required flow rate for continuous RCIC operation at turbine speeds of between 2000 rpm and 2500 rpm (Reference 3.29). By modelling in the analysis that the RCIC flow rate is always 800 gpm to the vessel or 163 gpm to the suppression pool, vessel water level is maintained between level 2 and level 8 and the time duration the UCP volume is available for use is minimized. Since the UCP volume will be depleted earlier in the event the analysis is conservative. RCIC system operation in the manner analyzed in the calculation also maximizes operation of the RCIC injection valve (1E51F013) and the minimum flow line isolation valve (1E51F019), resulting in increased loads on the station batteries during Phase 1. These increased battery loads due to operation of the valves during Phase 1 has been included in the DC battery capacity calculation EC-Q1111-14001 (Reference 3.12) and is thus conservative since the time duration the station batteries are available is reduced.

FLEX supports guidelines are provided to minimize diversion of the UCP inventory to the suppression pool by maintaining vessel level constant if possible (matching RCIC makeup to boil off) thus extending the time duration the UCP volume and station batteries would be available for use. However, as stated, analytically no credit is taken for this operator action.

The following represents the sequence of events for reactor core cooling based on the MAAP4 analysis (Reference 3.13):

- At approximately two hours after the event initiation, the heat capacity temperature limit (HCTL) curve is reached. At this point, reactor pressure is reduced to and maintained in a range between 200 and 400 psig (to maintain RCIC operation) by SRV operation from the MCR while maintaining the technical specification 100°F/hr cooldown limit.

- At approximately three hours after the event initiation, when suppression pool temperature exceeds 170°F, the UCP to RCIC flow path is opened; RPV water level is not challenged and the UCP volume will continue to provide an adequate RCIC suction source for approximately 17 additional hours.

- At approximately four hours after the event initiation, suppression pool temperature exceeds 190 °F. The modified EOP containment vent is opened and is maintained opened for the duration of the event.

- At approximately 20 hours after the event initiation, the UCP supply available for RCIC suction is depleted. Prior to depletion of the UCP inventory and after confirmation that the portable FLEX pump (1FLEXC001 or 1FLEXC002) is available, two SRVs are opened to depressurize the reactor and RCIC is secured. The reactor will be depressurized to less than 100 psig in order to allow initiation of RPV injection with the portable FLEX pump (1FLEXC001 or 1FLEXC002).

- The minimum RPV water level for the postulated event is approximately 2.9 ft. above the top of active fuel shortly after RPV depressurization for Phase 2 core makeup.

These analyses support the FLEX strategies discussed in subsections 2.3.1, 2.3.2 and 2.3.3.

Utilization of the MAAP4 Code:

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 3.30), 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 GGNS 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 3.31) are specifically addressed in the MAAP4 Analysis (Reference 3.13). The reactor vessel and containment nodalization followed standard schemes that are described. The MAAP4 Code is readily capable of analyzing the two-phase flow conditions from the RPV, and validations were performed for the key parameters that are checked for these two-phase level and flow conditions. Modeling of heat transfer and losses from the RPV, decay heat, and the plant-specific inputs are also described and followed standard practices.

2.3.8 Recirculation Pump Seal Leakage

The GGNS MAAP4 analysis (Reference 3.13) uses an initial leak rate of 66 gpm at normal RPV operating pressure to account for primary system leakage. The 66 gpm leakage is the same as that in Assumption 8 for BWR/6, Mark III analysis in Section 4.5.1.5 of NEDC-33771P (Reference 3.32). This assumption is applicable since GGNS is a BWR/6 Mark III plant. This includes 18 gpm seal leakage per reactor recirculation pump plus the Technical Specification LCO 3.4.5 allowable leakage rate of 30 gpm (Reference 3.28). The SBO analysis leakage rate of 18 gpm/pump has been determined by the NRC in Generic Letter 91-07 (Reference 3.33) and accepted per the NRCs acceptance of GNRI92-00024 (Reference 3.34). This leakage rate is assumed to start at the time zero and vary with reactor pressure consistent with the manner in which break flow is modeled in Reference 3.35.

The RPV leakage location is set at the Reactor Recirculation (RR) Pump suction nozzle elevation ZSRR and it was iteratively determined that a leakage area (ALOCA) of 1.02E-03 ft^2 would provide the assumed initial leakage of 66 gpm at normal reactor pressure (Reference 3.13). The leakage is determined using an area in order to allow variations in the leakage value depending on primary side pressure conditions. The primary system leakage is initially 66 gpm but increases to a maximum of approximately 136 gpm during the first hour as the amount of RPV subcooling increases due to RCIC injection. The leakage then decreases when the RPV is depressurized at two hours and remains between approximately 28 and 80 gpm. The RPV is further depressurized to less than 100 psig at approximately 20 hours to allow injection using the FLEX pump; the leakage at this pressure is approximately 17 gpm (Reference 3.13). Flow from the recirculation pump seal will be single-phase liquid due to the location of the break which is low in the RPV with RPV level continued to be maintained above TAF. Upon exiting the RPV, the seal leakage will flash a portion of the flow to steam based on saturated conditions in the drywell, creating a steam source and a liquid water source to the drywell.

2.3.9 Shutdown Margin Analysis

Not applicable to BWRs for FLEX.

2.3.10 Flex Pumps and Water Supplies

2.3.10.1 FLEX Injection Pumps

Consistent with NEI 12-06, Appendix C, Phase 2 RPV water injection capability is provided using a portable FLEX pump (1FLEXC001 or 1FLEXC002) through a primary or alternate connection (see Sections 2.3.5.1 and 2.3.5.2).

At approximately 20 hours, the UCP supply available for RCIC suction is nearing depletion. Two SRVs are then opened to depressurize the reactor to less than 100 psig and allow initiation of Phase 2 flow from the diesel driven FLEX pump (1FLEXC001 or 1FLEXC002) to start feeding the reactor (Reference 3.18).

One portable diesel driven FLEX pump (1FLEXC001 or 1FLEXC002) will be used to provide makeup water for Phase 2 reactor core cooling and inventory control, as well as SFP cooling and inventory control. This pump will take suction from one of the SSW basins. Sizing for the FLEX pump is provided in MC-Q1111-14008 (Reference 3.18). This calculation determines the total dynamic head (TDH) required for the Phase 2 FLEX pump (1FLEXC001 and 1FLEXC002) to take suction from a SSW basin and pump makeup water to the RPV and SFP. Results of this calculation demonstrate that a FLEX pump (1FLEXC001 or 1FLEXC002) capable of providing 500 gpm at a total dynamic head of 320 ft (139 psig) will be sufficient to simultaneously meet the requirements for RPV makeup and SFP makeup.

The FLEX pump (1FLEXC001 or 1FLEXC002) is capable of drafting from the SSW basin without external makeup from offsite supplied water transportation equipment and / or pumps or Phase 3 NSRC equipment for approximately 99 hours before cavitation occurs due to insufficient NPSH available (Reference 3.20). Adding water to the SSW Basins will support indefinite operation of the Phase 2 FLEX pump (1FLEXC001 or 1FLEXC002).

A total of two diesel driven FLEX pumps will be stored in FLEX storage facilities (i.e. one pump in each storage building) in order to meet the NEI 12-06 requirements of N+1 sets of equipment. The trailer mounted FLEX Injection Pumps (1FLEXC001 or 1FLEXC002) will be transferred and staged via haul routes and staging areas evaluated for impact from applicable external hazards. Programs and training will be implemented to support the deployment and operation of the FLEX Injection Pumps (1FLEXC001 or 1FLEXC002).

2.3.10.2 Makeup Water Supplies

Suppression Pool

Because the CST is not seismically qualified (Reference 3.24, Table 3.2-1), it is considered unavailable for the BDBEE; however, if it were available it would be used as a suction source for RCIC. If the CST is not available due to the BDBEE, the RCIC suction will automatically transfer to the suppression pool utilizing DC powered instrumentation, valves and control logic. The suppression pool volume ranges between 135,291 ft^3 at the low water level limit of 18 ft 4-1/12 inches and 138,701 ft^3 at the high water level limit of 18 ft 9-3/4 inches (Reference 3.28, TS Bases 3.6.2.2). Additionally, see Section 2.3.4.9.

Upper Containment Pool

At approximately three hours after the event initiation, the suppression pool temperature exceeds 170°F and the RCIC suction will be locally manually aligned to the upper containment pool in order to maintain a cool source of cooling water supply to the RCIC pump and turbine as well as to maintain net positive suction head for the RCIC pump without credit for containment overpressure. The UCP volume will provide an adequate RCIC suction source for approximately 17 additional hours (Reference 3.13). Additionally, see Sections 2.3.4.11 and 2.3.7.

Ultimate Heat Sink (SSW Basins)

Prior to depletion of the UCP inventory (in about 20 hours after the initial BDBEE), RPV depressurization to less than 100 psig will continue to allow initiation of RPV injection with the FLEX pump (1FLEXC001 or 1FLEXC002) for decay heat removal. When the primary system pressure is low enough for the FLEX pump to inject, the maximum injection rate will begin at a value of 250 gpm. When level 8 has been restored in the vessel, the FLEX pump flow rate will be reduced to a value roughly equivalent to the rate at which mass is leaving the primary system, to maintain a stable water level near level 8. The FLEX pump is capable of drafting from the SSW basin for approximately 99 hours before cavitation occurs due to insufficient NPSH available (Reference 3.20). Adding water to the SSW Basins will support indefinite operation of the Phase 2 FLEX pump. Additionally, see Sections 2.3.4.10 and 2.15.

2.3.10.3 Borated Water Supplies

Not applicable to BWRs for FLEX.

2.3.11 Electrical Analysis

The station batteries and installed Class 1E DC distribution system provides power for RCIC system operation and monitoring instrumentation. At the onset of the event, the operator is directed to take steps to begin minimizing the load on the station batteries by shedding unnecessary loads in accordance with station SBO procedure (Reference 3.19). Additional load shedding is completed within 2 hours. As a result of the shedding of non-essential loads, the Station Division I Battery 1A3 and Division II Battery 1B3 will maintain voltage above minimum requirements and will be capable of supplying power to the required loads for approximately 12 hours and 14 hours, respectively, and prior to battery depletion (Reference 3.12).

Transition from Phase 1 (reliance on station batteries) to Phase 2 (repowering station battery chargers) will be made using a FLEX portable 480V DG (1FLEXS009 or 1FLEXS010). The decision to deploy the FLEX portable 480V DG will be made during the initial response phase. With load shedding, the usable station Class 1E battery life is extended beyond twelve (12) hours and the Phase 2 FLEX 480V diesel generator (1FLEXS009 or 1FLEXS010) will be placed into service at or before 11 hours to recharge the Division I and Division II batteries as discussed in Section 2.3.2. Therefore, the time margin between the calculated battery duration for the FLEX strategy and the expected deployment time for FLEX equipment to supply the dc loads is greater than 1 hour. A single 300 kW generator (1FLEXS009 or 1FLEXS010) is capable of repowering two 125V battery chargers (one per division), an associated battery room exhaust fan, the Containment Vent UPS (1M41PS01), and the HPCS DG Fuel Oil Storage Tank fuel transfer pump (1P81C001).

Each of the two FLEX 480V 300 kW diesel generator is equipped with a 500 gallon diesel fuel tank which supports approximately 22 hours run time at full load (Reference 3.21). See Section 2.9.4 regarding refueling of diesel driven FLEX equipment and the assumed amount of fuel contained in each piece of essential diesel driven equipment at the beginning of the event.

Additional non-credited backup / replacement 480 VAC generators are available from the NSRC. The ratings for the NSRC equipment are listed in Table 4.

2.4 Spent Fuel Pool Cooling / Inventory

During the postulated ELAP event, the SFP will initially heat up due to the unavailability of the normal cooling system. Prior to pool boiling, the FLEX hoses and spray monitor nozzles stored in the SFP area will be set up, local Auxiliary Building doors will be opened to vent the SFP area to atmosphere, and the FLEX hoses will be routed out of the SFP area in preparation for SFP inventory makeup; this will be completed in about 4 hours after the BDBEE has occurred. The FLEX pump deployed and aligned for reactor core cooling / injection (1FLEXC001 or 1FLEXC002) is sized to allow the concurrent addition of water to the SFP from the UHS for inventory makeup as the SFP boils or to provide spray capability. The backup / replacement NSRC generators and pumps installed during recovery for decay heat removal will be utilized, as necessary, for the long term re-establishment of SFP cooling using the installed SFP cooling equipment as it becomes available. In addition, SFP level instrumentation (1G41-LE-N040A / 1G41-LI-R040A and 1G41-LE-N040B / 1G41-LI-R040B) added in response to NRC Order EA-12-051, *Reliable Spent Fuel Pool Level Instrumentation* (Reference 3.5) provides the operators with SFP level indication for decision making purposes.

The UCP is also used for interim storage and cooling of spent fuel assemblies and if necessary defective fuel storage containers (with fuel) during refueling operations. The spent fuel assemblies are transferred to the spent fuel pool in the Auxiliary Building for long-term storage. No fuel is contained in the upper containment pool during normal power operation of the plant. Makeup to the UCP during refueling would be handled via the Shutdown and Refueling strategies including the Shutdown Safety Management Program (Reference 3.103) (Section 2.16 addresses the UCP).

2.4.1 Phase 1 Strategy

Following an extended loss of AC power, there are no capabilities to provide SFP makeup during Phase 1. The Phase 1 strategy credits the plant design to maintain cooling for the spent fuel in the SFP via the large inventory and heat capacity of water in the SFP. GGNS Technical Specifications (Reference 3.28) LCO 3.7.6 requires the SFP water level to be maintained greater than or equal to 23 ft over the top of irradiated fuel assemblies seated in the spent fuel storage pool and upper containment fuel storage pool racks. At this level, the earliest that fuel in the SFP could be uncovered from boil-off for the worst case full core offload (outage conditions only) is approximately 57 hours which is the latest makeup could start per station analysis MC-Q1111-

14003 (Reference 3.36). The earliest that fuel in the SFP could be uncovered from a normal core offload (design basis heat load) is approximately 132 hours (Reference 3.36).

The BWROG issued EPG issue 1302 related to spent fuel pool inventory thermal expansion. Due to the temperature increase in the spent fuel pool, the water volume will expand and could cause water to enter the spent fuel pool sweep ventilation ducts. To mitigate this concern, spent fuel pool drain tank valve 1G41F214 will be opened at approximately 5 hours following the BDBEE to ensure that the water drains to the equipment drain sump rather than the ventilation ducts (Reference 3.21).

The initial coping strategy for SFP cooling is to remotely monitor SFP level using instrumentation (1G41-LE-N040A / 1G41-LI-R040A and 1G41-LE-N040B / 1G41-LI-R040B) installed as required by NRC Order EA-12-051 (Reference 3.5). No additional actions are required during Phase 1 for SFP cooling except that prior to SFP boiling (approximately 5 hours for a full core offload and approximately 12 hours for a design basis heat load), a vent pathway is established to minimize condensation of steam from the boiling SFP and the flexible hoses / portable monitor nozzles stored in the SFP area will be deployed on the SFP area floor to ensure these components are in place before the area becomes inaccessible due to steam, temperature, or radiation. Makeup to the pool is not required prior to pool boiling, but the hoses will be routed outside of the SFP area floor to an area that will not become inaccessible after boiling commences. Opening local Auxiliary Building doors 1A601 and 1A605 (Reference 3.62) as shown on Figure 1 provides adequate ventilation to minimize condensation of steam in the Auxiliary Building.

2.4.2 Phase 2 Strategy

From station analysis (Reference 3.36), using the worst case design basis heat load and worst case full core offload timing, bulk pool boiling will occur 5.17 hours following loss of pool cooling. At this heat load, a makeup rate of 90 gpm is required to maintain level in the pool. Using the design basis heat load and a normal refueling outage time of 20 days, the SFP will start boiling 11.91 hours after loss of pool cooling. A makeup rate of 39 gpm is required under these conditions. Note that the limiting SFP time to boil (5.17 hours) is for a full core offload. For a BDBEE in this plant configuration, actions and resources required for core cooling and containment would be diverted to SFP cooling since there would be no fuel in the reactor vessel. A full core offload would occur during a planned or forced outage when additional resources, significantly more than the minimum staffing level assumed for the at-power scenario, would be available to assist in debris removal and equipment staging.

Prior to SFP boiling (approximately 5 hours for a full core offload and approximately 12 hours for a design basis heat load), for SFP Makeup Strategy Methods 1 (Hose) and 2 (Spray) described below, flexible hoses and portable monitor nozzles stored in the SFP area will be deployed in the SFP area to ensure these components are in place before the area becomes inaccessible due to steam, temperature, or radiation. Makeup to the pool is not required prior to pool boiling, but the hoses will be routed outside of the SFP area to an area that will not become inaccessible after boiling commences. For SFP Makeup Strategy Method 3 (SFP Cooling Piping) described below, access to the SFP area is not required to initiate SFP makeup.

For the three SFP makeup strategy methods described below (SFP makeup strategy methods are not utilized simultaneously) a diesel driven FLEX pump (1FLEXC001 or 1FLEXC002) will be deployed to take suction from the SSW Basin. Discharge flow of the FLEX pump (1FLEXC001 or 1FLEXC002) will be routed from the SSW Basin "A" Valve room to the HPCS Diesel Generator Room through SSW underground piping, where a new hose connection and hose will deliver the water into the Auxiliary Building, as discussed above for reactor core cooling (see Section 2.3.5.1). In the Auxiliary Building, a gated wye with two 5" hose connections will be provided; one connection for reactor core cooling makeup and one for SFP makeup. The FLEX pump is capable of providing 250 gpm of flow to the monitor nozzles (Section 2.3.10.1), which bounds the 90 gpm makeup rate required under the worst case heat load conditions. The diesel-driven FLEX pump (1FLEXC001 or 1FLEXC002) is sized to simultaneously provide the required makeup flows for reactor core cooling and SFP cooling (Reference 3.18).

The following Phase 2 actions shown on Figure 1 are required to meet the baseline coping capabilities and maintain SFP cooling.

Makeup Strategy Method 1 (Hose)

Flexible hose will be connected to one of the two gated wye hose connections at the 139' elevation of the Auxiliary Building. The hose will then be routed to connect to the hose deployed from the SFP area for completion of the flexible hose flow path for direct makeup to the SFP. Prior to completion of the flexible hose flow path an additional gated wye will be installed at the 185' elevation of the Auxiliary Building for makeup strategy Method 3 (SFP cooling piping connection located at that elevation). Implementation of Method 1 of this Phase 2 SFP cooling strategy requires deployment of hose from the gated wye on elevation 139' to the SFP area on elevation 208'-10". For ease of hose routing prior to the onset of pool boiling, multiple sets of hose are currently stored in B.5.b lockers and an additional FLEX equipment storage locker (1FLEXD010) on elevation 208'-10" of Auxiliary Building as well as an additional FLEX equipment storage locker (1FLEXD009) on elevation 139'. This equipment is protected from external hazards such that it will be used following a BDBEE. The multiple methods of SFP makeup are not required simultaneously. Therefore, the hoses routed for direct SFP makeup and SFP spray are interchangeable (i.e., separate hoses for each strategy are not required).

Makeup Strategy Method 2 (Spray)

As with Method 1, flexible hose will be connected to one of the two gated wye hose connections at the 139' elevation of the Auxiliary Building. The hose will then be routed to connect to the hose deployed from the SFP area for completion of the flexible hose flow path for spray / makeup to the SFP. As with Method 1, prior to completion of the flexible hose flow path for spray an additional gated wye will be installed at the 185' elevation of the Auxiliary Building for makeup strategy method 3 (SFP cooling piping) connection located at that elevation). Implementation of Method 2 of this Phase 2 SFP cooling strategy requires deployment of 2 ½" hoses connected to two spray monitor nozzles secured to handrails on each side of the pool in accordance with 05-1-02-III-1 (Reference 3.37). For ease of hose routing prior to the onset of pool boiling, as with Method 1 multiple sets of hose, gated wye, and hose Storz connections are stored in B.5.b lockers and an additional FLEX equipment storage locker (1FLEXD010) on elevation 208'10" of the Auxiliary Building. As with Method 1, a FLEX equipment storage locker (1FLEXD009) has been located on elevation 139'. Two spray monitor nozzles are stored on the

Auxiliary Building refueling floor adjacent to each of the two (2) B.5.b lockers on elevation 208'10". This equipment is protected from applicable external hazards such that it may be used following a BDBEE. The multiple methods of SFP makeup are not required simultaneously. Therefore, the hoses routed for direct SFP makeup and SFP spray are interchangeable (i.e., separate hoses for each strategy are not required).

Makeup Strategy Method 3 (SFP Cooling Piping)

As with Methods 1 or 2, flexible 5" hose will be connected to one of the two 5" hose connections of the gated wye at the 139' elevation of the Auxiliary Building. The hose will then be routed to connect to a gated wye installed at the 185' elevation of the Auxiliary Building for makeup strategy Method 3. At the 185' elevation of the Auxiliary Building the 5" hose will be reduced and connected to an existing flush connection located on the Fuel Pool Cooling and Cleanup (FPCCU) piping just downstream of valve 1G41F247A as shown on Figure 1. Implementation of Method 3 of this this Phase 2 SFP cooling strategy requires deployment of approximately 300 ft of 5" hose from the gated wye on elevation 139' to the hose connection on elevation 185' of the Auxiliary Building. As with Method 1 and 2, a FLEX equipment storage locker (1FLEXD009) has been located on elevation 139' for ease of hose routing. This equipment is protected from external hazards such that it may be used following a BDBEE. The multiple methods of SFP makeup are not required simultaneously. Therefore, the hoses routed for direct SFP makeup and SFP spray are interchangeable (i.e., separate hoses for each strategy are not required).

2.4.3 <u>Phase 3 Strategy</u>

The strategies outlined above during Phase 2 can be continued indefinitely to maintain SFP cooling until offsite supplied water transportation equipment and / or pumps or the optional Phase 3 NSRC supplied equipment is used to refill the SSW basin. Once conditions permit, additional resources are available, and additional coping capabilities from the NSRC are available (e.g., Service Water flow restored), the SFP cooling pumps and heat exchangers can be returned to service.

Additional non-credited capabilities will be available from the NSRC as a backup / replacement to the on-site FLEX equipment.

2.4.4 Structures, Systems, and Components

2.4.4.1 Primary Connection

The makeup source for SFP inventory is the same as for reactor core cooling. See Section 2.3.5.1 or 2.4.2 for a description of the makeup source and the method of transferring the water from the SSW Basin to the Auxiliary Building where the SFP Makeup Strategies connect. In the Auxiliary Building, a gated wye with two 5" hose connections is provided; one connection for reactor core cooling makeup and one for SFP makeup. All hose connection locations are enclosed in seismic category I / tornado missile protected structures and are therefore protected from applicable external hazards such that they will be available following a BDBEE.

Makeup Strategy Method 1 (Hose)

Flexible hose will be connected to one of the two 5" hose connections of the gated wye at the 139' elevation of the Auxiliary Building. This hose will then be routed to the SFP area for direct hose makeup to the SFP. Implementation of this Phase 2 SFP cooling strategy requires deployment of approximately 250 ft of 5" hose from the hose wye on elevation 139' to a hose wye on elevation 185' and 150 ft of 4" hose from the hose wye on elevation 185' to the SFP. These hose connection locations and hose routes are enclosed in a seismic category I / tornado missile protected structure and are therefore protected from applicable external hazards such that they will be available following a BDBEE.

Makeup Strategy Method 2 (Spray)

Flexible hose will be connected to one of the two 5" hose connections of the gated wye at the 139' elevation of the Auxiliary Building. This hose will then be routed to the SFP area for direct spray monitor makeup to the SFP. Implementation of this Phase 2 SFP cooling strategy requires deployment of approximately 250 ft of 5" hose from the hose wye on elevation 139' to a hose wye on elevation 185', 150 ft of 4" hose from the hose wye on elevation 185' to the SFP area, and 50 ft of 2 ½" hose to each of two spray monitors at the SFP. These hose connection locations and hose routes are enclosed in a seismic category I / tornado missile protected structure and are therefore protected from applicable external hazards such that they will be available following a BDBEE.

Makeup Strategy Method 3 (SFP cooling piping)

Flexible hose will be connected to one of the two 5" hose connections of the gated wye at the 139' elevation of the Auxiliary Building. This hose will then be routed to the 185' elevation of the Auxiliary Building for direct connection to installed FPCCU piping for makeup to the SFP. Implementation of this Phase 2 SFP cooling strategy requires deployment of approximately 250 ft of 5" hose from the hose wye on elevation 139' to a hose wye on elevation 185' and 50 ft of 5" hose from the hose wye to the existing flush connection located on the FPCCU piping just downstream of valve 1G41F247A. Following a BDBEE, a 5" to 3" Storz adapter and a 3" Storz to 2" 150# ANSI flange adapter will be used to connect the 5" hose to the existing seismically designed and missile protected piping. These hose connection locations and hose routes are enclosed in a seismic category I / tornado missile protected structure and are therefore protected from applicable external hazards such that they will be available following a BDBEE.

2.4.4.2 Alternate Connection

If the HPCS SW system piping between the SSW basin A valve room and the HPCS DG Building is unavailable, 700 feet of flexible hose stored in each storage building will be available to be deployed and routed from the FLEX pump (1FLEXC001 or 1FLEXC002) discharge (when located at either service water basin) to the gated wye hose connection point in the Auxiliary Building at the 139' elevation for any of the three SFP makeup strategies and for the reactor core cooling primary or alternate makeup strategy.

Additionally, for any of the three SFP makeup strategies and for the RCS primary or alternate makeup strategies minor variations / equivalent hose configurations and fittings are allowed provided that the hydraulic head losses of the alternate installed configurations are documented in approved procedures to be within the capability of the FLEX pump (1FLEXC001 or 1FLEXC002).

2.4.4.3 Ventilation

Prior to SFP boiling (approximately 5 hours for a full core offload and approximately 12 hours for a design basis heat load), a vent pathway is established to minimize condensation of steam in the Auxiliary Building from the boiling SFP. Local Auxiliary Building doors 1A601 and 1A605 (Reference 3.62) as shown on Figure 1 will be opened to vent the SFP area to atmosphere, which will provide adequate ventilation to minimize condensation of steam in the Auxiliary Building. An evaluation was performed to ensure that the selected vent path provides a flow rate that exceeds the SFP boil off rate (Reference 3.21).

In addition to providing a ventilation path prior to SFP boiling (approximately 5 hours for a full core offload and approximately 12 hours for a design basis heat load), the spray monitor nozzles and hoses stored in the SFP area will be positioned and routed outside of the SFP area prior to SFP boiling. Since makeup to the pool is not required prior to pool boiling, the SFP area hoses do not require complete routing or connection to the associated FLEX supply hose prior to SFP boiling. Taking this action prior to SFP boiling will provide the capability for SFP spray and makeup via hoses without entering the refueling floor later in the event when the area may become inaccessible.

2.4.5 Key Reactor Parameters

The key parameter for the SFP Make-up strategy is the SFP water level. The SFP water level is remotely monitored by the instrumentation (1G41-LE-N040A / 1G41-LI-R040A and 1G41-LE-N040B / 1G41-LI-R040B) that was installed (Reference 3.38) in response to Order EA-12-051, *Reliable Spent Fuel Pool Level Instrumentation* (Reference 3.5).

2.4.6 Thermal-Hydraulic Analyses

Spent Fuel Pool

An analyses (Reference 3.36) was performed that determined with no operator action following a loss of SFP cooling at the maximum refueling outage design heat load, the SFP will reach 212°F in approximately 5 hours and will reach the level of the top of the spent fuel racks [NEI 12-02 Level 3 (Reference 3.6)] in approximately 57 hours if no additional water is supplied to the SFP. During non-outage conditions, the time to boiling in the pool is approximately 11 hours, and boil off to the level of the top of the spent fuel racks (NEI 12-02 Level 3) is approximately 5.5 days if no additional water is supplied to the SFP. The initial coping strategy for SFP cooling is to monitor SFP level using instrumentation (1G41-LE-N040A / 1G41-LI-R040A and 1G41-LE-N040B / 1G41-LI-R040B) installed as required by NRC Order EA-12-051.

A flow of 90 gpm will replenish the water being boiled for the most limiting refueling outage heat load case. Deployment of any of the SFP makeup strategies with a flow rate that bounds the boil-off rate (90 gpm for the limiting case) will provide for adequate makeup to restore the SFP level and maintain an acceptable level of water for shielding purposes. The diesel-driven FLEX pump (1FLEXC001 or 1FLEXC002) credited for the SFP makeup is capable of providing 250 gpm of flow to the monitor nozzles (Section 2.3.10.1), which bounds the 90 gpm makeup rate required under the worst case heat load conditions. The diesel-driven FLEX pump (1FLEXC001 and 1FLEXC002) is sized to simultaneously provide the required makeup flows for reactor core cooling and SFP cooling (Reference 3.18).

Below is a summary of time to boil, boil off rate and time to top of fuel for boil off for the SFP for full core offload and normal core offload from station analysis MC-Q1111-14003 (Reference 3.36):

Parameter	Full Core Offload	Normal Offload During a 20 Day Outage
Time to boil	5.17 hours	11.91 hours
Boil-off rate	90 gpm	39.07 gpm
Time to top of fuel	57.37 hours	132.16 hours

Upper Containment Pool

In addition to the SFP, the UCP is also used for interim storage and cooling of spent fuel assemblies and if necessary defective fuel storage containers (with fuel) during refueling operations. The spent fuel assemblies are transferred to the spent fuel pool in the Auxiliary Building for long-term storage. No fuel is contained in the upper containment pool during normal power operation of the plant.

Below is a summary of time to boil, boil off rate and time to top of fuel for boil off for the UCP for full core offload from station analysis MC-Q1111-14003 (Reference 3.36):

Parameter	Full Core Offload
Time to boil	3.54 hours
Boil-off rate	60 gpm
Time to top of fuel	49.01 hours

Makeup to the UCP during refueling would be handled via the Shutdown and Refueling strategies including the Shutdown Safety Management Program (Reference 3.103) (Section 2.16 addresses the UCP).

2.4.7 Flex Pump and Water Supplies

2.4.7.1 FLEX Injection Pumps

One portable diesel driven FLEX pump (1FLEXC001 or 1FLEXC002) will be used to provide makeup water for Phase 2 reactor core cooling and inventory control, as well as SFP cooling and inventory control. For the three SFP makeup strategy methods described in Section 2.4.2 (SFP makeup strategy methods are not utilized simultaneously) the diesel driven FLEX pump (1FLEXC001 or 1FLEXC002) will be deployed to take suction from one of the SSW Basins. Discharge flow of the FLEX pump will be routed to the 139' elevation of the Auxiliary Building via either the HPCS SSW underground piping and hose or only hose (Sections 2.4.4.1 and 2.4.4.2). In the Auxiliary Building, a gated wye with two 5" hose connections is provided; one connection for reactor core cooling makeup and one for SFP makeup. For SFP cooling and inventory control the FLEX pump is capable of providing 250 gpm of flow to the spray monitor nozzles (Section 2.3.10.1), which bounds the 90 gpm makeup rate required under the worst case heat load conditions. The diesel-driven FLEX pump is sized to simultaneously provide the required makeup flows for reactor core cooling and SFP cooling (Reference 3.18).

Refer to Section 2.3.10.1 for additional information regarding the diesel driven FLEX pump (1FLEXC001 or 1FLEXC002) utilized for SFP makeup.

A total of two diesel driven FLEX pumps will be stored in FLEX storage facilities (i.e. one pump in each storage building) in order to meet the NEI 12-06 requirements of N+1 sets of equipment. The trailer mounted FLEX Pumps (1FLEXC001 or 1FLEXC002) will be transferred and staged via haul routes and staging areas evaluated for impact from applicable external hazards. Programs and training will be implemented to support the deployment and operation of the FLEX Pumps (1FLEXC001 or 1FLEXC002).

2.4.7.2 Ultimate Heat Sink

The FLEX pump deployed and aligned for reactor core cooling / injection is sized to allow the concurrent addition of water to the SFP from the UHS for inventory makeup as the SFP boils or to provide concurrent spray capability. The ultimate heat sink (UHS) for the site includes the water inventory of the seismically designed Standby Service Water (SSW) basins.

The FLEX pump (1FLEXC001 or 1FLEXC002) is capable of pumping from the SSW basins for approximately 99 hours before cavitation occurs due to insufficient NPSH available (Reference 3.20). For the station analysis the FLEX pump delivers 500 gpm (250 gpm to the SFP and 250 gpm for reactor vessel makeup) for the duration of the 99 hours. Adding water to the SSW Basins will support indefinite operation of the Phase 2 FLEX pump. Additionally, see Section 2.15.

2.4.8 Electrical Analysis

SFP level will be monitored by instrumentation (1G41-LE-N040A / 1G41-LI-R040A and 1G41-LE-N040B / 1G41-LI-R040B) installed for Order EA-12-051. Power is provided to SFPI Channel-A from 120/240 VAC BOP power panel 1P199 which is powered from 480 VAC BOP MCC 13B12. Power is provided to SFPI Channel-B from 120 VAC lighting panel 1L143 which is powered from 480 VAC BOP MCC 14B21. Each instrument has the capability to connect to a source of power independent of the normal AC/DC power system. The instruments have built-in batteries that will enable them to function for at least seven days following a loss of power (Reference 3.38).

2.5 Containment Integrity

During the BDBEE containment integrity is maintained by normal design features of the containment, such as the containment isolation valves and the modified EOP containment vent path. As the suppression pool heats up due to RCIC operation and relief valve operation, the containment will begin to heat up and pressurize. The GGNS FLEX Strategy is based on performing containment venting for containment heat removal when the suppression pool temperature exceeds 190°F to maintain Containment pressure below design conditions and to minimize the resultant containment temperature increase above design conditions.

2.5.1 Phase I

The core and containment analysis in XC-Q1111-14005 (Reference 3.13) determined that Containment integrity is maintained using a "RPV feed and Containment vent" strategy where cool water is injected into the RPV, steam is discharged from the RPV to the SP via SRVs, and decay heat is removed from containment via the modified EOP containment vent path (see Section 2.5.4.1 for a description of the EOP containment vent path). Based on results of the core and containment analysis (Reference 3.13) the modified EOP containment vent path will be opened when the suppression pool temperature exceeds 190°F (approximately four hours after the start of the event). This action limits increases in containment pressure and temperature throughout the event. The vent path remains open to remove containment heat for the duration of the event until the "normal" design basis decay heat removal function has been adequately restored, at which time the vent flow will subside and eventually cease, allowing the valves in the vent path to be closed.

For the BDBEE driven ELAP, the core and containment analysis in XC-Q1111-14005 Case B (Reference 3.13) shows that the peak containment temperature of 233°F and the peak suppression pool water temperature of 226°F exceed their design values of 215°F by 18°F and 11°F, respectively. Confirmation of continued containment integrity for the BDBEE driven ELAP with these temperature parameters above their design values is provided in Section 2.5.4.2. All other containment parameters remain below their respective design values for the analysis duration of 72 hours (Reference 3.13).

The expected elevated temperatures within containment are also illustrated by the current licensing basis station blackout (SBO) analysis documented in GGNS-NE-10-00034 (Reference 3.41) (i.e. given the decay heat rate for the extended thermal rating of GGNS with no containment heat removal capability the suppression pool water temperature increases to approximately 200° F within 4 hours of the event initiation).

The BWROG GEH Evaluation of FLEX Implementation Guidelines NEDC-33771P (Reference 3.32) indicates that given the extended thermal rating of GGNS, even with unspecified FLEX strategies providing substantial alternate containment heat removal capabilities (see Appendices S and T of NEDC-33771P), the containment temperature and suppression pool water temperature peak above their design values. Calculation CC-Q1M10-14001 (Reference 3.42) and an additional evaluation in Attachment 6.020 of EC50275 (Reference 3.21) evaluated the impact to containment and concluded that the expected temperatures within containment are acceptable (see discussion in Section 2.5.4.2).

The Phase 1 coping strategy for Containment includes monitoring containment pressure, suppression pool temperature, suppression pool level, drywell pressure and containment air temperature (see Section 2.5.5). The installed Class 1E DC distribution system will provide power for this instrumentation. Following DC load shed the Station Division I Battery 1A3 and Division II Battery 1B3 will maintain voltage above minimum requirements and will be capable of supplying power to the required loads for approximately 12 hours and 14 hours, respectively, and prior to battery depletion. Prior to battery depletion, a FLEX generator (1FLEXS009 or 1FLEXS010) will be deployed to power the battery chargers to maintain the instrumentation for the duration of the event (see Section 2.5.8).

2.5.2 Phase 2

As described for Phase 1, permanently installed plant equipment / features are used to maintain containment integrity throughout the duration of the event. The nitrogen bottles that are used to operate the AOVs in the modified EOP containment vent path are of sufficient capacity to maintain the vent path open for over 72 hours which is also sufficient time to deploy and connect additional nitrogen bottles from either FLEX storage building or offsite resources. Similarly, the UPS used to operate the AOVs in the modified EOP containment vent path is of sufficient capacity to power the solenoid valves for 27 hours. A portable cable deployed from either FLEX storage building connects the 480V 300 kW diesel generator (1FLEXS009 or 1FLEXS010) to the UPS after 24 hours to ensure long term power for the solenoid valves. The 480V 300 kW portable FLEX generator (1FLEXS009 or 1FLEXS010) is required to repower the station battery chargers at approximately 11 hours into the event to maintain DC power including the monitoring instrumentation and is therefore readily available to power the AOVs of the modified EOP containment vent path.

NEI 12-06 guidelines (Reference 3.3) state that units with Mark III containment "...should address the deployment of portable power supplies for providing backup power to the containment hydrogen igniters, including a prioritization approach for deployment." In order to meet this requirement of the NEI 12-06 guidelines, a capability is provided to re-power a division of hydrogen igniters with a portable power supply. A portable diesel generator (1FLEXS011 or 1FLEXS022) is stored in each of the two (2) FLEX storage buildings that will be deployed to repower one train of the hydrogen igniters. The local initiation of the single division of hydrogen igniters is manually performed when directed by the emergency procedures.

Therefore, the strategy for Phase 2 is the continuation of the Phase 1 strategy (use of the modified EOP containment vent path), critical instrumentation powered by the FLEX generator (1FLEXS009 or 1FLEXS010), and the hydrogen igniters available to be powered by a portable FLEX generator (1FLEXS011 or 1FLEXS022).

2.5.3 Phase 3

The strategy for long-term containment integrity will be the continued use of the strategy of Phase 1 and Phase 2 (containment venting and availability of the hydrogen igniters) with no immediate reliance on equipment from the NSRC.

During plant recovery, operation of the vent path and the RHR system will support the continued safe removal of decay heat from the RPV and containment, further reducing containment temperature and pressure which will ensure containment integrity is maintained. NSRC Equipment that may be utilized during recovery is listed in Table 4.

2.5.4 Structures, Systems, Components

2.5.4.1 EOP Containment Vent Path

To support FLEX strategies, the existing EOP containment vent path was modified. A new 20" diameter butterfly type air operated valve (AOV) was installed inside of containment on a new 20" tee branch installed on the containment vent line upstream of the inboard containment isolation valve 1M41F034 such that the new 20" AOV opens directly into containment, bypassing the non-safety related / non-qualified charcoal filtration train to establish a modified vent path directly to the atmosphere. The new 20" AOV is remotely operated from a new alternate control panel (1M41P001) seismically installed outside of Containment, but nearby in the Auxiliary Building. The new 20" AOV is designed to operate without reliance on normal instrument air or normal AC power.

The two existing air operated 20" diameter primary containment isolation valves (PCIVs) and the two existing air operated 20" diameter secondary containment isolation valves (SCIVs) that are downstream of the new 20" AOV initially fail closed upon the loss of power event; however, following modification they are remotely opened from the new alternate control panel (1M41P001) without reliance on normal instrument air or normal AC power.

To support the new alternate control panel (1M41P001) and operation of the five (5) AOVs, independent nitrogen bottles are seismically installed in the Auxiliary Building next to the control panel. Also, an independent Uninterruptable Power Supply (UPS) and associated batteries are installed in panel 1M41P001. The nitrogen bottles have sufficient capacity to power and maintain the vent path open for at least 72 hours while the UPS batteries have sufficient capacity to power the AOV solenoid valves for at least 27 hours prior to which time additional onsite and offsite resources will be available.

For the AOVs, each additional air bottle will counteract leakage for more than 36 hours (PC-N1M41-14001, Reference 3.44). Considering that only 2 bottles are required to support the 72 hour duration, and 4 bottles are installed, more than 144 hours is available and sufficient time exists to deploy and connect an additional nitrogen supply from either FLEX storage buildings or offsite resources.

The UPS power supply (1M41PS01) for operation of the AOVs is sufficient for at least 27 hours following the ELAP considering the required single cycle of the five solenoid valves (Reference 3.45). A temporary cable will be routed from a convenience receptacle on the 480V FLEX diesel generator (1FLEXS009 or 1FLEXS010) within 27 hours to repower the UPS. There is sufficient capacity on the 480V FLEX Diesel Generator (1FLEXS009 or 1FLEX010) to carry the load of the AOV solenoid valve UPS integral to the control panel 1M41P001.

2.5.4.2 Containment

For the BDBEE driven ELAP, the core and containment analysis in XC-Q1111-14005 Case B (Reference 3.13) shows that the peak containment temperature of 233°F and the peak suppression pool water temperature of 226°F exceed their design values of 215°F by 18°F and 11°F, respectively. Containment temperature and suppression pool water temperature pass the design value of 215°F at about 7.5 hours after the start of the event. The peak containment temperature occurs at approximately 20.5 hours after the start of the event and the peak suppression pool temperature occurs at about 21.5 hours after the start of the event. As the event progresses, the suppression pool water temperature drops below the design value of 215°F at about 144 hours into the event and at the same time containment temperature returns to within about 2 degrees of the design value (Reference 3.13) where both remain for the duration of the event.

Although small increases, based on the peak values of the containment and suppression pool water temperature, calculation CC-Q1M10-14001 (Reference 3.42) and an evaluation in Attachment 6.020 of the FLEX Basis engineering evaluation, EC50275 (Reference 3.21) were performed to confirm the structural integrity of the containment wall and structures for these conditions associated with the FLEX Strategy. The method of analysis used to evaluate the existing containment wall was based on the following steps:

- The design calculations (Reference 3.47) were reviewed for thermal loading conditions to establish the maximum design temperature used in the analysis;
- The design calculations were reviewed to identify the critical load combinations;
- The design calculations were reviewed to identify the most critical locations in the containment wall; and
- The design calculations were reviewed to ensure that the stresses and strains in the concrete, reinforcing steel and liner plate did not exceed the allowable limits.

For the new temperature of 233°F, thermal loads were evaluated using temperature increase ratios.

The analysis (Reference 3.42) determined that the structural integrity of the existing containment wall is satisfactory subject to the small temperature increases at the peak temperatures associated with the FLEX Strategy as described in the FLEX Basis engineering evaluation, EC50275 (Reference 3.21).

2.5.5 Key Containment Parameters

In addition to the key containment parameters required by NEI 12-06, containment pressure, suppression pool temperature, and suppression pool level, the installed Class 1E DC distribution system will also provide power for instrumentation to monitor drywell pressure and containment air temperature.

The instruments and their associated power supplies for monitoring the containment parameters (NEI 12-06, Section 3.2.1.10) above are presented in Table 2. Instruments for alternate monitoring (NEI 12-06, Section 5.3.3, Item 1) are noted in Table 2 with an asterisk (*).

Table 2			
Function	**Instrument**	**Transmitter**	**Power Supplies**
Containment Pressure	M71-PDR-R601A	M71-PDT-002A* M71-PDT-027A*	Loop: 11DA; 72-11A29 Recorder: 11DA; 72-11A29
	M71-PDR-R601B	M71-PDT-002B M71-PDT-027B	Loop: 11DB; 72-11B32 Recorder: 11DB; 72-11B32
Suppression Pool Temperature	M71-TR-R605A M71-TR-R605C	M71-TE-N012A* M71-TE-N022A* M71-TE-N023A* M71-TE-N024A* M71-TE-N025A* M71-TE-N026A*	Recorders A & C: 11DA; 72-11A29 Temp sensors: 1Y89; 08-1Y89-15
	M71-TR-R605B M71-TR-R605D	M71-TE-N012B* M71-TE-N022B* M71-TE-N023B* M71-TE-N024B* M71-TE-N025B* M71-TE-N026B*	Recorders B & D: 11DB; 72-11B32 Temp sensors: 1Y84; 08-1Y84-15
Suppression Pool Level	E30-LR-R600A	E30-LT-N003C*	Loop: 11DA; 72-11A29 Recorder: 11DA; 72-11A29
	E30-LR-R600B	E30-LT-N003D*	Loop: 11DB; 72-11B32 Recorder: 11DB; 72-11B32
Containment Air Temperature	M71-TR-R602A M71-TR-R603A	M71-TE-N007A* M71-TE-N007C*	Recorders A & C: 1Y89; 08-1Y89-15 Temp sensors: 11DA; 72-11A29
	M71-TR-R602B M71-TR-R603B	M71-TE-N007B* M71-TE-N007D*	Recorders A & C: 1Y84; 08-1Y84-15 Temp sensors: 11DB; 72-11B32
Dry Well Pressure	M71-PDR-R601A	M71-PDT-001A*	Loop: 11DA; 72-11A29 Recorder: 11DA; 72-11A29
	M71-PDR-R601B	M71-PDT-001B*	Loop: 11DB; 72-11B32 Recorder: 11DB; 72-11B32

The above instrumentation is available prior to and after load shedding of the dc buses during Phase 1. Continued availability during Phases 2 and 3 is maintained by repowering the 125 VDC battery chargers for the station 125 VDC batteries using either FLEX Portable Diesel Generator (1FLEXS009 or 1FLEXS010) (see Section 2.5.8).

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

FLEX support guidelines are provided for alternate monitoring of the critical parameters locally in accordance with the guidelines of NEI 12-06 Section 5.3.3.1.

2.5.6 Thermal-Hydraulic Analyses

Calculation XC-Q1111-14005, Rev. 000, Grand Gulf Core and Containment Analysis of FLEX Strategies (Reference 3.13), analyzes the GGNS core and containment for the FLEX strategies during ELAP conditions with simultaneous LUHS (Case B of Appendix 9 is used as the basis for the GGNS FLEX strategy and all supporting analysis). The calculation determines timing significant actions in reference to the event initiation and associated symptomatic indications, including the following:

- Approximately 2 hours – HCTL curve is reached, operators reduce reactor pressure in accordance with tech spec temperature change of 100°F/hr and maintain reactor pressure between 200 - 400 psig;
- Approximately 3 hours – Suppression pool temperature exceeds 170°F, RCIC suction is swapped from the suppression pool to the UCP;
- Approximately 4 hours – Suppression pool temperature exceeds 190°F and the modified EOP containment vent is opened and maintained open throughout the rest of the event; and
- Approximately 20 hours – UCP level available for RCIC suction is depleted and RPV is depressurized to allow the required injection from portable diesel driven FLEX Makeup pump (1FLEXC001 or 1FLEXC002).

The results of the strategy indicate that drywell temperature, drywell pressure, containment pressure, core temperature, and RPV water level all remain within the acceptable design values. The calculated number of SRV actuations is 79 throughout the event. The analysis showed that the peak containment temperature of 233°F and the peak suppression pool water temperature of 225°F exceed their design values of 215°F by 18°F and 11°F, respectively. As discussed in Section 2.5.4.2, the elevated containment temperature has been evaluated for the unique loading conditions associated with the FLEX strategy. The evaluation concludes that the structural integrity of the existing containment wall subject to the increased temperature of 233°F is satisfactory. Because the RCIC pump is not taking suction from the suppression pool once the suppression pool temperature is greater than 170°F, exceeding these design values will not impact RCIC operation. Based on the results of calculation MC-Q1111-14001 (Reference 3.48), by using both the suppression pool and upper containment pool as a suction source, sufficient NPSH is available for RCIC pump operation throughout the event.

NEDC-33771P (Reference 3.32) documents that long term containment venting could potentially lead to negative pressures in containment since the analytical model supporting NEDC-33771P did not support reverse flow through the simulated 16" vent. Regardless of this analytical limitation of the NEDC-33771P model, reverse flow through the modified EOP vent is possible, which negates negative pressure concerns in containment and procedural precautions are provided for operator action to consider containment pressure control prior to transition from the approved FLEX support guidelines (Reference 3.104).

For the FLEX mitigation strategy, the pressure suppression pressure curve and the SRV tailpipe level limit water level are not exceeded for the event (References 3.13 and 3.14)

Refer to Section 2.3.7 regarding the use of the MAAP4 computer code.

2.5.7 FLEX Pump and Water Supplies

As discussed in Section 2.5.1, when the suppression pool temperature exceeds 190°F at 4 hours after the start of the event, the modified EOP containment vent path is opened to provide containment heat removal and begin a long term strategy of reactor makeup and boiling to protect the core and containment. See Section 2.3.10 for a discussion regarding reactor makeup with the portable diesel driven FLEX pump (1FLEXC001 or 1FLEXC002) from the SSW Basins.

2.5.8 Electrical Analysis

Power requirements for the containment critical instrumentation are provided by the station batteries. See Section 2.3.11 for a discussion regarding repowering the station battery chargers with the FLEX portable 480V DG (1FLEXS009 or 1FLEXS010).

A 15 kW portable diesel generator (1FLEXS011 or 1FLEXS022) is used to repower one train of the hydrogen igniters if necessary and when directed by the emergency procedures. A total of two 15 kW DGs will be stored in the FLEX storage facilities (i.e. one 15 kW DG in each storage building) in order to meet the NEI 12-06 requirements of N+1 sets of equipment.

The UPS power supply for operation of the AOVs is sufficient for greater than 27 hours following the ELAP considering the required single cycle of the five solenoid valves (Reference 3.45). There is sufficient capacity on the 480V 300 kW portable DG (1FLEXS009 or 1FLEXS010) to carry the load of the AOV solenoid valve UPS integral to the control panel 1M41P001 (EC-Q1111-14002, Reference 3.46). One 480V 300 kW portable DG (1FLEXS009 or 1FLEXS010) and its associated power cable will be stored in each storage building in order to meet the NEI 12-06 requirements of N+1 sets of equipment.

2.6 Characterization of External Hazards

2.6.1 Seismic

Per the GGNS UFSAR (Reference 3.24, Section 2.5), the seismic criteria for GGNS include two design basis earthquake spectra: the Operating Basis Earthquake (OBE) and the Design Basis Earthquake (DBE) (Safe Shutdown Earthquake). The DBE and the OBE are 0.15g and 0.075g, respectively; these values constitute the design basis of GGNS. Per NEI 12-06 Section 5.2 (Reference 3.3), all sites will consider the seismic hazard. Therefore, implementation of the FLEX coping strategy is structured to be achievable following a seismic event, including storage and deployment of FLEX equipment, and utilization of installed SSCs that are seismically robust as defined in NEI 12-06.

The conditions of the equipment deployment paths following a BDBEE were assessed (Reference 3.49). A subsurface exploration was performed to evaluate the engineering properties of the subsurface soils within the two FLEX storage building sites, NSRC Staging Area B (the Phase 3 recovery equipment staging area), and along the travel paths. The potential for soil liquefaction along the equipment deployment paths was determined to be low, with the maximum vertical settlement at the test locations following strong shaking estimated to be less than one inch; therefore, no mitigation or ground improvements were necessary in these areas.

In accordance with the NRC Request For Information Pursuant to 10 CFR 50.54(f) Regarding the Seismic Aspects of Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident (Reference 3.50), a seismic hazard and screening evaluation was performed for GGNS (Reference 3.51). A Ground Motion Response Spectra (GMRS) was developed solely for purpose of screening for additional evaluations in accordance with NRC endorsed EPRI Report 1025287, "Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic" (Reference 3.52). Based on the results of the screening evaluation, no further evaluation will be performed for GGNS.

2.6.2 External Flooding

The site was originally designated as a dry site for FLEX based on GGNS UFSAR Appendix 3A which identified the plant as a dry site based on the plant grade elevation being 30 feet greater than the probable maximum flood (PMF) level. After consideration of the need for flood barriers for probable maximum precipitation (PMP) and the guidance of NEI 12-06 (Reference 3.3), GGNS is classified as a wet site for beyond design basis events.

In accordance with the NRC Request for Information Pursuant to 10 CFR 50.54(f) regarding the flooding aspects of Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident (Reference 3.50), a reevaluation of flooding hazards at GGNS was performed (Reference 3.53). The reevaluation represents the most current flooding analysis for GGNS. Reevaluation of flooding due to Local Intense Precipitation (LIP) has resulted in a flooding height of 133.7 ft MSL versus the current licensing basis of 133.25 ft MSL which is based on PMP. (The flood mechanism considered to be controlling plant flood design in the current licensing basis is the PMP on the watersheds for the two local streams (Stream A and Stream B) which includes the site [Reference 3.24, Section 2.4.2.2]).

The impact of external flooding on the FLEX strategies is addressed by EC 50287 (Reference 3.49) and GGNS-SA-14-00002 (Reference 3.14) which consider the flood level of 133.7 ft from the revised flooding analysis (Reference 3.53). Even though considering this revised flooding analysis is not required to comply with EA-12-049 per current industry guidance (Reference 3.3), the impact of external flooding on the FLEX strategies is addressed in accordance with NEI 12-06 (sections 6.2.2 and 6.2.3 (including sub-sections 6.2.3.1 through 6.2.3.4)) including credit taken for existing site mitigating actions (deployment of sandbags) contained in procedure 05-1-02-VI-2 (Reference 3.54). This procedure directs the site to deploy sandbags up to an elevation of 134'-6".

2.6.3 Severe Storms with High Wind

The GGNS plant site is located below the 35th parallel (Reference 3.24, Section 2.1.1.1). Per Figures 7-1 and 7-2 of NEI 12-06 (Reference 3.3), hurricanes and tornado hazards are applicable to GGNS. Therefore, hazards from extreme high winds are considered in the development of the FLEX coping strategy, including storage and deployment of FLEX equipment, and utilization of installed SSCs that are adequately protected from extreme high wind and associated missile hazards.

2.6.4 Ice, Snow and Extreme Cold

The guidelines provided in Section 8.2.1 of NEI 12-06 (Reference 3.3) generally exclude the need to consider extreme snowfall at plant sites in the southeastern U.S. below the 35th parallel. The GGNS plant site is located below the 35th parallel at 32°0'27" latitude (Reference 3.24, Section 2.1.1.1) and thus the capability to address hindrances caused by extreme snowfall with snow removal equipment need not be provided.

The GGNS site is located within the region characterized by EPRI as ice severity level 4 (NEI 12-06, Figure 8-2). Ice storms in the general area surrounding the plant site have occurred with accumulated ice coatings in excess of 0.5 inches (Reference 3.24, Section 2.3.1.2.2). As such, the GGNS site is subject to severe icing conditions that could also cause severe destruction to electrical transmission lines and/or the existence of a large amount of ice. Therefore, accumulation of ice is the only extreme cold weather event that required consideration in the development of the FLEX coping strategy.

2.6.5 High Temperatures

Per Section 9.2 of NEI 12-06 (Reference 3.3), all sites will address high temperatures. Mississippi summers are warm and humid, with limited periods of extremely hot weather over 100°F (Reference 3.24, Section 2.3.2.1.2). Therefore, extreme high temperatures are considered in the development of the FLEX coping strategy.

2.7 Planned Protection of Flex Equipment

GGNS portable FLEX equipment will be stored in two, onsite FLEX storage buildings (1FLEXZ001 and 1FLEXZ002). Each storage building will contain N sets of FLEX equipment required for successful implementation of the coping strategies. For the single BWR 6 reactor sited at GGNS, N equals one (1). The location of the two storage buildings, as well as the primary and alternate deployment routes to the Protected Area (PA) from each location are shown in Figure 3.

The storage buildings are designed for wind loading determined per ASCE 7-10 (References 3.49 and 3.57). The storage buildings are designed for seismic loading determined per ASCE 7-10. The FLEX storage buildings have an overall footprint of 70' x 90' each. This size was developed based on the equipment to be stored within the buildings. Arrangement of all items to be stored in the storage buildings was established based on optimizing ease of deployment.

Seismic Considerations:

Section 5.3.2.1 of NEI 12-06 (Reference 3.3) states that large portable FLEX equipment should be secured as appropriate to protect them during a seismic event and that stored equipment and structures should be evaluated and protected from seismic interactions. A calculation, CC-N1FLEX-14001, Sliding and Rocking Evaluation of FLEX Storage Building Equipment (Reference 3.55), evaluated the rigid body sliding and rocking of unanchored equipment to determine the required separation distance of the equipment within the storage buildings to ensure that they protected from seismic interactions. The minimum spacing of equipment within the FLEX storage buildings is governed by the maximum displacement of the equipment during sliding and rocking. The maximum distance that any piece of equipment will slide was determined to be approximately 3.5", while the maximum rocking displacement was determined to be approximately 6". In order to protect the equipment from impacting each other, the minimum spacing is equal to greater than twice the maximum displacement. Per Section 7.1 of Reference 3.56, the design values of sliding and rocking are not required to be combined and therefore the minimum spacing between two pieces of equipment was determined to be approximately 12". For added conservatism, the minimum required spacing to prevent seismic interactions was chosen as 15" for GGNS. Equipment tie downs have been provided in the storage buildings but are not required due to the separation being maintained between equipment.

A subsurface exploration was performed (Reference 3.49) to evaluate the engineering properties of the subsurface soils within the two FLEX storage building sites, Staging Area B (the Phase 3 equipment staging area), and along the travel paths. The potential for soil liquefaction along the equipment deployment paths was determined to be low, with the maximum vertical settlement at the test locations following strong shaking estimated to be less than one inch.

High Wind Considerations:

NEI 12-06 Section 7.3.1.1.c allows for FLEX storage locations with sufficient separation distance to be designed to local building codes and ASCE 7-10 regarding high winds. The plant specific evaluated separation distance minimizes the probability that a single event would damage all FLEX mitigation equipment such that at least N sets of FLEX equipment would remain deployable following the high wind event. An evaluation (Reference 3.49) was performed to determine a reasonable separation distance that bounds a large majority of tornados in the region of the site based on the 90th percentile tornado width and 1973 – 2012 data; the separation distance was determined to be 990 feet. Separation of the storage building locations by at least this perpendicular distance to the predominant tornado path for the geographical location of GGNS provides reasonable assurance that N sets of FLEX equipment will remain deployable. Per the evaluation, based on the historical record, the axis of separation considered tornado paths from the Southwest to the Northeast. Based on the building locations the storage buildings are located at a distance of approximately 1500 ft. from each other perpendicular to the predominant tornado paths thus exceeding the calculated separation distance of 990 feet.

External Flooding Considerations:

Protection of FLEX equipment against external flooding events was evaluated in accordance with Section 6.2.3.1.1.a of NEI 12-06 which states that the FLEX equipment is protected from floods if it is stored above the flood elevation determined in the most recent site flood analysis. The recent flooding re-evaluation (see Section 2.6.2) determined that flooding due to Local Intense Precipitation (LIP) is the re-evaluated controlling event for GGNS. The predicted maximum flood elevation resulting from the LIP in the vicinity of the storage building at Site 4 is 133.5 ft above Mean Sea Level (MSL) (Reference 3.49). Only the storage building at the Site 4 is included in the area covered by the most recent LIP reanalysis. Due to its remote location and grade elevation, Site 1 is not included in the most recent LIP reanalysis;

however, the LIP reanalysis supports a maximum expected depth of 0.1 ft. to 0.2 ft. based upon the adjacent modeled areas (Reference 3.49). As specified in calculation CC-N1FLEX-14002 (Reference 3.58), Site 1 is located such that the top-of-slab elevation is at an elevation of 163 ft. and Site 4 has a top-of-slab elevation of 133.2 ft. The foundation (slab) designs of both storage buildings include an internal spill containment curb extending 0.5 ft. above the top-of-slab. This results in an "effective top-of-slab" elevation of 163.5 feet for Site 1 and 133.7 feet for Site 4, which are both above the actual projected maximum flood elevations due to LIP of 163.2 feet and 133.5 feet, respectively.

Impact of Snow, Ice and Extreme Cold

As stated in Section 2.6.4, accumulation of ice is the only extreme cold weather event that required consideration in the development of the FLEX coping strategy. The design of the storage buildings utilized the design procedure found in ASCE 7-10 (Reference 3.57) which determined a nominal ice thickness of 0.5". Using the density of ice of 56 pcf and an adjusted design ice thickness of 1", the resultant uniform ice load was determined to be 5 psf. This is less than the 20 psf roof live load per ASCE 7-10. Therefore the ice load did not govern the storage building design.

Impact of High Temperatures

The extreme high ambient temperature for GGNS of 104°F is found in Specification E100.0 (Reference 3.59). For the design of the storage buildings, a maximum indoor temperature limit of 120°F was used with respect to the extreme ambient temperature. Protection of the FLEX equipment from impacts due to extreme high ambient temperatures during storage is dependent on installed fans providing building ventilation. Procedure revisions (Reference 3.105) have been developed to provide guidance for protection of stored equipment against high ambient temperatures in the case of a loss of power to the storage buildings. With respect to storage, preventive maintenance of the FLEX equipment will detect abnormal wear on FLEX equipment due to prolonged periods of extreme temperatures.

Impact of Low Temperatures

Protection of FLEX equipment from impacts due to freezing weather is performed in accordance with Section 9.3.1 of NEI 12-06, which states that equipment should be maintained at a temperature within a range to ensure its likely function when called upon. In accordance with Section 8.3.1.b of NEI

12-06 the storage of equipment shall be in a structure designed to or evaluated equivalent to ASCE 7-10 for the plant's design basis for the snow, ice and cold conditions. Per Specification E100.0 (Reference 3.59), the plant's design basis low temperature is -1°F.

Protection of the FLEX equipment from impacts due to extrême cold during storage is not dependent on central heating. Electrical receptacles are provided for local heating elements, which may be necessary depending on the equipment, equipment fluids, and fuel storage requirements. Procedure revisions (Reference 3.105) have been developed to provide guidance for protection of stored equipment against cold weather in the case of a loss of power to the storage buildings

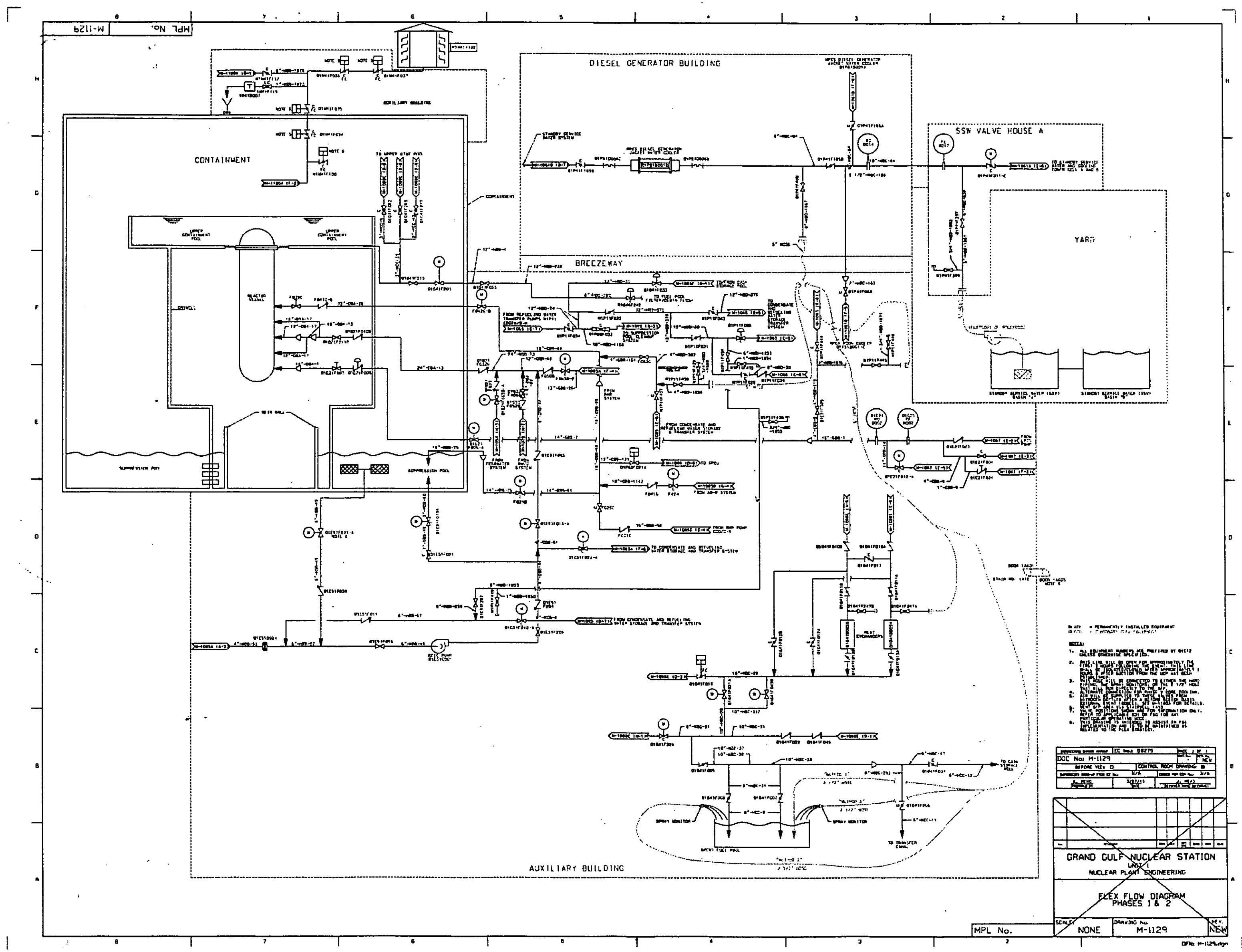

Figure 1: FLEX Flow Diagram Phases 1 & 2

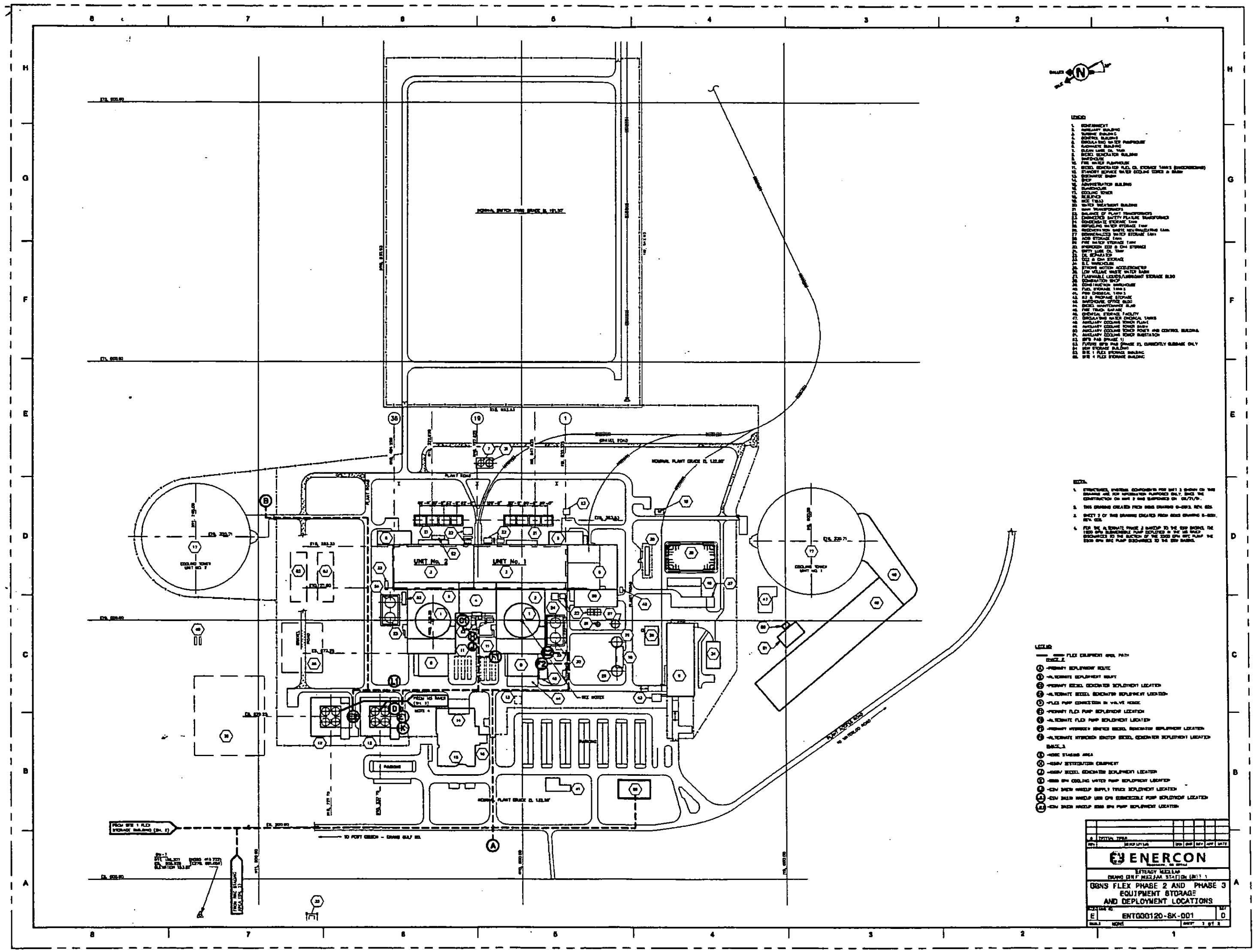

Figure 2: GGNS FLEX Phase 2 and 3 Equipment Deployment Routes and Locations

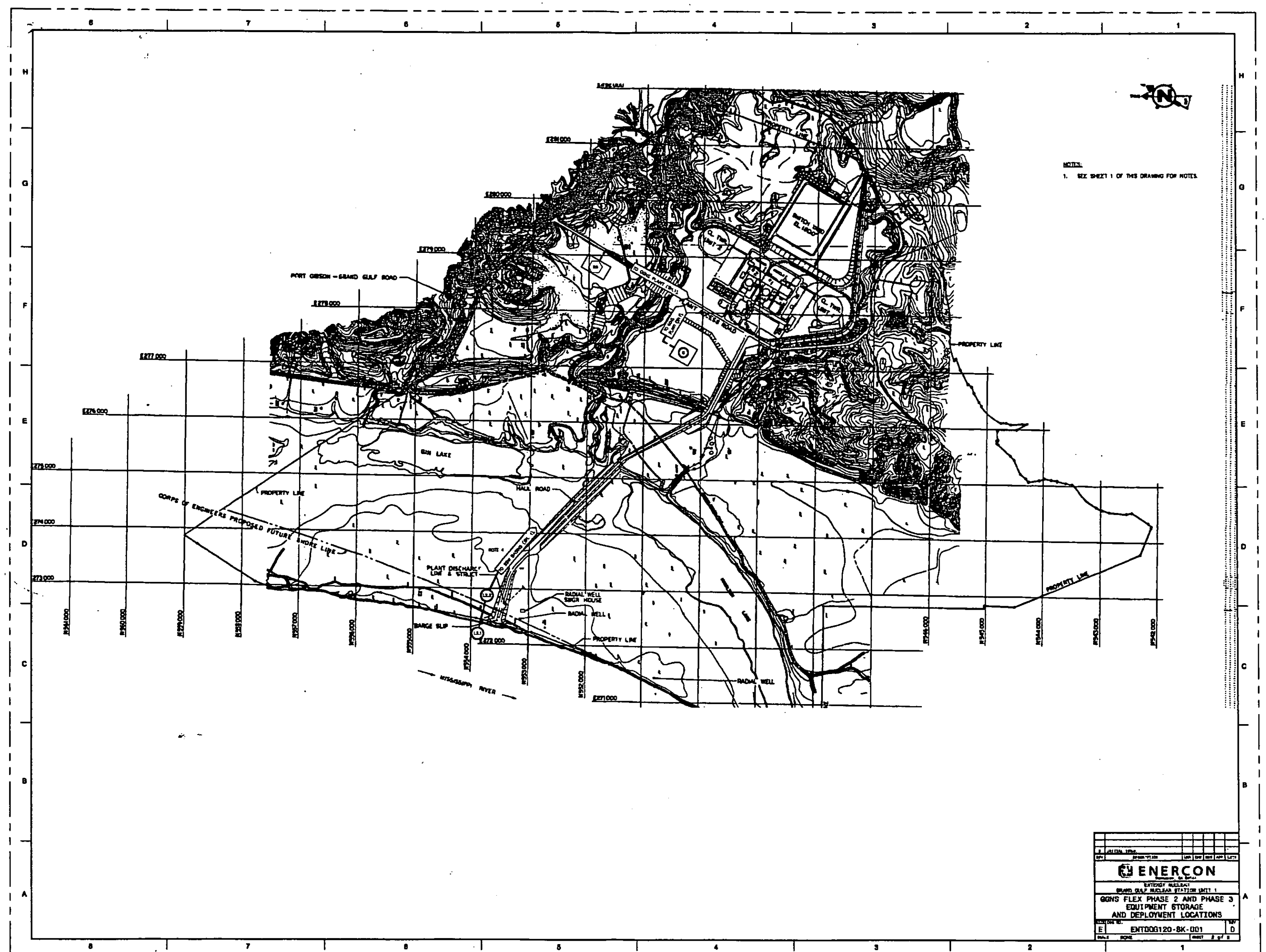

Figure 3: GGNS FLEX Phase 2 and 3 Equipment Storage Locations and Deployment Routes

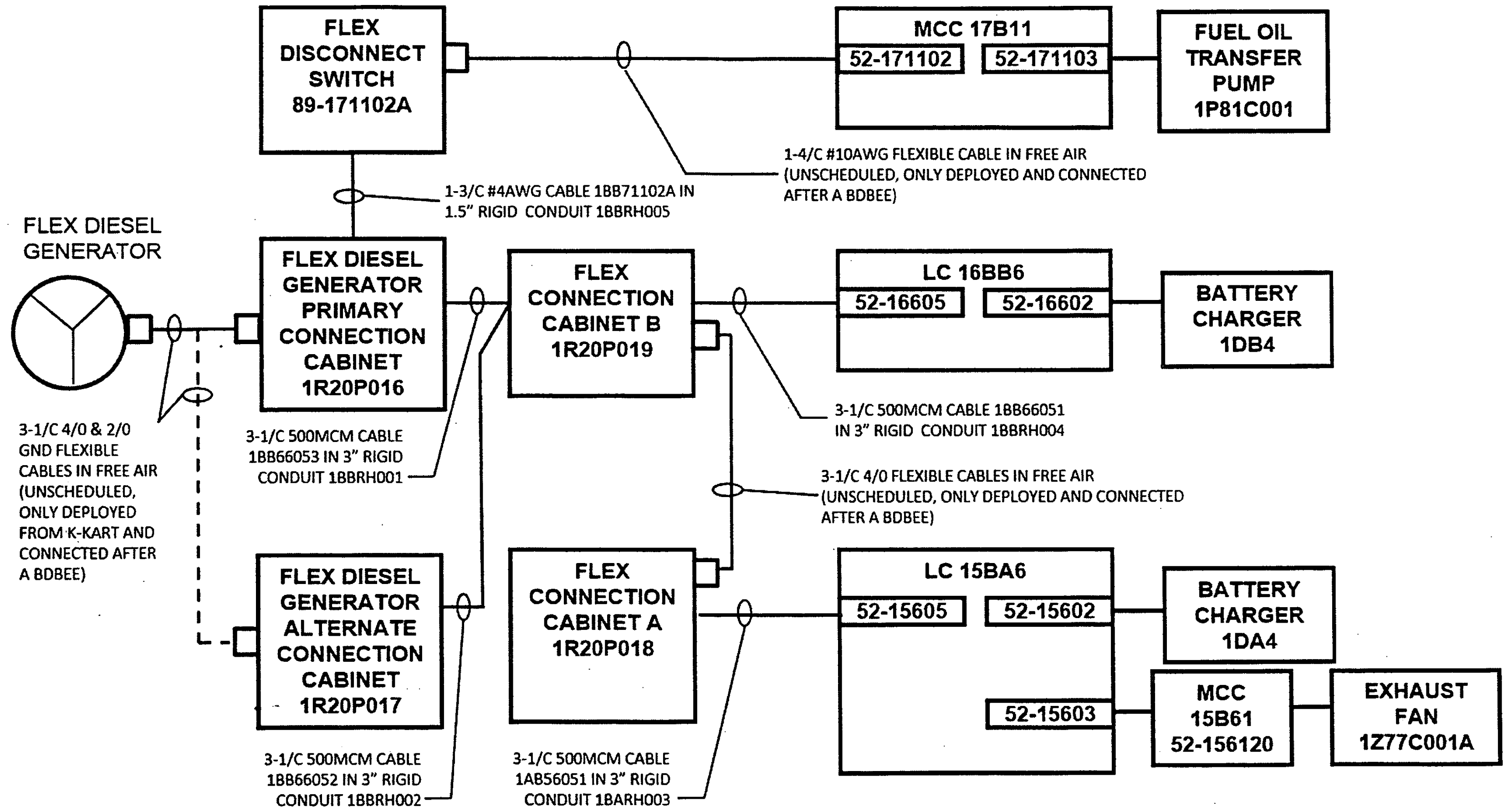

Figure 4: FLEX Connection Block Diagram

2.8 Planned Deployment of FLEX Equipment

2.8.1 Haul Paths and Accessibility

The location of the two storage buildings, as well as the primary and alternate deployment routes to the Protected Area (PA) from each location are shown in Figure 3 and continued on Figure 2.

A subsurface exploration was performed (Reference 3.49) to evaluate the engineering properties of the subsurface soils along the travel paths. The potential for soil liquefaction along the equipment deployment paths was determined to be low, with the maximum vertical settlement at the test locations following strong shaking estimated to be less than one inch.

An assessment (Reference 3.49) was performed for removal of debris along the primary and alternate deployment routes. The debris removal assessment concluded that a front-end loader would be sufficient to remove any debris by 6 hours after the event if two persons are deployed at 1 hour after the initiating event when the ELAP is declared. Therefore, the front-end loader (1FLEXE001 or 1FLEXE002) stored in each FLEX Storage Building is utilized to meet the deployment timeline. Additional debris removal equipment for personnel safety, that is stored in a seismically restrained storage cabinet installed in the Control Building, includes equipment such as flashlights; razor wire cutters and razor wire protective clothing; goggles and vapor respirator protection; and equipment to confirm lighting poles are de-energized when encountered before removal.

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

Doors and gates serve a variety of barrier functions on the site. One primary function is security and is discussed below. However, other barrier functions include fire, flood, radiation, ventilation, tornado, and HELB. As barriers, these doors and gates are typically administratively controlled to maintain their function as barriers during normal operations. Following an a BDBEE and subsequent ELAP event, FLEX coping strategies require the routing of hoses and cables to be through various barriers in order to connect FLEX equipment to station fluid and electric systems. For this reason, certain barriers (gates and doors) will be opened and remain open. Access to the Protected Area during a BDBEE is addressed in the FLEX Support Guidelines (FSGs) and FSG Support Procedures including security implementation of FLEX Strategies including suspension of the Security Plan under provisions of 10CFR50.54(x) and the use of security personnel in response to the BDBEE. This suspension of normal administrative controls is acknowledged and is acceptable during the implementation of FLEX coping strategies.

The ability to open doors for ingress and egress, ventilation, or temporary cables/hoses routing is necessary to implement the FLEX coping strategies. There are no strategy dependent security doors or gates that rely on electric power to operate to open and / or locking mechanisms that are barriers of concern. The Security force will initiate an access contingency upon loss of all ac/dc power as part of the Security Plan. Access to the Owner Controlled Area, site Protected Area, and areas within the plant structures will be controlled under this access contingency as implemented by security personnel.

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

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

Phase 3 of the FLEX strategies involves the receipt of equipment from offsite sources including the NSRC and various commodities such as fuel and supplies. Transportation of these deliveries can be through airlift or via ground transportation. Debris removal for the pathway between the site and the NSRC receiving location and from the various plant access routes may be required. Following completion of debris removal onsite for Phase 2 and Phase 3, the same debris removal equipment used for these on-site pathways may be used to support debris removal to facilitate road access to the site.

2.9 Deployment of strategies

2.9.1 RCS Primary Makeup Strategy

Prior to transition to Phase 2, a FLEX pump (1FLEXC001 or 1FLEXC002) will be deployment to either SSW Basin A (primary) or B (alternate) from either onsite storage building and will be placed on the concrete directly next to the railing surrounding the basin. This pump will be deployed early in the event (~11 hours) for SFP makeup capability prior to when it will be required for reactor core cooling (~20 hours). A 6" suction hose and strainer designed to prevent large debris from entering the pump suction will be lowered into a service water basin to provide suction to the portable FLEX pump (1FLEXC001 or 1FLEXC002). An additional suction strainer will be provided for each pump to allow for swapping out suction strainers. Prior to depletion of the UCP inventory (approximately 20 hours after the initial BDBEE) RPV depressurization to 100 psig will continue to allow initiation of RPV injection with the FLEX pump (1FLEXC001 or 1FLEXC002) for decay heat removal. The primary RCS makeup strategy is to connect to the RHR "C" system upstream of valve 1E12F063C in the CRWST System at hose connection valve 1P11F438 allowing injection into the RPV via the RHR system. The FLEX pump deployed and aligned for core cooling / injection is sized to allow the concurrent addition of water to the SFP from the UHS as the SFP boils or to provide SFP spray capability. See Section 2.3 for specifics regarding strategies for makeup to the RCS.

The diesel driven pump (1FLEXC001 or 1FLEXC002) is operated under manual speed control to achieve the desired pressure and flow as read locally. Once the diesel driven FLEX pump (1FLEXC001 or 1FLEXC002) is deployed near the UHS basins, the engine-driven pumps are started, purged and vented, and flow is established to ensure the pumps are operating and ready to supply makeup to the SFP and / or RPV. The diesel driven FLEX pump (1FLEXC001 or 1FLEXC002) is equipped with a 200 gallon diesel fuel tank which supports approximately 15 hours run time at full load (Reference 3.21).

The required FLEX pumps (1FLEXC001 and 1FLEXC002) will be maintained at the two on-site FLEX storage locations. The two FLEX pumps are required to be stored onsite to satisfy the N+1 requirement. These trailer mounted FLEX pumps (1FLEXC001 or 1FLEXC002) are transferred and staged via haul routes and staging areas evaluated for impact from applicable external hazards. Programs and training have been implemented to support the deployment and operation of the FLEX pumps.

The SSW basins (UHS) have the capacity to provide makeup to the RPV and SFP for up to 99 hours at which time makeup to the SSW basins is required (Reference 3.20) and Section 2.3.3. The Mississippi River provides an indefinite supply of water, as makeup to the SSW basin. The UHS and Mississippi will remain available for any of the external hazards listed in Section 2.6.

2.9.2 Alternate RCS Makeup Strategy

An alternate path for Phase 2 reactor core cooling is a connection location upstream of 1E21F025 also in the CRWST System at hose connection valve 1P11F445. This tie-in allows RPV injection via the LPCS system.

An additional alternate strategy considers that if the HPCS SW system piping between the SSW basins and the HPCS DG Building is unavailable, 700 feet of flexible hose stored in each storage building will be routed from either service water basin directly to either connection point for the RHR C or LPCS hose connections in the CRWST System piping in the Auxiliary Building.

These alternate strategies use the same diesel powered FLEX pump (1FLEXC001 or 1FLEXC002) credited for the primary strategy.

2.9.3 Electrical Strategy

Transition from Phase 1 (reliance on station batteries) to Phase 2 (repowering station battery chargers) will be made using a FLEX portable 480V DG (1FLEXS009 or 1FLEXS010). The decision to deploy the FLEX DG will be made during the initial response phase. The operator is directed to take steps to minimize the load on the station batteries by initially shedding unnecessary loads in accordance with station SBO procedures and within 2 hours of the event initiation shedding additional unnecessary loads in accordance with the FSGs. The load shedding ensures the station batteries will have greater than 12 hours of capability.

Prior to depletion of the batteries, the Phase 2 FLEX 480V diesel generator (1FLEXS009 or 1FLEXS010) will be placed into service at or before 11 hours and connected to recharge the Division I and Division II batteries as discussed in Section 2.3.2. Therefore, the time margin between the calculated battery duration for the FLEX strategy and the expected deployment time for FLEX equipment to supply the dc loads is greater than 1 hour. A single 300 kW generator (1FLEXS009 or 1FLEXS010) is capable of repowering the two 125V battery chargers (one per division), the HPCS DG fuel oil storage tank pump (1P81C001), the modified EOP containment vent UPS (1M41PS01), and a battery room exhaust fan (Q1Z77C001A). Each FLEX 480V 300 kW diesel generator is equipped with a 500 gallon diesel fuel tank which supports approximately 22 hours run time at full load (Reference 3.21).

One battery charger diesel generator (1FLEXS009 and 1FLEXS010) is stored in each FLEX storage building. Once inside the PA, the portable 480V DG is deployed to either the primary or alternate staging location. The primary staging location for the 480V DG (1FLEXS009 and 1FLEXS010) is at grade level, just west of the Control Building. The alternate staging location is at grade level on the southwest corner of the Unit 1 Auxiliary Building. The staging locations for the FLEX DG are shown in Figure 2.

The required FLEX 480V DGs (1FLEXS009 and 1FLEXS010) will be maintained at the two on-site FLEX storage locations. Two FLEX 480V DGs are required to be stored onsite to satisfy the N+1 requirement. The trailer mounted FLEX 480V DGs will be transferred and staged via specific haul paths / pre-defined routes (see Figure 2 and Figure 3) evaluated for impact from applicable external hazards. Programs and training have been implemented to support the deployment and operation of the FLEX 480V DGs.

2.9.4 Fueling of Equipment

The FLEX strategies for maintenance and / or support of safety functions involve several elements including the supply of fuel to necessary diesel engine driven generators, pumps, hauling vehicles, etc. To ensure adequate fuel exists to meet the strategy, all diesel-driven FLEX equipment stored in the FLEX storage buildings is maintained with a full tank of diesel fuel. Additional fuel will be needed to replenish the fuel used by the diesel driven equipment for the duration of the event.

GGNS has three safety related underground fuel oil storage tanks and three safety related fuel oil day tanks which supply the two standby diesel generators and the HPCS diesel generator. The three storage tanks are of the horizontal type and are buried approximately 11 feet underground, which is well below the frost line to eliminate low temperature damage of the fuel (Reference 3.24, Section 9.5.4.2). Each vertical type day tank has a nominal capacity of 550 gallons (Reference 3.111) and is located with each diesel generator within each diesel generator room of the Diesel Generator building. Each storage tank has a gross storage capacity of 76,000 gallons. The minimum required storage volume of the storage tanks for the standby diesel generators is 68,744 gallons (Reference 3.107). The minimum required storage volume of the storage tank for the HPCS diesel generator is 44,616 gallons (Reference 3.108).

The strategy for refueling the diesel driven portable equipment, i.e., pumps and generators, being utilized for the response to an ELAP / LUHS event, is to gravity drain fuel oil out of the HPCS DG Fuel Oil Day Tank (1P81A002), as necessary, and to pump additional fuel oil out of the HPCS DG Fuel Oil Storage Tank (1P81A001) using the HPCS DG fuel oil transfer pump (1P81C001) powered by the FLEX 480V 300 kW DG (1FLEXS009 or 1FLEXS010) which will be in operation at or before 11 hours after the start of the event (Reference 3.21). The HPCS DG fuel oil storage tank transfer pump, will be repowered by installing temporary power cable routed from the FLEX 480V DG primary connection cabinet (1R20P016) to power MCC 17B11 which feeds the transfer pump in accordance with the approved FSGs (Reference 3.94).

This installed pump will transfer diesel fuel from the underground storage tank to a portable 500 gallon fuel trailer via flexible 1.5" diameter hose connected to the HPCS DG fuel oil transfer pump discharge strainer located in the HPCS DG room. The 500 gallon fuel trailer will be towed around the site to the various equipment staging locations to refill the fuel tanks. A DC motor-driven fuel pump (1FLEXC003 or 1FLEXC004) on the trailer-mounted tank will be used to pump fuel from the trailer-mounted tank to FLEX equipment fuel tanks.

Fuel from the HPCS DG Fuel Storage Oil Tank can be transferred to all FLEX equipment in an estimated 212 minutes, or approximately 3.5 hours (Reference 3.21). The FLEX MCR ventilation fan diesel generator (1FLEXS012 or 1FLEXS013), which is started at 10 hours after the event to provide MCR ventilation, has a small fuel tank and is the first FLEX component that requires refueling 5.9 hours after it starts operating. Based on the fuel tank size of this portable diesel generator (4.6 gallons), a 28 gallon portable tank cart is stored and deployed with the generator to refill this tank. Using this cart will provide enough fuel to last for at least 30 hours, which is sufficient time until the 500 gallon tank (1FLEXC003 or 1FLEXC004) can be used to refuel this diesel generator.

The truck supported refueling cycle for the 500 gallon fuel trailer with the DC motor-driven pump will start at approximately 26 hours after the start of the BDBEE to refuel the diesel driven FLEX makeup pump (1FLEXC001 or 1FLEXC002) following the initial filling of the 500 gallon tank from the from the HPCS DG fuel oil storage tank and with the diesel driven FLEX makeup pump initially started 11 hours after the start of the BDBEE. All FLEX equipment can be refueled within 3.5 hours, therefore this refueling strategy ensures that all diesel-run FLEX equipment will be refueled following a BDBEE. Refueling requirements are shown in Table 3.

Table 3		
Truck Refueling	**1st Refuel Time (hrs)**	**Run Time Between Refills (hrs)**
FLEX Diesel Driven RCS / SFP Makeup Pump (1FLEXC001 or 1FLEXC002)	26.1	15.1
FLEX 300 kWDG (1FLEXS009 or 1FLEXS010)	33.6	22.6
FLEX Hydrogen Igniters DG(1FLEXS011 or 1FLEXS022)	44.3	33.3
(4) FLEX Diesel Light Towers (1FLEXS014 through 1FLEXS017 or 1FLEXS018 through 1FLEXS021)	74.6	66.6
Cart Refueling	**1st Refuel Time (hrs)**	**Run Time Between Refills (hrs)**
FLEX MCR Ventilation Fans DG (1FLEXS012 or	15.9	5.9

Table 3		
1FLEXS013)		
(3) EP Communications DG (1FLEXE001A through 1FLEXE001C or 1FLEXE001D through 1FLEXE001F)	22.5	14.5

The 3.5-hour refueling cycle for the 500 gallon trailer mounted tank may be required for an indefinite period. For the first 72 hours after deployment, calculated diesel fuel usage is approximately 3,726 gallons, based on a fuel consumption rate of 1,242 gallons per day (Reference 3.21). As discussed above, the minimum required diesel fuel oil volume of the HPCS DG fuel oil storage tank is 44,616 gallons (Reference 3.24, Section 9.5.4.2 and Reference 3.28, LCO 3.8.3) which is sufficient fuel to supply the FLEX equipment for approximately 35.9 days following a BDBEE, based on a fuel consumption rate of 1,242 gallons per day (Reference 3.21). In addition to the HPCS DG fuel oil storage tanks, the two standby DG fuel oil storage tanks contain a combined minimum required fuel oil volume of over 137,000 gallons that could also be available if required. Because there is a large volume of onsite diesel fuel available, diesel refueling will be procedurally controlled by the fuel oil levels in the equipment and not necessarily by the timing. Similarly, as staffing levels allow, use of the 28 gallon portable cart tanks for small loads may transition to use either the 500 gallon fuel trailers or the NSRC supplied equipment.

Therefore, onsite fuel oil supplies could provide onsite diesel driven FLEX equipment diesel fuel for well beyond 30 days. The onsite fuel and methods described above can also be used to refuel the Phase 3 NSRC equipment as necessary.

Diesel fuel in the standby and HPCS DG fuel oil storage tanks is maintained for operation of the emergency DGs and is routinely sampled and tested to assure fuel oil quality is maintained to ASTM standards (Technical Specifications 5.5.9, Diesel Fuel Oil Testing Program, Reference 3.28). Fuel oil in the fuel tanks of portable diesel engine driven FLEX equipment will be maintained in the Preventative Maintenance program in accordance with the EPRI maintenance templates.

2.10 Offsite Resources

2.10.1 National SAFER Response Center

The industry has established two National SAFER Response Centers (NSRCs) to support utilities during BDBEEs. Entergy has established contracts with the Pooled Equipment Inventory Company (PEICo) to participate in the process for support of the NSRCs as required (Reference 3.109). Each NSRC holds five sets of equipment, four of which will be able to be fully deployed when requested, the fifth set is assumed to be in a maintenance cycle. In addition, on-site FLEX equipment hose and cable end fittings are standardized with the equipment supplied from the NSRC or utilize adapters stored in the FLEX storage buildings. In the event of a BDBEE and subsequent ELAP/LUHS condition, equipment will be moved from an NSRC to a local assembly area established by the Strategic Alliance for FLEX Emergency Response (SAFER) team. FLEX Strategy requests to the National SAFER Response Center (NSRC) are directed by the Extended Loss of AC Power (ELAP) AOP / ONEP (Reference 3.89). FLEX support guideline Procedures direct connection of NSRC supplied equipment.

Communications will be established between the site and the NSRC via satellite phones. All NSRC arriving equipment will be delivered to the site within 24 hours from the initial request. The order at which equipment is delivered is identified in the GGNS "SAFER Response Plan (Reference 3.22)."

For GGNS, Staging Area 'B' is located in the ESC laydown area, an area west-northwest of the PA. Staging Area 'C' is located at the Vicksburg Tallulah Regional Airport and Staging Area 'D' is located at the Natchez Adams County Airport (Reference 3.22). From Staging Areas 'C' or 'D', equipment can be taken to the GGNS site and staged at Staging Area 'B' by helicopter if ground transportation is unavailable.

2.10.2 Equipment List

For GGNS, the equipment that is planned to be available for use from the NSRC includes the 2500 gpm Low Pressure / Medium Flow Pump and the 1000 gpm Portable Submersible Pump that could optionally be used for the Phase 2 to Phase 3 transition at 99 hours after the start of the event to supply makeup to the SSW basins from the Mississippi River. This equipment is within the air-lift capability of the NSRC. The equipment stored and maintained at the NSRC for transportation to the local assembly area to support the response to a BDBEE is listed in Table 4. Table 4 identifies the equipment that is credited in the FLEX strategies for GGNS recovery during Phase 3 and also lists the equipment that will be available for backup / replacement for on-site Phase 2 equipment or would be on hand as defense in depth. Since all the equipment will be delivered to the local staging area (Staging Area 'B') within 24 hours, the time needed for the replacement of a failed component will be minimal following equipment delivery.

Table 4
BWR Portable Equipment From NSRC

Use and (Potential / Flexibility) Diverse Uses										Performance Criteria		Notes
List Portable Equipment	**Qty Req'd /Unit**	**Qty Provided / Unit**	**Power**	**Core Cool-ing**	**Cont. Cooling/ Integrity**	**SFP**	**Access**	**Instrumen-tation**	**RCS Inventory**			
Medium Voltage Generators (Generic)	0	1	Turbine	X	X	X		X	X	4160 VAC	2 MW	Ref. 3.22 and 3.84 Section 7.1 (1)(2)
Low Voltage Generator (Generic)	0	1	Turbine	X	X	X		X		480 VAC	1000 kW	Ref. 3.22 and 3.84 Section 7.2 (1)
High Pressure Injection Pump (Generic)	0	1	Diesel							2000#	60 GPM	Ref. 3.22 and 3.84 Section 7.3 (3)
SG/RPV Makeup Pump (Generic)	0	1	Diesel							500#	500 GPM	Ref. 3.22 and 3.84 Section 7.4 (3)
Low Pressure / Medium Flow Pump (Generic)	1	1	Diesel	X	X	X				300#	2500 GPM	Ref. 3.22 and 3.84 Section 7.5
Low Pressure / High Flow (Dewatering) Pump (Generic)	0	1	Diesel	X	X	X				150#	5000 GPM	Ref. 3.22 and 3.84 Section 7.6 (1)

Table 4
BWR Portable Equipment From NSRC

Use and (Potential / Flexibility) Diverse Uses										Performance Criteria	Notes
List Portable Equipment	**Qty Req'd /Unit**	**Qty Provided / Unit**	**Power**	**Core Cool-ing**	**Cont. Cooling/ Integrity**	**SFP**	**Access**	**Instrumen-tation**	**RCS Inventory**		
Lighting Tower (Generic)	0	3	Diesel				X			440,000 Lu	Ref. 3.22 and 3.84 Section 7.7 (1)
Diesel Fuel Transfer (Generic)	0	1	AC/DC	X	X	X	X	X		240 Gallons	Ref. 3.22 and 3.84 Section 7.8 (1)
Fuel Air-Lift Containers (Generic)	0	1	N/A	X	X	X	X	X		500 Gallons	Ref. 3.22 and 3.84 Section 7.8.1 (1)
On-Site Diesel Transfer (Generic)	0	1	Diesel	X	X	X	X	X		60 GPM	Ref. 3.22 and 3.84 Section 7.8.2 (1)
Portable Diesel Fuel Tank and Attached Pumps (Generic)	0	1	AC/DC	X	X	X	X	X		264 Gallons 25 GPM	Ref. 3.22 and 3.84 Section 7.8.3 (1)
4160 VAC Distribution System (Generic)	0	1	4160 VAC	X	X	X		X		1200 AMP	Ref. 3.22 and 3.84 Section 7.9.1 (1)

Table 4
BWR Portable Equipment From NSRC

Use and (Potential / Flexibility) Diverse Uses										Performance Criteria		Notes
List Portable Equipment	Qty Req'd /Unit	Qty Provided / Unit	Power	Core Cool-ing	Cont. Cooling/ Integrity	SFP	Access	Instrumen-tation	RCS Inventory			
Air Compressor (Non-Generic)	0	1	Diesel	X	X					150#	300 scfm	Ref. 3.22 and 3.84 Section 8.6
Water Treatment (Pre-filter) (Non-Generic)	0	1	N/A	X		X			X		500 GPM	Ref. 3.22 and 3.84 Section 8.7 (1)
Water Treatment (Reverse Osmosis) (Non-Generic)	0	1	Diesel	X		X					250 GPM	Ref. 3.22 and 3.84 Section 8.7 (1)
Portable Submersible Pump (Non-Generic)	1	1	Diesel	X	X	X				75#	1000 GPM	Ref. 3.22 and 3.84 Section 8.8

Note 1 - NSRC Generic Equipment – Not required for FLEX Strategy – Provided as Defense-in-Depth.
Note 2 – The 4160 VAC generator is two pieces.
Note 3 - NSRC Generic Equipment – Not needed for FLEX Strategy – Provided as part of NSRC equipment for all plants.

2.11 Habitability and Operations

2.11.1 Equipment Operating Conditions

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

The key areas identified for all phases of execution of the FLEX strategy activities are the main control room (MCR), RCIC room, Battery Room and Switchgear Room.

2.11.1.1 Main Control Room

Calculation XC-Q1111-14001, Rev. 1, Control Room Heatup for Extended Loss of AC Power (Reference 3.60), determined the transient temperature response in the MCR for 120 hours following an ELAP. To maintain the control room below the maximum temperature of 110°F the following actions will be taken: a door to the roof will be opened within 1 hours of the initiating event; 13 control building doors will be opened within 4 hours of the initiating event; and, two 3,000 cfm (minimum) fans will be staged to exhaust air from the MCR into the corridor within 10 hours of the initiating event. Ventilation for the MCR will be via any two portable fans (1FLEXC005 through 1FLEXC008), powered by a portable 6 kW diesel generator (1FLEXS012 / 1FLEXS013). These actions will draw air in to the MCR through the stairwell open to the atmosphere on elevation 133'0" (and hot air is exhausted through the MCR through doors up through an additional stairwell to the roof (Reference 3.62). The heat up evaluation determined that the maximum temperature reached 120 hours after the start of the event is approximately 106°F. Based on Section 2.7.2.3 of Reference 3.9, a temperature of 110°F is an acceptable limit for Control Room habitability.

2.11.1.2 RCIC Room

Calculation XC-Q1111-14003, Rev. 000, Grand Gulf Nuclear Station RCIC Pump Room Heatup for Extended Loss of AC Power (Reference 3.17) determined the RCIC room transient temperature response for 120 hours following an ELAP. Acceptance criterion for maximum RCIC room temperature is 212°F (Reference 3.63). Four cases were analyzed in this calculation to evaluate different possible scenarios associated with shedding or not shedding the RCIC gland seal compressor following the BDBEE. The optimum strategy was determined to be to shed the RCIC gland seal compressor within 30 minutes of the BDBEE (the calculation assumes it is shed at time zero to conservatively maximize room heat up) as detailed in the Loss of AC Power procedure (Reference 3.19) and then re-energize the RCIC gland seal compressor when the station battery chargers are re-powered by the FLEX 480V 300 kW DG (1FLEXS009 or 1FLEXS010) at 11 hours. The maximum room temperature reached is 193°F for this case. This recommended action is based on extending the installed battery discharge capacity and minimizing areas of increased airborne contamination outside the RCIC room that would otherwise result due to the shutdown of the gland seal compressor if the room doors were opened to provide room cooling (two of the cases evaluated in Reference 3.17) even though opening the doors is an acceptable strategy for maintaining adequate temperatures.

Personnel are not required to enter the RCIC room during Phase 1 since remote operation from the control room remains available.

2.11.1.3 Battery Room and Switchgear Room Ventilation

Calculation MC-QSZ77-09004 (Reference 3.64) evaluates heat up of the Control Building Safeguard Switchgear and Battery Rooms. Ventilation for the battery rooms and switchgear rooms is provided by using the FLEX DG

(1FLEXS009 or 1FLEXS010) to repower an installed battery room exhaust ventilation fan (1Z77C001A). Prior to repowering the installed ventilation fan, six Control Building doors will be opened by 1 hour after the initiating event to provide natural circulation. The calculation assumes normal operating heat loads. Since the SBO battery and switchgear room heat loads will be less than normal operation heat loads with no AC power available, opening the required doors by 1 hour after the initiating event maintains these rooms below 120°F.

Non-safety related electrical equipment in the switchgear rooms will be de-energized during the ELAP, therefore, the load on the transformers feeding the breakers will be reduced. The heat load in the rooms is primarily comprised of the heat generated by electrical equipment and will decrease after a loss of power (LOP) due to the loss of non-safety related electrical switchgear. GGNS92-0002 (Reference 3.65) documents that Load Centers 15BA6 and 16BB6 including all associated devices, i.e. breakers, are expected to function properly at an elevated temperature of 120°F for a 100 day period.

Actions will need to occur in the switchgear rooms during phases 1 and 2 for load shedding and deploying the cables associated with the battery charger diesel generator. Plant procedure EN-IS-108 (Reference 3.66) addresses working in hot environments.

During routine / normal battery charging operations, ventilation is required in the main battery rooms due to hydrogen generation. Calculation E0046 (Reference 3.67) determined that if a loss of ventilation occurs during charging operations, then the time for the room to reach a dangerous concentration of 2% hydrogen is approximately 24 hours under worst case conditions. Battery room ventilation fan 1Z77C001A will be repowered from the portable FLEX 480V 300 kW DG (1FLEXS009 or 1FLEXS0101) via Load Center 15BA6 prior to 24 hours. This exhaust fan will provide the necessary hydrogen removal from the battery rooms in addition to providing additional ventilation. There are no unpowered devices that would negatively impact the FLEX function of the repowered exhaust fan (References 3.68 and 3.69).

To mitigate the effects of extreme low temperatures for the battery rooms, personnel will monitor outdoor and room temperatures as necessary and implement mitigating strategies (e.g. closing doors or cycling the exhaust fan) to ensure battery room temperatures remain above 70°F.

2.11.2 Heat Tracing

The strategy utilizes HPCS SW lines that are potentially subjected to freezing conditions. GGNS-SA-14-00002 (Reference 3.14) discusses concerns associated with freezing of non-heat traced lines in the HPCS SW system. As stated in SDC P41 (Reference 3.70), the siphon between the two SSW basins is installed below grade and is therefore protected from freezing. Similarly, HPCS SW basin piping that is being utilized is either below grade or in heated rooms and protected from freezing. Following a BDBEE resulting in an ELAP, heating is lost in the SSW Basin A valve room, such that the 6 inch and 10 inch nominal diameter pipes are potentially subject to freezing conditions as an event progresses if they are not drained or if flow is not established through the piping in a reasonable time frame. Flow could be reasonably established through the 6 inch tee connection in the SSW Basin A valve room since the room temperature is expected to remain above freezing for an extended period of time based on the results of similar evaluations for the SSW pump house (Reference 3.110) and flow for SFP makeup is established within ~11 hours of the initiating BDBEE. Discounting this conclusion, however, during implementation of the FLEX strategy subject to freezing conditions, the alternate RPV and SFP makeup strategy (hoses run from the basin to the Auxiliary Building) in lieu of the HPCS SW piping could be used if necessary. Based on analysis performed at the Indian Point Energy Center located in a region that experiences colder temperatures than GGNS (Reference 3.71) hose freezing is not a concern for the flow rates required by Sections 2.3.2, 2.3.3, 2.4.2 and 2.4.3.

Therefore, the GGNS FLEX Strategy does not have dependency on heat tracing for any required equipment after the initiation of the event.

2.12 Personnel Habitability

Personnel habitability was evaluated for the MCR in Section 2.11.1.1 above and determined to be acceptable. An auxiliary building heat up calculation was performed and the results of this evaluation determine that every area in the auxiliary building requiring operator actions will be accessible following an ELAP event (Reference 3.85).

Entergy industrial safety procedures currently address activities with a potential for heat stress to prevent adverse impacts on personnel (Reference 3.66).

2.13 Lighting

Following the BDBEE, emergency lighting is retained for the MCR. Following shedding of non-essential DC loads, the Division II station batteries have the capacity to feed the MCR emergency lighting for up to 13 hours. After 11 hours the battery chargers are powered from the FLEX 480V 300 kW DG (1FLEXS009 or 1FLEXS0101) which carries the DC loads (Reference 3.12).

The standard gear/equipment of operators with duties in the plant (outside the main control room) includes flashlights; therefore, flashlights would be available to operations personnel immediately following the start of the event. This requirement is in plant procedure EN-OP-115-01, Operator Rounds (Reference 3.72). Additionally, portable flashlights are provided in control room evacuation bags along with the control building ops work area (References 3.73 and 3.74). Flex support guidelines address lighting requirements during the ELAP.

2.14 Communications

GGNS has communication capabilities with off-site response organizations, the NRC, between emergency response facilities, with field and off-site monitoring teams, and with in-plant and off-site emergency response organization staff. An assessment of communications assuming a large-scale natural event, which would lead to an extended loss of all AC power was performed and described in References 3.75 and 3.76. As part of this assessment, GGNS identified enhancements / changes to maintain communications capabilities for responding to emergency events.

Changes resulting from design evolution occurred such that some of the original strategies communicated to the NRC in Reference 3.76 were revised. The implemented design ensures the required power and physical protection from flooding, wind, and seismic events are provided for the essential equipment per NEI 12-01 (Reference 3.77).

The GGNS plant paging system provides public address capability over a large portion of the site. The system is limited primarily by the lack of system wide back up power. Although portions of the system may be available, it is not credited as available for notification of plant personnel. Plant personnel will become aware of the large scale natural event by personal observation (e.g., loss of lighting). General Employee Training (GET) includes direction regarding actions to be taken by personnel upon observation of site events, i.e., they are to report to the designated site assembly area(s). Site accountability process will be implemented to ensure all personnel are notified.

Table 5 provides is a summary of the communication equipment provided (Reference 3.78):

Table 5		
CREDITED COMMUNICATION EQUIPMENT SUMMARY		
Building	**Location**	**Communication and Power Supply Equipment**
Turbine Building	Elevation 186'-3" Radio Room	Channel 1 Radio Repeater and Active Filter 1 UPS and 5 Battery Packs
		Channel 3 Radio Repeater and Active Filter Satellite Phone Docking Station 1 UPS and 5 Battery Packs
Admin Building (Maintenance	OSC	Two Desktop Radios 1 UPS and 2 Battery Packs

Table 5		
CREDITED COMMUNICATION EQUIPMENT SUMMARY		
Building	**Location**	**Communication and Power Supply Equipment**
Shop)		3 Handheld Satellite Phones 3 Spare Satellite Phone Batteries 1 Four Slot Satellite Phone Charger 2 Deployable Satellite Phones 2 Spare Deployable Satellite Phone Batteries 2 Deployable Satellite Phone Battery Chargers 23 Handheld Radios 46 Spare Radio Batteries Twelve (12) Six Slot Radio Chargers
Control Building	Unit 1 Main Control Room	Radio Console 1 UPS and 1 Battery Pack
		2 Deployable Satellite Phones 2 Spare Deployable Satellite Phone Batteries 2 Deployable Satellite Phone Battery Chargers
Control Building	TSC	2 Handheld Satellite Phones 2 Spare Satellite Phone Batteries 1 Four Slot Satellite Phone Charger 2 Deployable Satellite Phones 2 Spare Deployable Satellite Phone Batteries 2 Deployable Satellite Phone Battery Chargers 3 Handheld Radios 6 Spare Radio Batteries 2 Six Slot Radio Chargers
Energy Services Center	EOF	4 Deployable Satellite Phones 4 Spare Deployable Satellite Phone Batteries 4 Deployable Satellite Phone Battery Chargers 4 Handheld Satellite Phones 4 Spare Satellite Phone Batteries 1 Four Slot Satellite Phone Charger
Control Building - Elevation. 148'-0"	Backup OSC	2 Handheld Satellite Phones 2 Spare Satellite Phone Batteries 1 Four Slot Satellite Phone Charger
Maintenance and Engineering Building	Backup TSC	2 Handheld Satellite Phones 2 Spare Satellite Phone Batteries 1 Four Slot Satellite Phone Charger
Baxter Wilson Steam Plant	Backup EOF	2 Handheld Satellite Phones 2 Spare Satellite Phone Batteries 1 Four Slot Satellite Phone Charger

Table 5		
CREDITED COMMUNICATION EQUIPMENT SUMMARY		
Building	**Location**	**Communication and Power Supply Equipment**
FLEX Storage Building	Deployed at Ground Level Outside of Control Building	1 Portable Generator
	Deployed at Ground Level Outside of Maintenance Shop	1 Portable Generator
	Deployed at Ground Level Outside of EOF	1 Portable Generator

A combination of batteries and uninterruptible power supplies (UPSs) to power site communications equipment will be available. The site strategies will result in: (1) each satellite phone will be provided a 24 hour power supply capability through batteries; (2) radios will be provided a 24 hour power supply capability through batteries, and (3) Radio repeater systems will be provided back-up power by a combination of UPS units and portable diesel generators to maintain communication capability.

Three (3) diesel generators will be deployed and positioned in strategic locations to provide continuous power to credited EP Communications system equipment. One generator will be deployed to a location adjacent to the Control building. One generator will be deployed to a location adjacent to the Maintenance and Engineering Building. A third generator will be deployed to a location adjacent to the Energy Services Center. Three (3) spare generators are stored in each FLEX storage building.

Portable self-contained satellite phone “pelican cases” contain an antenna, docking station, satellite phone and an analog phone; these will be staged in the Control Building, Energy Services Building, and Maintenance Shop to allow quick deployment when needed. In the event that normal telephone service is unavailable following a BDBEE, the pelican cases and antennas will be installed on the roof of the buildings and telephone wire installed from the pelican cases to analog phones in each facility to provide emergency response personnel use of satellite phones from within the facility. Battery chargers and spare batteries will be staged in each facility to ensure continuous satellite phone usage by emergency personnel.

2.15 Water sources

In regards to water sources, only the suppression pool, UCP, SFP, SSW basins (the UHS), and Mississippi meet the qualification guidelines of NEI 12-06 for an injection source that can be credited for the ELAP/LUHS event. Other water sources, depending on the cause of the event, may be available for injection and although are not credited, could be considered during an actual event.

RPV Makeup

Even though RCIC is normally aligned to the CST, the CST is not credited for FLEX because the tank is not seismically designed or protected from missiles. However, the CST could be utilized as the initial source of RPV makeup if the ELAP/LUHS initiating event is not due to a seismic or missile generating event or if the CST survives these events. The suppression pool is the initial source of water for RCIC for ELAP/LUHS events which result in the loss of the CST. At approximately 3 hours, RCIC suction is transferred to the UCP because of increasing suppression pool temperature. The available volume in the UCP is depleted at approximately 20 hours (See section 2.3.7).

At approximately 20 hours, the UCP supply available for RCIC suction is nearing depletion. Two SRVs are then opened to depressurize the reactor to less than 100 psig and allow initiation of Phase 2 flow from the diesel driven FLEX pump (1FLEXC001 or 1FLEXC002) to start feeding the reactor. One portable diesel driven FLEX pump will be used to provide the makeup water for Phase 2 reactor core cooling and inventory control, as well as SFP cooling and inventory control. This pump will take suction from one of the SSW basins.

The FLEX pump is capable of drafting from the SSW basins for approximately 99 hours without external makeup before cavitation occurs due to insufficient NPSH available per calculation MC-Q1111-14007 (Reference 3.20). For the calculation the FLEX pump delivers 500 gpm (250 gpm to the SFP and 250 gpm for reactor vessel makeup) for the duration of the 99 hours. Adding water to the SSW Basins will support indefinite operation of the Phase 2 FLEX pump.

Any method to provide basin makeup is acceptable provided at least 23,000 gallons per hour can be provided by 99 hours after event initiation. Offsite supplied pumps and / or water transportation equipment will provide water from the Mississippi River via public access roads from the Port of Port Gibson, from Grand Gulf Military Park, or from the owner controlled access road from the site barge slip. Additionally, the NSRC supplied SSW basin makeup pump and submersible pump can be deployed to the river to provide makeup to the SSW Basin for indefinite core cooling.

SPF Makeup

For SFP makeup, the limiting (full core offload) required makeup due to inventory loss from boiloff is ~90 gpm starting at approximately 57 hours when the SFP water level reaches the top of the fuel in the storage racks. For the design basis SFP heat load, the required makeup due to boiloff is ~39 gpm starting at approximately 132 hours when the SFP level reaches to top of the fuel in the storage racks. NEI 12-06 also requires plants to have the capability of spray cooling at 200 gpm (or 250 gpm for overspray) for the SFP. The GGNS SFP makeup strategies provide these capabilities.

For the three SFP makeup strategy methods, a diesel driven FLEX pump (1FLEXC001 or 1FLEXC002) will be deployed and available at approximately 11 hours after the start of the event to take suction from the SSW Basins. The FLEX pump is capable of providing 250 gpm of flow to the monitor nozzles, which bounds the 90 gpm makeup rate required under the worst case heat load conditions. The diesel-driven FLEX pump is sized to simultaneously provide the required makeup flows for reactor core cooling and SFP cooling.

FLEX Raw Water Strategy Considerations:

The GGNS FLEX Strategy is, by necessity, partly a "Raw Water" Strategy, that is, in the extreme case of losing preferred sources of RPV makeup water (i.e., CST, suppression pool, UCP), the Ultimate Heat Sink (UHS) raw water source will be used in accordance with guidance for handling low quality but plentiful water sources. This Strategy is in accordance with NEI guidance.

NEI 12-06 (Reference 3.3) Section 3.2.2, states:

> Under certain Beyond-Design-Basis Conditions, the integrity of some water sources may be challenged. Coping with an ELAP / LUHS may require water supplies for multiple days. Guidance should address alternate water sources and water delivery systems to support the extended coping duration. Cooling and makeup water inventories contained in systems or structures with designs that are robust with respect to seismic events, floods, and high winds, and associated missiles are assumed to be available in an ELAP / LUHS at their nominal capacities.

Finally, when all other preferred water sources have been depleted, lower water quality sources may be pumped as makeup flow using available equipment (e.g., a diesel driven fire pump or a portable pump drawing from a raw water source). Procedures / guidance should clearly specify the conditions when the operator is expected to resort to increasingly impure water sources.

2.16 Shutdown and Refueling Analysis

GGNS abides by the Nuclear Energy Institute position paper entitled "Shutdown/Refueling Modes" (Reference 3.80) addressing mitigating strategies in shutdown and refueling Modes. This paper has been endorsed by the NRC Staff (Reference 3.81). Therefore, Entergy has incorporated the supplemental guidance provided in the NEI position paper to enhance the shutdown risk process and procedures.

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

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

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

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

RPV Core Cooling:

Hot Shutdown (Mode 3) and Cold Shutdown (Mode 4) conditions (other than Refueling Modes) are bounded by the FLEX Strategy for Power Operation. The FLEX Strategy response times for an event that occurs while already in Hot or Cold Shutdown are longer than for the Power Operation condition because the RPV is initially re-pressurized to allow use of the steam-driven RCIC system for core cooling. The subsequent Phase 1, 2, and 3 actions are the same as for Power Operation, but occur later as the decay heat is lower and heat up times longer, dependent on the elapsed time since shutdown.

The transition from Mode 4 to Mode 5 at the beginning of each refueling outage requires draining the drywell cavity and removing the drywell head to gain access to the RPV head. Once one or more RPV head bolts are de-tensioned RCIC will not be available since the RPV pressure boundary is compromised. For an ELAP in this configuration, RPV injection using a FLEX pump is required. Other non-limiting conditions (e.g. fuel currently being transferred through horizontal fuel transfer system, Mode 2 startup or Mode 3 with RCIC unavailable) have the same strategy as the limiting conditions with less sensitive timelines.

During refueling the timeline for the Mode 5 strategy could be challenged by the available debris removal time depending upon conditions at the time of a loss of shutdown cooling event. However, the debris removal assessment is based on minimal staffing and the conservative consideration of the worst case debris generation. Most debris would be easily removed sheet metal from the non-qualified metal structures. Also, in order to effectively manage risk and maintain safety during refueling, the plant maintains contingencies to address the precautions and response actions for loss of cooling. These contingencies direct actions to minimize the likelihood for a loss of cooling and also direct the actions to be taken to respond to such an event. During modes 4 and 5, there would be additional staff available to respond to the event including debris removal which would allow for quicker deployment of the FLEX pump.

Pre-staging of FLEX equipment can be credited per the guideline of NEI 12-06 as long as the pre-staged equipment is protected from the natural hazards. However, the equipment staging area is not typically protected from natural hazards, so staging and deployment of FLEX portable pumps to supply injection flow must commence immediately from the time of the event. This strategy remains consistent with the contingencies developed to address the precautions and response actions for a loss of cooling during refueling. The core cooling strategy for Modes 4 and 5 rely on the primary and alternate injection paths described for Mode 1 for reactor makeup (Section 2.3.5).

SFP and UCP Cooling:

Following an extended loss of AC power, there are no capabilities to provide SFP or UCP makeup during shutdown conditions. The strategy credits the plant design's which maintains cooling for the spent fuel in the SFP and UCP (when spent fuel is present) via the large inventory and heat capacity of water in the SFP and UCP. GGNS Technical Specifications (Reference 3.28) LCO 3.7.6 requires the SFP and UCP water levels to be maintained greater than or equal to 23 ft over the top of irradiated fuel assemblies seated in the spent fuel storage pool and upper containment fuel storage pool racks. At this level, the earliest that fuel in the SFP could be uncovered from boil-off for the worst case full core offload (outage conditions only) is approximately 57 hours which is the latest makeup could start per station analysis (Reference 3.36).

The earliest that fuel in the UCP could be uncovered from boil-off for the worst case full core offload is approximately 49 hours (Reference 3.36). Below is a summary of time to boil, boil off rate, and time to top of fuel for boil off for the SFP and UCP for full core offload from station analysis (Reference 3.36):

Parameter	SFP	UCP
Time to boil for full core offload	5.17 hours	3.54 hours
Boil-off rate for full core offload	90 gpm	60 gpm
Time to top of fuel for full core offload	57.37 hours	49.01 hours

The SFP makeup strategy discussed in Section 2.4 can be used to provide makeup to both the UCP and SFP at the same time by also establishing a flow path in the SFP system to the UCP (Reference 3.82).

2.17 Sequence of Events

Table 6 below presents a sequence of events (SOE) timeline for an ELAP/LUHS event at GGNS. Validation (Reference 3.87) of each of the FLEX time constraint actions has been completed in accordance the FLEX validation process document issued by NEI and includes consideration for staffing (References 3.88). A debris removal assessment based on site reviews of the equipment deployment routes and the locations of each of the two FLEX storage buildings (1FLEXZ001 and 1FLEXZ002) has been performed to determine a reasonable time needed to clear debris to allow FLEX equipment deployment to support the Phase 2 and beyond strategies. Debris removal equipment (1FLEXE001 and 1FLEXE002) is stored in each FLEX Storage Building.

Table 6
Sequence of Events Timeline

Action item	Elapsed Time	Action	FLEX Time Constraint Y/N	Remarks / Applicability
	0	**Event Starts**	**NA**	Plant @100% power
1.	~ 1 minute	RCIC starts	N	Reactor operator Initiates or verifies initiation of reactor water level restoration with steam driven high pressure injection and enters SBO procedure 05-1-02-I-4
2.	~ 30 minutes	Shed RCIC gland seal compressor	N	To extend battery life. See 05-1-02-I-4 Section 3.2.2 (Reference 3.19)
3.	~ 30 minutes	Open all panel doors in control room and upper control room	N	See 05-1-02-I-4 Section 3.2.2 (Reference 3.19)
4.	~ 1 hour	Attempts to start EDGs have been unsuccessful. Enter ELAP procedure	Y	Entry into ELAP procedure 05-1-02-I-7 (Reference 3.89) provides guidance to operators to perform ELAP actions
5.	~ 1 hour	Open Control Building Safeguard Switchgear and Battery Room doors	Y	Control Building Safeguard Switchgear and Battery Room doors are opened at approximately 1 hour. See 05-1-02-I-4 Section

Table 6
Sequence of Events Timeline

Action item	Elapsed Time	Action	FLEX Time Constraint Y/N	Remarks / Applicability
				3.2.3 (Reference 3.19). Opening doors is necessary to maintain temperature in rooms at less than 120°F. See Section 2.11.1.3
6.	~ 1 hour	Open Control Building stairway door to the roof	Y	Analysis indicates that opening this door will initially maintain MCR temperature below 110°F. See Section 2.11.1.1. See 05-1-02-I-4 Section 3.2.3 (Reference 3.19).
7.	~ 2 hours	Perform DC load shed on Division I and Division II batteries	Y	Starts at ~1 hour and completed by ~ 2hours. Provides at least 12 hour battery life for each station battery. See Section 2.3.11 See 05-S-01-FSG-004 (Reference 3.90).
8.	~ 2 hours	Use manual control of SRVs to depressurize the RPV to approximately 200 - 400 psig (via control room hand-switches)	Y	Manual SRV operation to depressurize RPV to approximately 200 - 400 psig must occur prior to the point of entering the Unsafe Region of the HCTL Curve. EOPs require operators to keep reactor pressure and temperature from causing entry into Unsafe Region of HCTL curve. See Section 2.3.1
9.	~ 3 hours	Swap RCIC suction from the suppression pool to the UCP at a suppression pool temperature of 170°F (open 1G41F201 via panel 1H22P003 on El. 139' Auxiliary Building)	Y	Maintains a cool source of cooling water supply to the RCIC pump and turbine as well as to maintain net positive suction head for the RCIC pump without credit for containment overpressure. See Section 2.3. See 05-S-

Table 6 Sequence of Events Timeline				
Action item	**Elapsed Time**	**Action**	**FLEX Time Constraint Y/N**	**Remarks / Applicability**
				01-FSG-002 (Reference 3.91) and 05-S-01-FSG-003 (Reference 3.95).
10.	~ 4 hours	Open MCR doors to minimize heat-up of the MCR during Phase 1	Y	Analysis indicates that opening these doors will continue to maintain MCR temperature below 110°F. See Section 2.11.1.1.
11.	~ 4 hours	Initiate use of modified EOP M41 vent path before the suppression pool temperature exceeds approximately 190°F (open new AOV 1M41F100 and isolation valves 1M41F034, 1M41F035, 1M41F036, and 1M41F037 via panel 1M41P001 on El. 166' Auxiliary Building)	Y	The modified EOP containment vent path is opened to provide containment heat removal and begin a long term strategy of reactor makeup and boiling to protect the core and containment. See Section 2.5.1. See 05-S-01-FSG-012 (Reference 3.92).
12.	~ 4 hours	At the SFP set up 2.5" and 4" hoses and monitor nozzle for SFP makeup and cooling and establish the SFP area vent flow path	N	Prior to pool boiling (5 hours for worst case full core offload), the FLEX hoses and spray monitor nozzles stored in the SFP area will be set up, local Auxiliary Building doors will be opened to vent the SFP area to atmosphere. See Section 2.4. See 05-S-01-FSG-011 (Reference 3.93).
13.	~ 5 hours	Open valve 1G41F214 to prevent SFP water from entering SFP sweeps ventilation duct	N	Due to the temperature increase of the SFP, the water volume will expand and would enter the spent fuel pool sweeps ventilation ducts. The spent fuel pool drain tank valve 1G41F214 is opened to ensure that the water drains to the equipment drain sump

Table 6
Sequence of Events Timeline

Action item	Elapsed Time	Action	FLEX Time Constraint Y/N	Remarks / Applicability
				rather than the ventilation ducts. See Section 2.4.1. See 05-S-01-FSG-011 (Reference 3.93).
14.	~ 6 hours	Complete debris removal and deployment of FLEX 480 VAC DG (1FLEXS009 or 1FLEXS010).	N	The FLEX 480 VAC DG is required for powering the station battery chargers approximately 11 hours after the start of the BDBEE (the station batteries have >12 hours capacity). See Sections 2.3.11 and 2.8.1. See 05-S-01-FSG-005 (Reference 3.94) and 05-S-01-FSG-004 (Reference 3.90).
15.	~ 10 hours	Deploy cables and portable fans (1FLEXC005 through 1FLEXC008) to MCR doors. Deploy and place in service FLEX 6 kW DG (1FLEXS012 or 1FLEXS013) outside the Control Building. Exhaust air from MCR to corridor via open doors.	Y	A minimum of a 6000 CFM air flow supplied to the corridor from the MCR is required within 10 hours of the initiating event to maintain the MCR at <110°F. See Section 2.11.1.1.
16.	~ 11 hours	Deploy cables, connect, and place FLEX 480 VAC 300 kW DG (1FLEXS009 or 1FLEXS010) in service.	Y	The FLEX 480 VAC 300 kW DG supplies power to Class 1E Load Centers 15BA6 and 16BB6 which power up the station battery chargers, diesel fuel oil transfer pump, and battery room exhaust fan. The time margin between the calculated battery duration for the FLEX strategy and the expected deployment time for FLEX equipment to supply the dc loads is >1 hour. See Section 2.3.11.
17.	~ 11 hours	Restart RCIC Gland Seal	N	Restarting the RCIC

Table 6 Sequence of Events Timeline				
Action item	**Elapsed Time**	**Action**	**FLEX Time Constraint Y/N**	**Remarks / Applicability**
		Compressor		gland seal compressor minimizes areas of increased airborne contamination outside the RCIC room that would otherwise result due to the shutdown of the RCIC gland seal compressor (since doors would have to be opened to provide room cooling if compressors were not restarted). See Section 2.11.1.2.
18.	~ 11 hours to ~ 13 hours	Deploy and place in service (if needed) the FLEX H_2 igniter DG (1FLEXS011 or 1FLEXS022) and initiate H_2 igniters	N	See Section 2.5.2.
19.	~ 11 hours	Deploy and make available diesel driven FLEX pump (1FLEXC001 or 1FLEXC002) for SFP makeup.	Y	During non-outage conditions, the time to boiling in the SFP is ~11 hours, and boil off to the level of the top of the spent fuel racks (NEI 12-02 Level 3) is ~5.5 days if no additional water is supplied to the SFP. The initial coping strategy for SFP cooling is to monitor SFP level using instrumentation (1G41-LE-N040A / 1G41-LI-R040A and 1G41-LE-N040B / 1G41-LI-R040B) installed as required by NRC Order EA-12-051. See Section 2.4.6
20.	~ 15 hours	Use 28 gallon tank cart (1FLEXC009 through 1FLEXC016) to refuel small portable equipment (e.g., MCR fans DG [1FLEXS012 or 1FLEXS013])	N	See Section 2.9.4.
21.	~ 20 hours	Open two SRVs to depressurize	Y	At approximately 20

Table 6 Sequence of Events Timeline				
Action item	**Elapsed Time**	**Action**	**FLEX Time Constraint Y/N**	**Remarks / Applicability**
		the reactor to less than 100 psig and begin Phase 2 RPV flow from the FLEX pump (1FLEXC001 or 1FLEXC002).		hours, the UCP supply available for RCIC suction is nearing depletion. Pump was deployed at 11 hours for SFP makeup. See Section 2.3.2. See 05-S-01-FSG-003 (Reference 3.95)
22.	~ 24 hours to ~ 27 hours	Deploy cable from 480V 300 kW DG (1FLEXS009 or 1FLEXS010) to repower 1M41P001 Panel El. 166 Auxiliary Building.	Y	Needed to ensure long term operability of containment vent. See Section 2.5.2. See 05-S-01-FSG-012 (Reference 3.92)
23.	~26 hours	Deploy cable from Disconnect Switch 89-171102A to 17B11 Breaker 2 to repower HPCS DG fuel transfer pump for refueling large portable equipment.	N	Powered from FLEX 480V 300 kW DG through Disconnect 89-171102A to 17B11 Breaker 2. See Section 2.9.4. See 05-1-02-I-7 (Reference 3.89) and 05-S-01-FSG-005 (Reference 3.94).
24.	40 hours	Align nitrogen bottle(s) to recharge the ADS SRV receiver tanks	Y	The 40 hours is based on the initial opening of the SRVs as the reactor scrams at the initiation of the event, the use of the low-low set function of the SRVs to control RPV pressure, and the use of two SRVs to depressurize the RPV for Phase 2 makeup with the diesel driven FLEX pump for a total of 79 SRV actuations. See Section 2.3.2. See 05-1-02-I-7 (Reference 3.89)
25.	~99 hours	Offsite supplied pumps and / or water transportation equipment begins delivery of 23,000 gallons per hour river water makeup to UHS basin.	N	See Section 2.3.3. See 05-1-02-I-7 (Reference 3.89) and 05-S-01-FSG-001 (Reference 3.96).

2.18 Programmatic Elements

2.18.1 Overall Program Document

The FLEX program document EN-OP-201-02 (Reference 3.98) provides a description of the FLEX program for GGNS. The key program elements provided in the Program Document include:

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

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

Existing design control and licensing procedures such as EN-DC-115 (Reference 3.99) and EN-LI-100 (Reference 3.100), respectively, have been revised to ensure that changes to the plant design, physical plant layout, roads, buildings, and miscellaneous structures will not adversely impact the approved FLEX strategies.

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

2.18.2 Procedural Guidance

The inability to predict all actual plant beyond design basis external events (BDBEEs) and conditions that require the use of FLEX equipment makes it impractical to provide specific procedural guidance. As such, the FLEX support guidelines (FSGs) provide guidance that can be employed for a variety of conditions. Clear criteria for entry into FSGs ensures that FLEX strategies are used only as directed for BDBEE conditions, and are not used inappropriately in lieu of existing procedures. When FLEX equipment is needed to supplement EOPs or Abnormal Operating Procedures (AOPs) / Off-Normal Event Procedures (ONEPs) strategies, the EOP or AOP / ONEP, Severe Accident Mitigation Guidelines (SAMGs), or Extreme Damage Mitigation Guidelines (EDGMs) / Alternate Strategy (B.5.b) (Reference 3.101) direct the entry into and exit from the appropriate FSG procedure.

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

Procedural Interfaces have been incorporated into Procedure 05-1-02-I-4, Loss of AC Power, to the extent necessary to include appropriate reference to FSGs and provide command and control for the ELAP. Additionally, by direct or indirect procedural interfaces with the Loss of AC Power AOP / ONEP, appropriate reference to the FSGs has been incorporated into the following AOPs / ONEPs:

- 05-1-02-VI-1 “Flooding”
- 05-1-02-VI-2, “Hurricanes, Tornados, And Severe Weather”
- 05-S-02-VI-3, “Earthquake”

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

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

2.18.3 Staffing

Using the methodology of (Nuclear Energy Institute) NEI 12-01, *Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities* (Reference 3.77), an assessment of the capability of the GGNS on-shift staff and augmented Emergency Response Organization (ERO) to respond to a BDBEE was performed. The results were provided to the NRC (Reference 3.83) and subsequently clarified (Reference 3.88). The clarifying revision does not change the overall conclusions as detailed in the original report.

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

- an extended loss of ac power (ELAP)
- an extended loss of access to ultimate heat sink (UHS)
- impact on the unit (unit is operating at full power at the time of the event)
- impeded access to the unit by off-site responders as follows:
    - 0 to 6 Hours Post Event – No site access.
    - 6 to 24 Hours Post Event – Limited site access. Individuals may access the site by walking, personal vehicle or via alternate transportation capabilities (e.g., private resource providers or public sector support).
    - 24+ Hours Post Event – Improved site access. Site access is restored to a near-normal status and / or augmented transportation resources are available to deliver equipment, supplies and large numbers of personnel.

A team of subject matter experts from Operations, Operations Training, Radiation Protection, Chemistry, Security, Emergency Planning and FLEX Project Team personnel performed a tabletop in July 2015. The participants reviewed the assumptions and applied procedural guidance, including applicable draft and approved FLEX Support Guidelines (FSGs) for coping with a BDBEE using minimum on-shift staffing. Particular attention was given to the sequence and timing of each procedural step, its duration, and the on-shift individual performing the step to account for both the task and the estimated time to prepare for and perform the task. A validation and verification of the time and resources needed to reasonably assure required tasks, manual actions and decisions for FLEX strategies are feasible and may be executed within the time constraints identified in the Overall Integrated Plan (OIP) / Final Integrated Plan (FIP) was also conducted (Reference 3.87)

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

2.18.4 Training

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

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

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

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

2.18.5 Equipment List

The equipment stored and maintained at the GGNS FLEX Storage areas necessary for the implementation of the FLEX strategies in response to a BDBEE at GGNS is listed in Table 7. Table 7 identifies the quantity, applicable strategy, and capacity / rating for the major FLEX equipment components only. Details regarding fittings, tools, hose lengths, consumable supplies, etc. are not in Table 7.

Table 7 - BWR Portable Equipment Stored On-Site						
Use and (Potential / Flexibility) Diverse Uses						Performance Criteria
List Portable Equipment	Core	Containment	SFP	Instrumentation	Accessibility	
Two (2) FLEX Diesel Generators (1FLEXS009 and 1FLEXS010),	X			X		300kW @ 0.8PF, 3Ø, 480 VAC
Two (2) FLEX Diesel Driven RCS / SFP Makeup Pumps (1FLEXC001 and 1FLEXC002)	X		X			500 gpm at 337 ft total dynamic head
Two (2) FLEX Hydrogen Igniter Diesel Generators (1FLEXS011 and 1FLEXS022)		X				15kW, 240VAC, 50 ampere breaker
Two (2) FLEX Fuel Tank on Trailer with DC Powered Transfer Pump (1FLEXC003 and 1FLEXC004)	X	X	X	X		500 gallon tank with DC powered 20 gpm transfer pump
Eight (8) FLEX Portable Fuel Cart with Hand Pump (1FLEXC009 through 1FLEXC016)					X	28 gallon tank
Two (2) FLEX MCR Ventilation Fan Diesel Generators (1FLEXS012 and 1FLEXS013)	X	X	X			6 kW (5.5kW continuous rating), 240 VAC
Two (2) FLEX Auxiliary Equipment Trailers	X	X	X		X	
Two (2) FLEX Front End Loaders for debris removal(1FLEXE001 and 1FLEXE002)					X	Case 821F, Four Wheel Drive (or equivalent)
Two (2) FLEX Tow Vehicles (1FLEXE003 and 1FLEX3004)					X	3500 Chevrolet 4WD Pickup Truck, V8 Turbocharged Diesel, 23,000 lb towing capacity
Eight (8) FLEX Diesel driven portable light towers (1FLEXS014 through 1FLEXS021)					X	1000W metal halide lamps
Four (4) FLEX Portable MCR Fans (1FLEXC005 through 1FLEXC008)	X	X	X	X		3200 cfm, 240 VAC

2.18.6 Equipment Maintenance and Testing

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

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

The Entergy PM Basis Templates include activities such as:

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

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

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

The unavailability of equipment and applicable connections that directly perform a FLEX mitigation strategy for core, containment, and SFP are managed by Technical Requirements Manual (TRM) Section

6.10 such that risk to mitigating strategy capability is minimized (Reference 3.101). Maintenance / risk guidance conforms to the guidance of NEI 12-06 as follows:

- Portable FLEX equipment may be unavailable for 90 days provided that the site FLEX capability (N) is available.
- If portable equipment becomes unavailable such that the site FLEX capability (N) is not maintained, initiate actions within 24 hours to restore the site FLEX capability (N) and implement compensatory measures (e.g., repair equipment, use of alternate suitable equipment or supplemental personnel) within 72 hours.

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

3. References

3.1 SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," (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. ML12221A205)

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 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, March 12, 2012 (ML12056A046)

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

3.10 Task Interface Agreement (TIA) 2004-04, "Acceptability of Proceduralized Departures from Technical Specifications (TSs) Requirements at the Surry

Power Station," (TAC Nos. MC4331 and MC4332)," dated September 12, 2006 (ADAMS Accession No. ML060590273)

3.11 SDC-E51, Revision 003, Reactor Core Isolation Cooling

3.12 EC-Q1111-14001, Rev. 000, Station Division I Battery 1A3 and Division II Battery 1B3 Discharge Capacity during Extended Loss of AC Power

3.13 XC-Q1111-14005, Rev. 000, Grand Gulf Core and Containment Analysis of FLEX Strategies

3.14 GGNS-SA-14-00002, Rev. 000, Further Development of Grand Gulf FLEX Strategy Analytical Bases and Conceptual Design

3.15 BWROG-TP-018, Beyond Design Basis RCIC Elevated Temperature Functionality Assessment, December 2014

3.16 GGNS-SA-14-00003, Rev. 000, BWROG – RCIC Pump and Turbine Durability Evaluation – Pinch Point Study, Grand Gulf Nuclear Station Evaluation and Recommendations

3.17 XC-Q1111-14003, Rev. 000, Grand Gulf Nuclear Station RCIC Pump Room Heatup for Extended Loss of AC Power

3.18 MC-Q1111-14008, Rev. 000, Grand Gulf Nuclear Station FLEX Phase 2 Pump Sizing Calculation

3.19 05-1-02-I-4, Rev. 050, Loss of AC Power

3.20 MC-Q1111-14007, Rev. 000, Grand Gulf Nuclear Station FLEX Pump Net Positive Suction Head Available Calculation for a Beyond Design Basis External Event

3.21 EC 50275, Rev. 2, FLEX Basis Engineering Evaluation

3.22 GGNS-SA-15-00001, Rev. 000, Grand Gulf Nuclear Station SAFER Response Plan

3.23 MC-Q1111-14010, Rev. 000, Grand Gulf Nuclear Station FLEX Phase 3 Hydraulic Pump Sizing Calculation

3.24 Grand Gulf Nuclear Station Updated Final Safety Analysis Report (Updated 1/28/2015)

3.25 SDC-B21, Revision 003, Nuclear Boiler System

3.26 SDC-01, Revision 001, 125 Volt DC Class 1E Distribution System

3.27 SDC-Z77, Rev. 002, Safeguard Switchgear & Battery Room Ventilation

3.28 GGNS Technical Specifications and Bases, Amendment 202

3.29 04-1-01-E51-1, Rev. 132, System Operating Instruction Reactor Core Isolation Cooling System

3.30 EPRI Technical Report 3002001785, "Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications" June 2013

3.31 MAAP4 Application Guidance, Desktop Reference for Using MAAP4 Software, Revision 2" (Electric Power Research Institute Report 1020236), July 2010

3.32 NEDC-33771P Rev 2 GEH Evaluation of FLEX Implementation Guidelines

3.33 NRC Generic Letter 91-07: GI-23, "Reactor Coolant Pump Seal Failures" and its Possible Effect on Station Blackout

3.34 GNRI92-00024, Safety Evaluation of Response to Station Blackout Rule TAC-M68549

3.35 NEAD-92-SR-045, GGNS Station Blackout Analysis Using GOTHIC, Rev. 0

3.36 MC-Q1111-14003, Rev. 000, Grand Gulf Nuclear Station Water Requirements and Availability for a Beyond Design Basis External Event

3.37 05-1-02-III-1, Revision 039, Inadequate Decay Heat Removal

3.38 EC 50286, GGN Spent Fuel Pool Level Instrumentation Upgrade

3.39 BWROG Technical Report, Rev. 1, BWR Containment Venting, dated 10/29/2013 (NRC ADAMS Accession No. ML13352A057)

3.40 NRC Letter to NEI dated January 9, 2014, Endorsing BWROG Technical Report, Rev. 1, BWR Containment Venting, dated 10/29/2013 (NRC ADAMS Accession No. ML13358A206)

3.41 GGNS-NE-10-00034, Rev. 001, GGNS EPU Station Blackout

3.42 CC-Q1M10-14001, Rev. 000, Evaluation of Containment Wall for FLEX Strategy

3.43 05-S-01-STRATEGY, Alternate Strategy, Revision 012

3.44 PC-N1M41-14001, Rev. 000, Number of Nitrogen Bottles Required to Support FLEX Strategy for Operation of the Containment Cooling System (M41) Air-Operated Valves

3.45 EC 50282, Rev. 0, Flex Containment Cooling System (M41) Vent Path to Atmosphere

3.46 EC-Q1111-14002, Rev. 1, FLEX Strategy - Portable Diesel Generator System Sizing

3.47 CC-Q1M10-10001, Rev. 0, Evaluation of Containment Wall for Extended Power Uprate

3.48 MC-Q1111-14001, Rev. 000, Grand Gulf Nuclear Station Reactor Core Isolation Cooling Net Positive Suction Head Available Calculation for a Beyond Design Basis External Event

3.49 EC 50287, Rev. 0, GGNS FLEX Storage Building

3.50 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 (ML12053A340)

3.51 Entergy Letter to NRC, Entergy Seismic Hazard and Screening Report (CEUS Sites), Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, Grand Gulf Nuclear Station, Unit 1, dated March 31, 2014 (GGNS Letter GNRO-2014/00027) (ML14090A098)

3.52 EPRI Report 1025287, "Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic", dated February 2013

3.53 Grand Gulf Nuclear Station Letter to NRC, "Required Response 2 for Near-Term Task Force Recommendation 2.1: Flooding-Hazard Reevaluation Report", dated March 11, 2013 (GGNS Letter GNRO-2013/00020) (ADAMS Accession No. ML13071A457)

3.54 05-1-02-VI-2, Revision 127, Hurricanes, Tornados, and Severe Weather

3.55 CC-N1FLEX-14001, Rev. 000, Sliding and Rocking Evaluation of FLEX Storage Building Equipment

3.56 ASCE 43-05, "Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities"

3.57 ASCE 7-10, Minimum Design Loads on Buildings and Other Structures

3.58 N1FLEX-14002, Rev. 0, Drainage Analysis for FLEX Storage Buildings

3.59 Specification E100.0, Rev. 007, Environment Parameters for GGNS

3.60 XC-Q1111-14001, Rev. 1, Control Room Heatup for Extended Loss of AC Power

3.61 Drawing A-0012, Rev. 15, Units 1 & 2, Gen. Fl. Plan - Fl. Plan at El. 133'-0", 136'-0", 139'-0", 144'-3" & 148'-0"

3.62 Drawing A-0015, Rev 9, Units 1 & 2, General Floor Plan, Fl. Plan at El. 208'-10"

3.63 Engineering Report GGNS-ME-12-00009, Rev. 0, Station Blackout Evaluation for Grand Gulf Nuclear Station

3.64 MC-QSZ77-09004, Rev. 000, Alternate Ventilation for Safeguard Switchgear and Battery Rooms

3.65 GGNS92-0002, Rev. 002, Engineering Report for the Evaluation of Safety Related Electrical Equipment in Various Rooms with Elevated Post LOCA Temperatures

3.66 EN-IS-108 Rev 10, Working in Hot Environments

3.67 E0046, Revision 001, Hydrogen Gas Evolution from Class 1E + Non Class 1E Battery

3.68 E1267 SH021, Rev. 002, Schematic Diagram Z77 Safeguard Switchgear & Battery Room Exhaust Fan Q1Z77C001A-A

3.69 04-1-01-Z77-1, Rev. 024, Safeguard Switchgear and Battery Room Vent System

3.70 SDC-P41, Rev. 004, System Design Criteria for Standby Service Water System

3.71 IP-CALC-13-00058, Rev. 001, Freezing of Unit 3 Coolant Sources for FLEX Event (EC 45784)

3.72 EN-OP-115-01, Revision 000, Operator Rounds

3.73 02-S-01-32, Revision 030, Control Building Rounds

3.74 02-S-01-31, Revision 034, Control Room Rounds

3.75 GGNS Letter GNRO-2012/00131, dated October 31, 2012, Entergy's Response to the March 12, 2012 Information Request Pursuant to 10 CFR 50.54(f) Regarding Recommendation 9.3 for Completing Emergency Communication Assessments, Grand Gulf Nuclear Power Station, Unit 1

3.76 GGNS Letter GNRO-2013/00014, dated February 21, 2013, Entergy's Response to NRC Technical Issues for Resolution Regarding Licensee Communication Submittals Associated with Near-Term Task Force Recommendation 9.3, Grand Gulf Nuclear Power Station, Unit 1

3.77 NEI 12-01, Rev. 1, Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities

3.78 EC 50711, Rev. 0, GGNS FLEX Emergency Plan (EP) Communications System Enhancements

3.79 NRC letter to All Power Reactor Licensees and holders of Construction Permits in Active or Deferred Status, "Follow-up Letter on Technical Issues for Resolution Regarding Licensee Communication Submittals Associated with Near-Term Task Force Recommendation 9.3 (TAC No. ME7951)," dated January 23, 2013 (ADAMS Accession No. ML13010A162)

3.80 Nuclear Energy Institute position paper entitled "Position Paper: Shutdown/ Refueling Modes," dated September 18, 2013 (ADAMS Accession No. ML13273A514)

3.81 United States NRC Endorsement Letter of the Nuclear Energy Institute (NEI) Position Paper entitled "Position Paper: Shutdown/ Refueling Modes," dated September 30, 2013 (ADAMS Accession No. ML13267A382)

3.82 M1088E, Rev. 020, Piping & Instrumentation Diagram Fuel Pool Cooling & Cleanup System

3.83 Grand Gulf Nuclear Station Letter to NRC, "Response to March 12, 2012, Request for Information (RFI) Pursuant to Title 10 of the Code of Federal Regulation 50.54(f) Regarding Recommendations of the Near-Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident, Enclosure 5 Recommendation 9.3, Emergency Preparedness - Staffing, Requested Information Items 1, 2, and 6 - Phase 2 Staffing Assessment," dated 10/21/15 (GNRO2015-00054)

3.84 EC 50275 Attachment 10.030, Areva Engineering Information Record 51 - 9199717 – 013, National SAFER Response Center Equipment Technical Requirements

3.85 XC-Q1111-15002, Rev. 0, GGNS FLEX Auxiliary Building Heat-Up

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

3.87 Entergy Grand Gulf Nuclear Plant FLEX Validation dated February 5, 2016 (CIN2016-00023)

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3.89 05-1-02-I-7, Rev. 0, Extended Loss of AC Power (ELAP)

3.90 05-S-01-FSG-004, Rev. 0, ELAP DC Bus Load Shed and Management

3.91 05-S-01-FSG-002, Rev. 0, Alternate RCIC Suction Source

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3.93 05-S-01-FSG-011, Rev. 0, Alternate Spent Fuel Pool Makeup and Cooling

3.94 05-S-01-FSG-005, Rev. 0, Initial Assessment and Flex Equipment Staging

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3.97 E-1020, Rev. 11, One Line Meter & Relay Diagram 480V Buses 15BA6 and 16BB6

3.98 EN-OP-201-02, Rev. 0, GGNS FLEX Program Document

3.99 EN-DC-115, Rev. 18, Engineering Change Process

3.100 EN-LI-100, Rev. 18, Process Applicability Determination

3.101 05-S-01-STRATEGY, Rev. 13, Alternate Strategy

3.102 LBDCR 2016-0015 Technical Requirements Manual (TRM) Section 6.10 and TRM Bases Section 6.10 addition for Beyond Design Basis Components

3.103 EN-OU-108, Rev. 8, Shutdown Safety Management Program (SSMP)

3.104 05-S-01-FSG-013, Rev. 0, Transition from FLEX Equipment

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