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December 13, 2016

L-PI-16-096
10 CFR 2.202
10 CFR 50.4

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

Prairie Island Nuclear Generating Plant Units 1 and 2
Docket Numbers 50-282 and 05-306
Renewed Facility Operating License Nos. DPR-42 and DPR-60

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," Prairie Island Nuclear Generating Plant, Units 1 and 2 (TAC Nos. MF0834 and MF0835)

References:

1. NRC Order EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012 (ADAMS Accession No. ML12054A736)

2. NRC letter to NSPM, "Prairie Island Nuclear Generating Plant Units 1 and 2 - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC Nos. MF0834 AND MF0835)," dated February 27, 2014 (ADAMS Accession No. ML14030A540)

3. NSPM Letter (L-PI-16-001) to NRC, "Notification of Compliance with NRC Order EA-12-049, 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,' Prairie Island Nuclear Generating Plant Unit 2 (TAC No. MF0835)," dated January 14, 2016 (ADAMS Accession Nos. ML16014A754, ML16014A755, and ML16014A756)

4. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 2, dated December 2015 (ADAMS Accession No. ML16005A625)

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On March 12, 2012, the NRC staff issued Order EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," (Reference 1) to all NRC power reactor licensees and holders of construction permits in active or deferred status. The Reference 1 Order was immediately effective and directed Northern States Power Company, a Minnesota corporation (NSPM), doing business as Xcel Energy, to develop, implement and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities following a beyond-design-basis external event for the Prairie Island Nuclear Generating Plant (PINGP), Units 1 and 2. Section IV.C.3 of the Order directed licensees to report when full compliance with the requirements described in Attachment 2 of the Order had been achieved.

The purpose of this letter is to report that full compliance with the Order has been achieved for PINGP, Units 1 and 2. Enclosure 1 of this letter provides a summary description of the key elements associated with PINGP Unit 1 Order compliance. Enclosure 2 provides summary responses for the confirmatory items (CIs) from the Reference 2 NRC Interim Staff Evaluation (ISE) that were not docketed in the Reference 3 letter. Enclosure 2 also updates information for three responses previously docketed. Enclosure 3 contains the required Final Integrated Plan (FIP). The FIP provides the strategies to maintain or restore core cooling, containment, and spent fuel pool cooling in the event of a beyond-design-bases external event for the PINGP. NSPM notified NRC of compliance for PINGP Unit 2 in Reference 3.

The enclosed responses and FIP are based on information and analyses that have been completed as of the date of full compliance. This includes updating the FLEX strategies and the FIP to Revision 2 of NEI 12-06 (Reference 4). The Mitigating Strategies Assessments (MSAs) for reevaluated flood and seismic hazards, which are described in the Appendices of Reference 4, are submitted separately.

Please contact Lynne Gunderson, Licensing Engineer, at 651-267-7421, if additional information or clarification is required.

Summary of Commitments

This letter makes no new commitments and no revisions to existing commitments.

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

Executed on December 13, 2016.

Scott Northard
Site Vice President, Prairie Island Nuclear Generating Plant
Northern States Power Company – Minnesota

Enclosures (3)

cc: Administrator, Region III, USNRC
Project Manager, Prairie Island Nuclear Generating Plant, USNRC
Resident Inspector, Prairie Island Nuclear Generating Plant, USNRC

PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1

COMPLIANCE WITH NRC ORDER EA-12-049, "ORDER MODIFYING LICENSES WITH REGARD TO REQUIREMENTS FOR MITIGATION STRATEGIES FOR BEYOND-DESIGN-BASIS EXTERNAL EVENTS"

1.0 INTRODUCTION

On March 12, 2012, the NRC staff issued Order EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," (Reference 1) to all NRC power reactor licensees and holders of construction permits in active or deferred status. Reference 1 was immediately effective and directed Northern States Power Company, a Minnesota corporation (NSPM), doing business as Xcel Energy, to develop, implement and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities following a beyond-design-basis external event for the Prairie Island Nuclear Generating Plant (PINGP), Units 1 and 2. Specific requirements were outlined in Attachment 2 of Reference 1.

In response to NRC Order EA-12-049, NSPM developed and submitted an Overall Integrated Plan (OIP) (Reference 3) describing the diverse and flexible mitigation strategies (FLEX) for responding to beyond-design-basis external events at PINGP. As required by the NRC Order, NSPM has submitted seven OIP status updates at six-month intervals (References 4, 5, 7, 8, 10, 15 and 16). The second six-month status (Reference 5) was corrected by Reference 19.

In accordance with Reference 1, licensees are required to complete full implementation of the Order no later than two refueling cycles after submittal of the OIP, or December 31, 2016, whichever comes first. The second refueling outage after the Reference 3 submittal for PINGP Unit 1 occurred in the Fall of 2016. Additionally, the Order requires that licensees report when full compliance has been achieved. The information provided in this Enclosure documents Unit 1 compliance with NRC Order EA-12-049. NSPM notified NRC of compliance for Unit 2 in Reference 14. Therefore, full compliance with the referenced Orders has been achieved for PINGP, Units 1 and 2.

2.0 OPEN ITEM RESOLUTION

Open and pending items from the NRC Interim Staff Evaluation (ISE) (Reference 6) and NRC Audit Report (Reference 11) for both Units 1 and 2 are addressed by NSPM in Reference 14. The remaining ISE Confirmatory Items (CI) that were closed on the Safety Evaluation (SE) Tracker but require docketing are listed below. Note that two CI responses and one SE response that were previously docketed in Reference 14 are updated in Enclosure 2 to this letter. NSPM had no ISE Open Items and no Licensee Identified Open Items.

ISE Confirmatory Item responses:

- CI 3.1.1.4.A, SAFER Plan Routes, Closed
- CI 3.2.1.A, Applicability of WCAP-17601-P, Closed
- CI 3.2.1.1.A, NOTRUMP for ELAP Analysis, Closed
- CI 3.2.1.3.A, Decay Heat, Closed
- CI 3.2.1.6.A, Plant Parameter Comparison to WCAP-17601-P, Closed
- CI 3.2.1.8.A, Core Sub-criticality, Closed
- CI 3.2.1.9.A, Time Before Makeup Water Source is Required, Closed
- CI 3.2.2.A, Confirm licensees SFP Spray Capability, Closed (Updated in Enclosure 2 of this letter and replaces response in Reference 14)
- CI 3.2.4.4.A, Emergency Lighting, Closed
- CI 3.2.4.4.B, Site Communication System Upgrades, Closed
- CI 3.2.4.8.A, Confirm Appropriate Electrical Isolation/Connections, Closed
- CI 3.2.4.8.B, Sizing Calculation for FLEX Generators, Closed
- CI 3.2.4.9.A, Fuel Consumption, Open (Updated information is provided for this response in Enclosure 2 of this letter)
- CI 3.2.4.10.B, Station Batteries, Closed
- CI 3.3.2.A, Historical Record and Engineering Basis, Closed
- CI 3.4.A, Off-site Resources, Closed

Audit Report Safety Evaluation (SE) responses:

- SE.16, Spent Fuel Pool (SFP) Spray, Open (Updated in Enclosure 2 of this letter and replaces response in Reference 14)

The above items are summarized in Enclosure 2 to this letter. Note that the above CIs and SE and the respective responses in Enclosure 2 apply to both Units 1 and 2. These items are complete pending NRC closure.

3.0 Milestone Schedule - Items Complete

The table below lists the Unit 1 Milestones and completion dates. The Unit 2 Milestones with completion dates were submitted in the Unit 2 compliance letter (Reference 14) in January of 2016.

Unit 1 Milestone	Completion Date
Submit 60 Day Status Report (Reference 2)	October 2012
Submit Overall Integrated Plan (Reference 3)	February 2013
Submit First Six-Month Status Update (Reference 4)	August 2013
Commence Engineering Modification Design -- Phase 2 & 3 (Unit 1)	September 2013
Submit Second Six-Month Status Update (Reference 5)	February 2014
National SAFER Response Center Operational	August 2015
Procure Equipment (Unit 1)	September 2016
Submit Third Six-Month Status Update (Reference 7)	August 2014
Commence Installation for Online Modifications – Phase 2 and 3 (Unit 1)	January 2016
Implement Storage	November 2015
Issue Maintenance Procedures	November 2015
Implement Training	September 2016
Submit Fourth Six-Month Status Update (Reference 8)	February 2015
Submit Phase 2 Staffing Assessment (Reference 9)	May 2015
Implement Communication Recommendations	June 2015
Issue Procedures updated for FLEX strategies (Unit 1)	October 2016
Submit Fifth Six-Month Status Update (Reference 10)	August 2015
Submit Sixth Six-Month Status Update (Reference 15)	February 2016
Submit Seventh Six-Month Status Update (Reference 16)	August 2016
Unit 1 Implementation Outage	November 2016
Validation Walk-throughs	August 2016
Submit Completion Report – Unit 1	Complete with this submittal

4.0 Order EA-12-049 Compliance Elements Summary

Strategies - Complete

The PINGP strategies are in compliance with Order EA-12-049. Strategy related Open Items, Confirmatory Items, or Audit Questions/Audit Report Open Items have been addressed by NSPM as discussed in Section 2.0 above.

Modifications - Complete

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

Equipment - Procured and Maintenance & Testing - Complete

The equipment required to implement the FLEX strategies for PINGP has been procured in accordance with NEI 12-06 (Reference 17), Section 11.1 and 11.2, received at PINGP, initially tested/performance verified as identified in NEI 12-06, Section 11.5, and is available for use.

Maintenance and testing will be conducted through the use of the PINGP Preventative Maintenance Program such that equipment reliability is achieved and maintained.

Protected Storage - Complete

The storage facility required to implement the FLEX strategies for PINGP has been completed and provides protection from the applicable site hazards, with the exception of the design basis flood. The PINGP FLEX strategy during a design basis flood relies on the expected warning time, the pre-deployment of SAFER equipment (4 kV turbine generators) to the site prior to the site grade flooding, and pre-deployment of site FLEX equipment associated with operation of the SAFER turbine generators. The equipment required to implement the non-flood FLEX strategies for PINGP is stored in its protected configuration.

Procedures - Complete

FLEX Support Guidelines (FSGs) for PINGP have been developed and integrated with existing procedures. The FSGs and affected existing procedures have been validated and are available for use in accordance with the site procedure control program.

Training - Complete

Training for PINGP has been implemented in accordance with an accepted training process as recommended in NEI 12-06, Section 11.6.

Staffing - Complete

The staffing study for PINGP has been completed in accordance with 10 CFR 50.54(f), "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force review of Insights from the Fukushima Dai-ichi Accident," Recommendation 9.3, dated March 12, 2012 (Reference 18), as documented in the letter to the NRC dated May 28, 2015 (Reference 9). The staffing study concluded that no additional staff is required to mitigate the ELAP event.

National SAFER Response Center - Complete

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

Validation - Complete

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

FLEX Program Document - Established

The NSPM FLEX Program Document for PINGP has been developed in accordance with the requirements of NEI 12-06.

5.0 References:

1. NRC Order EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012 (ADAMS Accession No. ML12054A736)

2. NSPM Letter (L-PI-12-092) to NRC, "Initial Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated October 29, 2012 (ADAMS Accession No. ML12305A287)

3. NSPM Letter (L-PI-13-007) to NRC, "Prairie Island Nuclear Generating Plant's Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 26, 2013 (ADAMS Accession No. ML13060A379)

4. NSPM Letter (L-PI-13-080) to NRC, "Prairie Island's First Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated August 26, 2013 (ADAMS Accession No. ML13239A094)

5. NSPM Letter (L-PI-14-018) to NRC, "Prairie Island Nuclear Generating Plant's Second Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 26, 2014 (ADAMS Accession No. ML14057A771)

6. NRC Letter to NSPM, "Prairie Island Nuclear Generating Plant Units 1 and 2 - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC Nos. MF0834 and MF0835)," dated February 27, 2014 (ADAMS Accession No. ML14030A540)

7. NSPM Letter (L-PI-14-078) to NRC, "Prairie Island Nuclear Generating Plant's Third Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) (TAC Nos. MF0834 and MF0835)," dated August 25, 2014 (ADAMS Accession No. ML14237A512)

8. NSPM Letter (L-PI-15-021) to NRC, "Prairie Island Nuclear Generating Plant's Fourth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) (TAC Nos. MF0834 and MF0835)," dated February 26, 2015 (ADAMS Accession No. ML15057A323)

9. NSPM Letter (L-PI-15-044) to NRC, "Prairie Island Nuclear Generating Plant Phase 2 Staffing Assessment in Response to March 12, 2012, Request for Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Recommendations of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, Enclosure 5, Recommendation 9.3, Emergency Preparedness - Staffing, Requested Information Items 1, 2, and 6," dated May 28, 2015

10. NSPM Letter (L-PI-15-065) to NRC, "Prairie Island Nuclear Generating Plant's Fifth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) (TAC Nos. MF0834 and MF0835)," dated August 25, 2015 (ADAMS Accession No. ML15237A403)

11. NRC Letter to NSPM, "Prairie Island Nuclear Generating Plant, Units 1 and 2 - Report for the Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Pool Instrumentation Related to Orders EA-12-049 and EA-12-051 (TAC Nos. MF0834, MF0835, MF0832, and MF0833)," dated August 20, 2015 (ADAMS Accession No. ML15224B396)

12. Not used

13. Not used

14. NSPM Letter (L-PI-16-001) to NRC, "Notification of Compliance with NRC Order EA-12-049, 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,' Prairie Island Nuclear Generating Plant Unit 2 (TAC No. MF0835)," dated January 14, 2016 (ADAMS Accession Nos. ML16014A754, ML16014A755, and ML16014A756)

15. NSPM Letter (L-PI-16-007) to NRC, "Prairie Island Nuclear Generating Plant, Unit 1, Sixth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) (TAC No. MF0834))," dated February 24, 2016 ADAMS Accession No. ML16057A061)

16. NSPM Letter (L-PI-16-063) to NRC, "Prairie Island Nuclear Generating Plant, Unit 1, Seventh Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) (TAC No. MF0834)," dated August 17, 2016 (ADAMS Accession No. ML16230A521)

17. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 2, dated December 2015 (ADAMS Accession No. ML16005A625)

18. 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 (ADAMS Accession No. ML12056A046)

19. NSPM Letter (L-PI-14-104) to NRC, "Prairie Island Nuclear Generating Plant's Second Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) CORRECTED," dated October 20, 2014 (ADAMS Accession No. ML14295A761)

PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 and 2

RESPONSES TO CLOSED CONFIRMATORY ITEMS (CIs) AND SAFETY EVALUATION (SE) ITEMS

1.0 Background

On March 12, 2012, the NRC staff issued Order EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," (Reference 1) to all NRC power reactor licensees and holders of construction permits in active or deferred status. In response to the Reference 1 NRC Order, Northern States Power Minnesota, a Minnesota corporation (NSPM), doing business as Xcel Energy, developed and submitted an Overall Integrated Plan (OIP) (Reference 2) describing the diverse and flexible mitigation strategies (FLEX) for responding to beyond-design-basis external events at the Prairie Island Nuclear Generating Plant (PINGP). In the Interim Staff Evaluation (ISE) (Reference 3), the NRC documented their review of the PINGP OIP and provided Confirmatory Items (CIs) for NSPM to address. The NRC performed an onsite audit in May 2015. The results of that audit, including open or pending CIs and Safety Evaluation Items (SEs), were documented in the NRC's Audit Report (Reference 4).

Responses to the open and pending CIs and SEs from Reference 4 were provided to the NRC in the Unit 2 compliance letter (Reference 5) submitted in January 2016. Additional information regarding the compliance change that supports the response to SE.20 was submitted in the fifth six-month status report (Reference 6).

In Section 2.0 below, NSPM provides responses to the CIs listed in the ISE (Reference 3) that were subsequently closed in the on-site audit. Additionally, NSPM has evaluated (Reference 14) and incorporated NEI 12-06, Revision 2 (Reference 7), into the PINGP Final Integrated Plan and the PINGP FLEX Program Document. Based on Reference 7, and the NRC's associated endorsement of it (Reference 8), NSPM eliminated Spent Fuel Pool (SFP) spray from the FLEX strategies as described in the seventh six-month status letter (Reference 9). Responses to CI 3.2.2.A and SE.16, which were both docketed in the Unit 2 compliance letter (Reference 5), were affected by the elimination of SFP spray. The responses for CI 3.2.2.A and SE.16 are revised and included in Section 4.0 below. The response to CI 3.2.4.9.A regarding fuel consumption was also docketed in Reference 5. The response is affected by a change in access to the fuel tanks. The revised response for CI 3.2.4.9.A is provided in Section 3.0 below.

2.0 Responses to Remaining Closed Confirmatory Items

NRC Confirmatory Item CI 3.1.1.4.A (Closed):

Confirm the SAFER group plan routes for deployment of off-site resources are acceptable.

NSPM Response:

The deployment routes of the Strategic Alliance for FLEX Emergency Response Program (SAFER) off-site resources are described in the "SAFER Response Plan for Prairie Island Nuclear Generating Plant" (Reference 17). A copy of this plan was provided for audit in the NSPM Fukushima Response online reference portal.

The SAFER plan designates the site ball field directly across from the PINGP gate house as Staging Area B. Staging Area B is adjacent to a Helipad. The SAFER plan also designates the Newport Service Center at 3000 Maxwell Avenue in Newport, Minnesota as Staging Area C. The Newport Service Center is an Xcel facility primarily used for emergency distribution and restoration of transmission lines. The Fleming Field Airport, located in South Saint Paul, Minnesota, can support helicopter operations and is relatively close to the Newport Service Center. The primary route from Staging Area C to Staging Area B is approximately 30 driving miles. The alternate route is approximately 44 driving miles. The primary and alternate access routes cross several bridges. However, air-lift capability is available to circumvent damage to these bridges and routes.

NRC Confirmatory Item CI 3.2.1.A (Closed):

Confirm applicability of the WCAP-17601-P analysis to PINGP to include differences between the reference case and plant specific parameter values.

NSPM Response:

NSPM is not relying on any of the WCAP-17601-P analyses as the basis for the design of the FLEX equipment or for the determination of any PINGP specific time constraints. PINGP specific analyses were used as the FLEX equipment and time constraint bases. NSPM provided a discussion of the applicability of each analysis in WCAP-17601-P to PINGP for audit in the NSPM Fukushima Response online reference portal. A table comparing the PINGP specific parameter values and those used in the WCAP-17601-P was also provided for audit in the NSPM Fukushima Response online reference portal in response to CI 3.2.1.6.A.

NRC Confirmatory Item CI 3.2.1.1.A (Closed):

Confirm that use of the NOTRUMP code for the ELAP analysis is limited to the flow conditions before reflux condensation initiates. This includes specifying an acceptable definition for the onset of reflux condensation cooling.

NSPM Response:

Reflux cooling occurs when the Reactor Coolant System (RCS) inventory decreases beyond the point where the Steam Generator (SG) hot legs become uncovered and the two-phase natural circulation flow breaks down.

PWROG-14027-P, "No. 1 Seal Flow Rate for Westinghouse Reactor Coolant Pumps Following Loss of All AC Power, Task 3: Evaluation of Revised Seal Flow Rate on Time to Enter Reflux Cooling and Time at Which the Core Uncovers," Revision 3 (Reference 27), contains a summary of analyses performed to determine the onset of reflux cooling using the NOTRUMP code. However, the analyses were based on seal leakage rates corresponding to the Westinghouse style reactor coolant pump (RCP) seals and not on the Flowserve RCP seals installed at PINGP. NSPM performed a site-specific calculation (Reference 18) to determine the time to the onset of reflux cooling with the Flowserve RCP seal packages. NSPM's calculation relied upon the NOTRUMP two-loop analysis contained in Westinghouse Pressurized Water Reactors Owners Group (PWROG) document PWROG-14027-P for the determination of the net RCS mass loss prior to the onset of reflux cooling.

The analysis in PWROG-14027-P for two-loop designs showed that the onset of reflux cooling (i.e., when the one hour centered moving average (CMA) of SG U-bend flow quality has increased to 0.1 in any loop) occurred 28 hours into the event. However, to be consistent with the recommendations in PWROG-14064-P, "Application of NOTRUMP Code Results for Westinghouse Designed PWRs in Extended Loss of AC Power Circumstances," Revision 0, dated September 2014 (Reference 28), NSPM's calculation used the net mass loss at 17 hours into the event as the basis for determining when reflux cooling would occur.

NSPM's calculation performed a mass balance to determine when this net RCS mass loss would occur. The mass balance included the minimum water volume injected from the accumulators, a mass loss rate from the Flowserve seal package corresponding to 2.625 gpm/pump, and a mass loss rate corresponding to 1 gpm of unidentified RCS leakage. The calculation determined that reflux cooling would not occur until after 32 hours from initiation of the event. This NSPM calculation is the basis for the 32 hour time constraint for repowering a charging pump (i.e., establishing RCS makeup capability) during an ELAP event, which is discussed in the response to CI 3.2.1.9.A . A copy of NSPM's calculation (Reference 18) was provided for audit in the NSPM Fukushima Response online reference portal.

The approach described above ensures that NSPM's reliance on the NOTRUMP code is limited to the flow conditions prior to reflux condensation initiation.

NRC Confirmatory Item CI 3.2.1.3.A (Closed):

Decay Heat - Confirm the applicability and adequacy of the ANS 5.1-1979 + 2 sigma model analysis relative to Prairie Island, and if a different decay heat model is used, address the acceptability of the model.

NSPM Response:

This Confirmatory Item is addressing the applicability of input assumption 4 from Section 4.2.1, "Input Assumptions – Common to all Plant Types," of WCAP-17601-P. As discussed in the response to CI 3.2.1.A, NSPM is not relying upon any analyses in WCAP-17601-P as a basis for the design of the FLEX equipment or the determination of any time constraints for PINGP. Therefore, the acceptability of the decay heat models used in determining the PINGP mitigating strategies for decay heat removal is discussed below.

Decay heat modeling has two impacts on NSPM's mitigating strategies. The first impact is the time available for transferring the suction supply of the Turbine Driven Auxiliary Feedwater Pumps (TDAFWP) from the Condensate Storage Tanks (CSTs) (if they are not available) to the Cooling Water (CL) supply. The second impact is the sizing of the portable SG makeup pump.

PINGP's current design basis analysis (Reference 19) shows that the operators have 74 minutes to transfer the Auxiliary Feedwater Pump (AFWP) suction supply to the CL system if the CSTs are not available following a reactor trip. This site-specific analysis was created by changing some inputs (e.g., decay heat was based on the ANS 5.1-1979 decay heat model with no uncertainty included) to the PINGP Loss of All Alternating Current (AC) Power to the Station Auxiliaries (LOOP) safety analysis. Since the site-specific analysis is part of PINGP's current design basis, it is acceptable for determining the time available for transferring TDAFWP suction to the CL system during an extended loss of AC power (ELAP) event. The site-specific analysis (Reference 19) has been provided for audit in the NSPM Fukushima Response online reference portal.

As discussed in Attachment 1A of the OIP, there is no time constraint associated with connecting the SG makeup pump. However, NSPM expects to be able to connect the portable SG makeup pump within 24 hours of the event. The AFW demand at 24 hours is less than 60 gpm. This flow is based on a curve in an existing PINGP procedure for long-term decay heat removal. The curve is based on an equation from the Background Information for Westinghouse Owner's Group (WOG) Severe Accident Management Guidance CA-2, "Injection Rate for Long Term Decay Heat Removal," Revision 1, October 2001. The equation has been provided for audit in the NSPM Fukushima Response online reference portal.

While the required flow at 24 hours is less than 60 gpm, the sizing calculation for the SG Makeup pumps ensures the pumps are capable of providing 100 gpm to each unit, (i.e., 50 gpm to each steam generator) (Reference 20). The curve used to determine the required AFW flow rate at 24 hours is part of NSPM's current procedures. The actual sizing of the pumps is much greater than the curve would require.

Therefore, the above method for determining the required flowrate to remove decay heat is acceptable for use during an ELAP event.

NRC Confirmatory Item CI 3.2.1.6.A (Closed):

Verify differences between the plant parameter values used in this reference case contained in Table 5.2.2-1 of WCAP-17601-P and the PINGP plant specific parameters.

NSPM Response:

As discussed in the response to CI 3.2.1.A, NSPM is not relying on any analyses in WCAP-17601-P as the basis for the design of the PINGP FLEX equipment or the determination of any PINGP specific time constraints. However, NSPM provided a table for audit that compared the specific parameters used in the WCAP-17601-P and the corresponding PINGP value. The comparison is in the NSPM Fukushima Response online reference portal.

NRC Confirmatory Item CI 3.2.1.8.A (Closed):

Core Sub-Criticality - Confirm the licensee adopts the generic resolution for boron mixing under natural circulation conditions potentially involving two-phase flow, in accordance with the Pressurized-Water Reactor Owners Group position paper, dated August 15, 2013 (ADAMS Accession No. ML 13235A135 (nonpublic for proprietary reasons)), and subject to the conditions provided in the NRC endorsement letter dated January 8, 2014 (ADAMS Accession No. ML13276A183), or the approach as detailed in Xcel Energy correspondence IC OC-PX-2012-021 is acceptable.

NSPM Response:

PINGP FLEX strategies ensure the reactor remains subcritical during an ELAP by crediting control rod insertion, xenon transient, and boron injection from the Safety Injection (SI) Accumulators or boron injection from a charging pump. As illustrated in the paragraphs below, the strategies are within the limitations identified in the Westinghouse August 15, 2013, position paper entitled, "Westinghouse Response to NRC Generic Request for Additional Information (RAI) on Boron Mixing in Support of the Pressurized Water Reactor Owners Group (PWROG)." The strategies also abide by the clarifications in the January 8, 2014, NRC letter that endorsed the Westinghouse position paper.

The NSPM evaluation (Reference 21) shows that k_{eff} for PINGP's reactors will remain less than 0.99 (i.e., the required shutdown margin) for at least 36 hours with all control rods fully inserted and the RCS at 420°F. Additionally, cycle specific calculations are performed to determine the required RCS boron concentration (as a function of temperature and cycle burnup) needed to maintain shutdown margin. The cycle specific calculations also determine the minimum amount of borated water needed to achieve these concentrations based on the normal full power RCS inventory, i.e., no assumed RCS leakage. While the ELAP response procedure and guidelines allow the cycle specific volumes to be used, the instructions also provide a conservative bounding volume of 1190 ft^3 (8900 gallons). This ensures that the required shutdown margin is maintained with a xenon-free reactor and an RCS temperature of 350°F.

PINGP's FLEX strategies ensure that shutdown margin is maintained under both a RCS leakage scenario and a no RCS leakage scenario. In a RCS leakage scenario, it is postulated that the inventory in the RCS decreases to the point where the RCS pressure will be controlled by the SG temperature/pressure. Calculations show that under this condition, a minimum of 1190 ft^3 of borated water will be injected into the RCS cold legs from the SI Accumulators (Reference 22). In a no RCS leakage scenario, it is postulated that the temperature of the upper head region will control RCS pressure such that injection from the SI accumulators will be delayed. Under these conditions, the ELAP response procedure and guidelines would call for the re-energized charging pump to be used to inject the required amount of borated water into the RCS cold leg. NSPM's response to CI 3.2.1.9.A, points out that the charging pump will be repowered within 32 hours of the event to provide RCS makeup prior to the onset of reflux cooling. Therefore, the ability to provide RCS makeup with the repowered charging pump will ensure boration is accomplished within the 36 hour time frame.

The ELAP response procedure and guidelines provide instructions to complete boration (i.e., inject enough borated water via the SI Accumulators or the charging pump to maintain shutdown margin with the RCS at 350°F and xenon-free) of the RCS within 36 hours of the event. The instructions also call for the operators to wait at least one hour after the boration has been completed prior to depressurizing the SGs from 350 psig to 160 psig (i.e., from an RCS temperature of approximately 436°F to 370°F).

NRC Confirmatory Item CI 3.2.1.9.A (Closed):

Confirm that the time required before a makeup water source is required for RCS inventory control can be extended following installation FlowServe N-9000 RCP seals with the Abeyance seal option such that the portable pump would not be necessary until Phase 3. In addition, determination of method or connection point for the RCS portable pump is needed.

NSPM Response:

NSPM's second six-month status report, dated February 26, 2014 (Reference 10), indicated the decision to install low leakage seals at PINGP. It was noted in the status report that this proposed change could increase the RCS inventory coping time for Phase 1 to several days. Therefore, NSPM anticipated that the time required for providing RCS makeup water would be extended such that a portable pump for supplying RCS makeup water would not be necessary until Phase 3. At the time of the Reference 10 submittal, the specific impact of the Flowserve seals on the RCS inventory control Phase 2 strategy was still under evaluation by the vendor and the industry. As a backup strategy to the low leakage RCP seals, NSPM stated portable generators would be provided, if needed, to repower the charging pumps during Phase 2. The second six-month status report was corrected by letter dated October 20, 2014 (Reference 11). Reference 11 included the originally transmitted letter and an Attachment to the Enclosure, which had been referenced but not included in the original Enclosure. The attachment contained the revised FLEX OIP for maintaining RCS inventory control strategies.

Subsequent to the second six-month status report and the corrected letter, the seal vendor and industry completed the evaluation of the Flowserve seals during an ELAP. NSPM evaluated information from Flowserve for the RCP seals along with new criteria for when RCS makeup must be reestablished. The new criteria for when RCS makeup must be reestablished is "prior to onset of reflux cooling" and is established to address NRC concerns with modeling the thermal hydraulics of the RCS during reflux cooling and with potential diluting of the cold legs during reflux cooling. NSPM concluded that the repowering of the charging pumps is a required action to be taken during Phase 2 and is no longer considered a backup strategy to the low leakage seals. Additionally, NSPM determined there is a 32 hour time constraint (Reference 18) associated with repowering the charging pumps. NSPM notified the NRC of the strategy change and the determination of the time constraint in the fifth six-month status report dated August 25, 2015 (Reference 6). Refer to NSPM response to CI 3.2.1.1.A for more discussion of NSPM's calculation that determined the 32 hour time constraint for repowering the charging pumps.

As part of NSPM's Phase 3 strategy, equipment is available to re-configure the discharge check valve on a SI pump to enable the SAFER portable RCS makeup pump to be connected.

NRC Confirmatory Item CI 3.2.4.4.A (Closed):

Confirm emergency lighting will be available during DC load shedding or that the licensee provides adequate lighting for the mitigating strategies.

NSPM Response:

The PINGP OIP identified the ability to restore the Emergency Lighting System once the portable generators have repowered the battery chargers. However, based on other planned plant configuration changes, NSPM intends to permanently remove the Emergency Lighting from the DC (direct current) Power System. Therefore, NSPM will not restore the Emergency Lighting System once the portable generators have repowered the Battery Chargers. The strategy for lighting will be through the battery backed Appendix R light units (as long as the batteries last) and through portable lighting such as head lamps and flashlights. NSPM notified the NRC of this change to the method of compliance in the fifth six-month status report dated August 25, 2015 (Reference 6).

NRC Confirmatory Item CI 3.2.4.4.B (Closed):

Confirm upgrades to the site's communications systems have been completed.

NSPM Response:

The following seven (7) communications enhancements were detailed in NSPM's 10 CFR 50.54(f) response letter to the NRC dated October 31, 2012 (Reference 12).

1. Communications will be maintained post event through the use of satellite phone technologies until normal systems are restored.

   NSPM has permanently installed twenty-three (23) new satellite phone fixed base units and docking stations in the Technical Support Center (TSC), Training Building Emergency Operations Facility (EOF), and the Service Building.

2. Communications with the NRC via the Emergency Notification System (ENS) line will be supported by satellite communications phone (in addition to the phone used for Emergency Planning Zone (EPZ) Offsite Response Organizations (OROs)) within the Control Room (CR).

   Four (4) of the new satellite communication links were installed in the CR for the Emergency Response Organization (ERO) function. One of these four is designated for the Emergency Notification System (ENS) function.

3. Communications with the NRC via the ENS line will be supported by satellite communications phone (in addition to the phone used for EPZ OROs) within the Technical Support Center (TSC).

   Nine (9) of the new satellite communication links were installed in the TSC for the ERO function. One of these nine is designated for the ENS function.

4. Communications between the site and the NRC will be supported by satellite communications capabilities in both the TSC and near site EOF.

   Nine (9) of the new satellite communication links were installed in the TSC and seven (7) were installed in the EOF for the ERO functions. Two (2) of these links (one (1) in the TSC and one (1) in the EOF) are designated for the ENS. Satellite communication links are also designated for other offsite communication functions including the Health Physics Network.

5. Communications between the site Emergency Response Facilities (ERFs) will be maintained post event through the use of the Sound Powered Phone System and enhanced reliability of the site Private Branch Exchange (PBX) system. Satellite phones may also be used.

   The PINGP USAR Section 10.3.8, "Emergency Communication System," states that:

   > "*... a sound powered communications system is installed with communications jacks located throughout the plant. The sound powered system requires no external power, and headsets for use with the system are readily available.*"

   The reliability of the PBX system was enhanced by installing a new PBX system and integrating the new satellite communication system. The integrated satellite communications equipment included the satellite phones and docking stations, external antennae and a new Uninterruptible Power System (UPS) to allow the satellite communications to remain available upon loss of normal system AC electrical power. The satellite communications are designed to have power for a minimum of 24 hours with an UPS power supply or telephone batteries with provisions for a generator to charge the satellite phone batteries.

6. The Key Site functions with offsite officials (Management links, Radiological support, etc.) will be maintained through the use of satellite phone capabilities in the site ERFs.

   Nine (9) of the new satellite communication links were installed in the TSC and seven (7) were installed in the EOF for the ERO functions. Two (2) of these links (one (1) in the TSC and one (1) in the EOF) are designated for the ENS. New satellite communication links are also designated for the Health Physics Network, Emergency Manager, Radiation Protection Support Supervisor, and the Field Team Communicator.

7. Environmental Field Monitoring Teams will be provided with satellite phone capabilities to backup normal radio links. Team direction from the EOF will similarly be supported by satellite capabilities.

   Each field team vehicle was issued a satellite communication system including a car charger. One (1) of the nine (9) satellite communication links installed in the TSC is designated for the Field Team Communicator. One (1) of the seven (7) satellite communication links installed in the EOF is designated for the Field Team Communicator.

NRC Confirmatory Item CI 3.2.4.8.A (Closed):

Confirm the licensee provides appropriate electric isolation and connections.

NSPM Response:

NSPM's mitigating strategies involve connecting two portable 480VAC diesel generators. One portable 480VAC portable diesel generator is to be connected to one Motor Control Center (MCC) in the Screenhouse (to repower a fuel oil transfer pump) and to one MCC per unit in the battery rooms (to repower a battery charger for each unit). The second portable 480VAC diesel generator is to be connected to one MCC per unit in the Auxiliary Building to repower charging pumps.

The electric isolation and connections of the portable 480VAC diesel generators repowering the MCCs are controlled in FLEX Support Guideline (FSG) procedures. The FSGs direct electrically isolating the MCCs by opening the normal power supply breaker and all the load breakers on the MCC. The portable generator output supply breaker is then closed followed by closing the breaker on the MCC. The desired individual load breakers are then closed.

NSPM performed an evaluation (Reference 23) of the adequacy of the FLEX 480VAC design to reliably withstand faults. This evaluation included a review of the FLEX 480VAC protective device coordination, cable protection, and portable diesel generator protection. The evaluation concluded that the as-built configuration is adequate to reliably withstand faults. A copy of the evaluation was provided for audit in the NSPM Fukushima Response online reference portal.

NRC Confirmatory Item CI 3.2.4.8.B (Closed):

Confirm the licensee's sizing calculations for 480VAC and the 4KV DGs are acceptable.

NSPM Response:

NSPM performed a calculation (Reference 24) confirming the steady state loading of the Safeguard buses during Phase 3 is within the capability of the SAFER 4kV Turbine Generators. A copy of the calculation was provided for audit in the NSPM Fukushima Response online reference portal.

The sizing calculations for the portable 480VAC diesel generators were performed by the generator vendor and provided to NSPM in Project Sizing Reports. NSPM incorporated the Project Sizing Reports into a NSPM FLEX portable 480VAC diesel generator sizing calculation (Reference 25). The calculation concluded that the portable diesel generator for the Battery/Screenhouse requires a minimum size of 250kW/312.5kVA and the portable diesel generator for the charging pumps requires a minimum size of 300kW/375kVA. Therefore, NSPM purchased 480VAC 300kW portable diesel generators. A copy of the calculation was provided for audit in the NSPM Fukushima Response online reference portal.

NRC Confirmatory Item CI 3.2.4.10.B (Closed):

Confirm the adequacy of the licensee's FLEX strategy station battery run-time calculation, battery depletion calculation, the supporting vendor discharge test data, FLEX strategy battery load profile, and other inputs/initial conditions.

NSPM Response:

NSPM performed a detailed station battery depletion calculation (Reference 26) for an ELAP condition. Excerpts from that calculation were provided for audit in the NSPM Fukushima Response online reference portal. The calculation excerpts included the body of the calculation, attachments showing the voltage profiles for each battery, attachments showing detailed load sheds and timing of the load sheds, and an attachment showing the manufacturer's discharge data for the batteries.

The calculation determined that the depletion time and minimum voltage was based on the instrument inverters. This minimum voltage was then used to perform a battery sizing calculation in accordance with IEEE 485-1997 to verify that the battery is adequate for the loading and duration modeled. Following the guidance in IEEE 485-1997, the calculation used a battery discharge rating for extended durations (8 to 72 hours) obtained from the battery manufacturer.

The calculation concluded that the limiting battery would provide the minimum voltage for at least 11.5 hours. This calculation is the basis for the time constraint for restarting the battery chargers and inverters. The Staffing Study tabletop, submitted in Reference 13, estimated the timeframe for restarting the battery chargers and inverters to be completed by nine hours into the event.

NRC Confirmatory Item CI 3.3.2.A (Closed):

Confirm the licensee addresses considerations 1 and 2 of NEI 12-06, Section 11.8 regarding maintaining a historical record and documented engineering basis.

NSPM Response:

The FLEX strategies and basis are maintained in a controlled program document. This program document includes a historical record of FLEX strategy changes and the basis for the changes. The program document also documents the preventative maintenance (PM) basis and testing program of FLEX credited equipment. Therefore, the program document fulfills the requirements of NEI 12-06, Section 11.8, consideration 1. The program document was provided for audit in the NSPM Fukushima Response online reference portal.

NSPM revised the design modification process to ensure that plant design changes will not negatively impact the approved FLEX strategies. The modification process's Design Input Checklist has been revised to identify if the modification affects FLEX equipment, FLEX equipment storage locations, and FLEX strategies. Additionally, proposed changes to mitigating strategies are controlled by NSPM procedure. The procedure includes the criteria that must be met in order for the change to be made without prior NRC approval. A copy of this procedure was provided for audit in the NSPM Fukushima Response online reference portal.

The revisions to the NSPM modification process and the addition of a change process for mitigating strategies fulfills the requirements of NEI 12-06, Section 11.8, considerations 2 and 3.

NRC Confirmatory Item CI 3.4.A (Closed):

Off-Site Resources - Confirm the licensee's arrangement for off-site resources addresses the guidance of Guidelines 2 through 10 in NEI 12-06, Section 12.2..

NSPM Response:

NSPM is participating in SAFER through a contractual agreement with the Pooled Equipment Inventory Company (PEICo). PEICo and its subcontractor AREVA, together called the SAFER Team, will provide engineering and management services for selecting and procuring emergency response equipment. The SAFER Team will also provide ongoing management, maintenance, and testing of the National SAFER Response Center (NSRC) equipment.

There are two, redundant NSRCs established with five sets of generic active equipment (e.g., pumps and generators). These NSCRs are located in Memphis, Tennessee, and

Phoenix, Arizona. There are also diverse delivery methods for transporting this equipment to the site.

The SAFER capabilities are described in the document, "White Paper - National SAFER Response Centers," dated September 11, 2014. The white paper includes a table that addresses the capabilities of the SAFER Team to meet the minimum offsite capability guidance in NEI 12-06, Section 12.2. The White Paper was formally transmitted to the NRC for endorsement on September 11, 2014 (ADAMS Accession No. ML14259A222). By letter dated September 26, 2014 (ADAMS Accession No. ML14265A107), the US NRC staff endorsed the white paper concluding that SAFER has procured equipment, implemented appropriate processes to maintain the equipment, and developed plans to deliver the equipment needed to support site responses to BDBEEs, consistent with NEI 12-06 guidance. Therefore, the NRC staff concludes that licensees can reference the SAFER program and implement their SAFER Response Plans to meet the Phase 3 requirements of Order EA-12-049. The White Paper was added to the supplemental guidance found in Section 3.2.1.13 of Reference 7.

Based on the above, NSPM has determined that NEI 12.06, Revision 2, Section 12.2, considerations 2 through 10, have been adequately addressed.

3.0 Revised Response to CI 3.2.4.9.A

The response to Item CI 3.2.4.9.A was provided in the Unit 2 compliance letter (Reference 5). CI 3.2.4.9.A is related to the fuel consumption and refueling of the portable FLEX equipment. The response to CI 3.2.4.9.A discussed the primary and a secondary source of fuel for refueling the FLEX equipment during non-flood conditions. If the primary source was not available, fuel would be extracted from the safety-related fuel oil storage tanks (FOSTs) for the Emergency Diesel Generators (EDGs) D1 and D2. The response notes that access to the tanks requires removing large steel plates that cover the manway into the pit. Subsequent to the Reference 5 submittal, NSPM permanently removed the steel plates covering the FOST pit manways. Based on the removal of the steel plate, the discussion regarding these steel plates is removed from the response.

Revised NRC Confirmatory Item CI 3.2.4.9.A (Open)

NRC Audit Item in Reference 8: *Portable Equipment Fuel - Confirm the total fuel consumption need calculations when FLEX equipment designs are finalized and the methods for onsite fuel transport are acceptable.*

Only the fourth paragraph of the Reference 5 CI 3.2.4.9.A response is revised to update the means of gaining access to the tank. The new text is in italics:

> The primary source for refueling the FLEX equipment during non-flood conditions is the 121 or 122 Heating Boiler Fuel Oil Storage Tanks, if available. These tanks

are below grade and have a nominal capacity of 35,000 gallons each. Access to the tanks is through the manhole covers to the pits and then through the manhole covers on the tanks. These tanks are non-safety related and thus are not documented as seismically robust. In the event that these tanks are not available, fuel will be extracted from the safety-related (i.e., seismically robust, protected from high winds and associated missiles) 121, 122, 123, or 124 Diesel Generator Oil Storage Tanks, for Emergency Diesel Generators D1 and D2. These fuel oil storage tanks (FOSTs) are below grade and have a nominal capacity of 19,000 gallons each. *The access to these tanks is through manhole covers in the tank pits and then through the manhole covers on the tanks. Equipment is available to remove both sets of manhole covers.* The fuel in these tanks is #2 diesel and provisions exist to add cold weather additives to the fuel that is extracted for refueling of FLEX equipment during cold weather.

4.0 Revised Responses to CI 3.2.2.A and SE.16

As stated above, CI 3.2.2.A and SE.16 were previously docketed in the Unit 2 compliance letter (Reference 5). Both are related to PINGP's SFP spray capability and the use of the station's B.5.b pumps. Subsequent to the Reference 5 letter, NSPM processed a compliance change that removed the requirement for SFP spray.

Background – SFP Spray Compliance Change:

NEI 12-06, Revision 2 (Reference 7), was issued in December 2015 and removed the requirement for SFP spray. However, the NRC's endorsement of Revision 2 (Reference 8) retained the requirement for SFP spray unless SFP integrity was demonstrated by performing a seismic SFP integrity evaluation. The SFP integrity evaluation was to be in accordance with the criteria specified in EPRI 3002007148, Section 3.3, "Site-Specific Spent Fuel Pool Criteria for Low Ground Motion Response Sites (GMRS)," of which was also endorsed by the NRC.

NSPM performed the SFP integrity evaluation (Reference 14) and demonstrated the SFP spray could be removed from the SFP cooling strategy. The evaluation has been provided for audit in the NSPM Fukushima Response online reference portal. In addition, the NRC concluded in their Staff Assessment (Reference 15) that PINGP provided an acceptable response to the Requested Information Items 1 through 7 from the 10 CFR 50.54(f) letter (Reference 16). The NRC Staff confirmed that the reevaluated hazard was bounded by the PINGP design-basis safe shutdown earthquake (SSE) and that the seismic risk evaluation, the high frequency confirmation and the seismic SFP evaluation were not merited.

Based on the above, NSPM discussed a compliance change in Reference 9 to remove SFP spray from the PINGP FLEX strategies. The compliance change is based on:

1. the removal of SFP spray requirements in NEI 12-06, Revision 2,

2. the NRC endorsement of NEI-12-06, Revision 2, with the condition of the SFP integrity demonstration for elimination of SFP spray, and
3. the PINGP SFP integrity demonstration (Reference 14).

Based on this compliance change, NSPM removes all discussion and FSG actions associated with SFP spray from the PINGP FLEX strategies. NSPM remains in compliance with the Order requirements through application of the NEI endorsed guidance.

Revised NRC Confirmatory Item CI 3.2.2.A (Closed):

NRC Confirmatory Item in Reference 3: *Confirm the licensee's SFP spray capability from its existing B.5.b strategy is reasonably protected.*

NSPM Response:

This response supersedes the previous response to CI 3.2.2.A in Reference 5 in its entirety.

NSPM has removed SFP spray from the PINGP SFP cooling strategies. As allowed by the NRC endorsed NEI 12-06, Revision 2 (Reference 7), NSPM demonstrated SFP integrity by evaluation (Reference 14) in accordance with EPRI 3002007148. The evaluation has been provided for audit in the NSPM Fukushima Response online reference portal. Based on elimination of the SFP spray strategy, the FLEX SFP spray capability that relied on the B.5.b equipment is no longer a credited FLEX strategy. Reasonable protection per NEI 12-06 is no longer required for the B.5.b equipment for FLEX Order compliance.

Revised NRC Audit Item (Reference 4) SE.16 (Open):

Item Description as stated in Reference 4: *SFP Spray Flow – the number of protected B.5.b pumps and inability to deliver 500 gallons per minute under low river level conditions (downstream seismic dam failure) appears to be an alternative to NEI 12-06.*

Licensee Input Needed as stated in Reference 4: *Provide an updated strategy or basis for an alternative to the SFP spray provisions of NEI 12-06.*

NSPM Response to NRC Audit Item:

This response supersedes the previous response to SE.16 in Reference 5 in its entirety.

NSPM has removed SFP spray from the PINGP SFP cooling strategies. As allowed by the NRC endorsed NEI 12-06, Revision 2 (Reference 7), NSPM demonstrated the SFP integrity by evaluation (Reference 14) in accordance with EPRI 3002007148. The potential alternative to NEI 12-06 no longer exists based on this change in strategy. The SFP integrity evaluation has been provided for audit in the NSPM Fukushima Response online reference portal.

5.0 References:

1. NRC Order EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012 (ADAMS Accession No. ML12054A736)

2. NSPM Letter (L-PI-13-007) to NRC, "Prairie Island Nuclear Generating Plant's Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 26, 2013 (ADAMS Accession No. ML13060A379)

3. NRC Letter to NSPM, "Prairie Island Nuclear Generating Plant Units 1 and 2 - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC Nos. MF0834 and MF0835)," dated February 27, 2014 (ADAMS Accession No. ML14030A540)

4. NRC Letter to NSPM, "Prairie Island Nuclear Generating Plant, Units 1 and 2 - Report for the Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Pool Instrumentation Related to Orders EA-12-049 and EA-12-051 (TAC Nos. MF0834, MF0835, MF0832, and MF0833)," dated August 20, 2015 (ADAMS Accession No. ML15224B396)

5. NSPM Letter (L-PI-16-001) to NRC, "Notification of Compliance with NRC Order EA-12-049, 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,' Prairie Island Nuclear Generating Plant Unit 2 (TAC No. MF0835)," dated January 14, 2016 (ADAMS Accession Nos. ML16014A754, ML16014A755, and ML16014A756)

6. NSPM Letter (L-PI-15-065) to NRC, "Prairie Island Nuclear Generating Plant's Fifth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) (TAC Nos. MF0834 and MF0835)," dated August 25, 2015 (ADAMS Accession No. ML15237A403)

7. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 2, dated December 2015 (ADAMS Accession No. ML16005A625)

8. Interim Staff Guidance, JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," Revision 1, dated January 22, 2016 (ADAMS Accession No. ML15357A163)

9. NSPM Letter (L-PI-16-063) to NRC, "Prairie Island Nuclear Generating Plant, Unit 1, Seventh Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) (TAC No. MF0834)," dated August 17, 2016 (ADAMS Accession No. ML16230A521)

10. NSPM Letter (L-PI-14-018) to NRC, "Prairie Island Nuclear Generating Plant's Second Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 26, 2014 (ADAMS Accession No. ML14057A771)

11. NSPM Letter (L-PI-14-104) to NRC, "Prairie Island Nuclear Generating Plant's Second Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) CORRECTED," dated October 20, 2014 (ADAMS Accession No. ML14295A761)

12. NSPM Letter (L-PI-12-099) to NRC, "Emergency Preparedness (EP) Communications Assessment Requested by 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," dated October 31, 2012 (ADAMS Accession No. ML12306A198)

13. NSPM Letter (L-PI-15-044) to NRC, "Prairie Island Nuclear Generating Plant Phase 2 Staffing Assessment in Response to March 12, 2012, Request for Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Recommendations of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, Enclosure 5, Recommendation 9.3, Emergency Preparedness - Staffing, Requested Information Items 1, 2, and 6," dated May 28, 2015

14. Engineering Change (EC) 27057, "Reconciliation of U1 and U2 EC FLEX Strategy Implementation with NEI 12-06 Revision 2," Revision 0.

15. NRC Letter to K. Davison, "Prairie Island Nuclear Generating Plant, Units 1 and 2 – Staff Assessment of Information provided Pursuant to Title 10 of the *Code of Federal Regulations* Part 50, Section 50.54(f), Seismic Hazard Reevaluations for Recommendation 2.1 of the Near-Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident and Staff closure of Activities Associated with NTTF Recommendation 2.1, "Seismic" (TAC Nos. MF3784 and MF3785)," dated December 15, 2015 (ADAMS Accession No. ML15341A162)

16. 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 (ADAMS Accession No. ML12056A046)

17. "SAFER Response Plan for Prairie Island Nuclear Generating Plant," Revision 2

18. Calculation ENG-ME-825, "Time to Onset of Reflux Cooling during ELAP," Revision 2

19. Calculation NSP-07-33, "Loss of Offsite power with Delayed AFW Analysis Results," Revision 0A

20. EC 22374-09, "Evaluation of the SFP Spray and Steam Generator Make-Up for a Post-Seismic Event," Revision 2

21. OC-PX-2012-021, "Prairie Island Subcritical Cooldown," dated December 26, 2012

22. Calculation 178599.51.2001, "Prairie Island Steam Generator Pressure Determination," Revision 2

23. EC 22374-13, "PINGP FLEX 480V Coordination Evaluation," Revision 0

24. Calculation 178599.51.3005, "Prairie Island – 4KV Generator Sizing Evaluation," Revision 0

25. Calculation ENG-EE-202, "FLEX 480V Portable Diesel Generator Sizing," Revision 0"

26. Calculation ENG-EE-199, "FLEX Strategy Battery Depletion Calculation," Revision 0

27. WCAP-14027-P, "No. 1 Seal Flow Rate for Westinghouse Reactor Coolant Pumps Following Loss of All AC Power, Task 3: Evaluation of Revised Seal Flow Rate on Time to Enter Reflux Cooling and Time at which the Core Uncovers," Revision 3

28. WCAP-14064-P, "Application of NOTRUMP Code Results for Westinghouse Designed PWRs in Extended Loss of AC Power Circumstances," Revision 0

FINAL INTEGRATED PLAN

Beyond Design Basis
FLEX Mitigation Strategies

Prairie Island Nuclear Generating Plant, Units 1 and 2

Northern States Power Company – Minnesota (NSPM)
d/b/a Xcel Energy

Table of Contents

Acronym	Definition
AC	Alternating Current
AFW	Auxiliary Feedwater
AOP	Abnormal Operating Procedure
BDBEE	Beyond-Design-Basis External Event
CL	Cooling Water
CFR	Code of Federal Regulations
CST	Condensate Storage Tank
DBA	Design Basis Accident
DBE	Design Basis Earthquake
DC	Direct Current
DDCLP	Diesel Driven Cooling Water Pump
DG	Diesel Generator
EDG	Emergency Diesel Generator
ELAP	Extended Loss of Alternating Current Power
EOP	Emergency Operating Procedure
EPRI	Electric Power Research Institute
FCU	Fan Coil Unit
FODT	Fuel Oil Day Tank
FOST	Fuel Oil Storage Tank
FSG	FLEX Support Guidelines
INPO	Institute of Nuclear Power Operations
LIP	Local Intense Precipitation
LOOP	Loss of Off-site Power
LUHS	loss of Normal Access to the Ultimate Heat Sink
MCC	Motor Control Center
MDAFWP	Motor Drive Auxiliary Feedwater Pump
MSL	Mean Sea Level
MSSV	Main Steam Safety Valve
NEI	Nuclear Energy Institute
NRC	Nuclear Regulatory Commission
NSPM	Northern States Power Company, a Minnesota corporation
NSRC	National SAFER Response Center
NSSS	Nuclear Steam Supply System
NTTF	Near-Term Task Force
PA	Protected Area
PBX	Private Branch Exchange
PEICo	Pooled Equipment Inventory Company
PINGP	Prairie Island Nuclear Generating Plant
PM	Preventive Maintenance
PORV	Power Operated Relief Valve
PWR	Pressurized Water Reactor

PWROG	Pressurized Water Reactor Owners Group
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RG	Regulatory Guide
RHR	Residual Heat Removal
RPV	Reactor Pressure Vessel
RWST	Refueling Water Storage Tank
SAFER	Strategic Alliance for FLEX Emergency Response
SI	Safety Injection
SBO	Station Blackout
SDM	Shutdown Margin
SFP	Spent Fuel Pool
SG	Steam Generator
SSC	Structure, System, and Components
SSE	Safe Shutdown Earthquake
TDAFWP	Turbine Driven Auxiliary Feedwater Pump
TG	Turbine Generators
TSC	Technical Support Center
UBC	Uniform Building Code
UHS	Ultimate Heat Sink
USAR	Updated Safety Analysis Report
VAC	Volt Alternating Current

1.0 Background

In 2011, an earthquake-induced tsunami caused Beyond-Design-Basis 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 (SFP) 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 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 (BDBEE).

Based on NTTF Recommendation 4.2, the NRC issued Order EA-12-049 (Reference 2) on March 12, 2012, to implement mitigation strategies for BDBEE. The Order included the following requirements:

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

- Phase 1 - Initially cope relying on installed equipment and onsite resources.
- Phase 2 - Transition from installed plant equipment to onsite Beyond-Design-Basis equipment.
- Phase 3 - Obtain additional capability and redundancy from offsite equipment until power, water, and coolant injection systems are restored or commissioned.

NRC Order EA-12-049 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 came first.

The Nuclear Energy Institute (NEI) developed NEI 12-06, Revision 2 (Reference 3), which provided 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, Revision 1 (Reference 4), dated January 22, 2016, which endorsed NEI 12-06, Revision 2, with clarifications on determining baseline coping capability and equipment quality.

NRC Order EA-12-051 (Reference 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 1).

NEI 12-02, Revision 1 (Reference 6), provided guidance for compliance with Order EA-12-051. The NRC determined that, with the exceptions and clarifications provided in JLD-ISG-2012-03 (Reference 7), conformance with the guidance in NEI 12-02 was an acceptable method for satisfying the requirements in Order EA-12-051.

2.0 NRC Order EA-12-049 – Diverse and Flexible Mitigation Capability (FLEX)

2.1 General Elements and Assumptions

The assumptions and boundary conditions used for the evaluations of Prairie Island Nuclear Generating Plant (PINGP) ELAP/LUHS event and the development of FLEX strategies are stated below. Note that the PINGP is following the guidance in Revision 2 of NEI 12-06 (Reference 3). The assumptions and boundary conditions used by PINGP are consistent with those detailed in NEI 12-06, Section 3.2.1, *General Criteria and Baseline Assumptions.*

- The BDBEE occurs impacting both units at the site.
- Prior to the event, both reactors have been operating at 100 percent rated thermal power for at least 100 days or have just been shut down from such a power history as required by plant procedures in advance of the impending event.
- At the time of the postulated event, the reactor and supporting systems are within normal operating ranges for pressure, temperature, and water level for the appropriate plant condition. All plant equipment is either normally operating or available from the standby state as described in the plant design and licensing basis. The minimum conditions for plant equipment Operability or functionality do not need to be assumed in establishing the capability of that equipment to support FLEX strategies, provided there is an adequate basis for the assumed value (e.g., procedural controls). For example, the minimum Technical Specification value for volume of water for Operability of the Condensate Storage Tank (CST) does not need to be assumed if procedures normally maintained a greater volume.
- No specific initiating event is used. The initial condition is assumed to be a Loss of Off-Site Power (LOOP) at the plant site resulting from an external event that affects the off-site power system either throughout the grid or at the plant with no prospect for recovery of off-site power for an extended period. The LOOP is assumed to affect both units.
- All installed sources of emergency on-site AC power and Station Blackout (SBO) Alternate AC power sources are assumed to be not available and not imminently recoverable. Station batteries and associated DC buses along with AC power from buses fed by station batteries through inverters remain available.
- Cooling and makeup water inventories contained in systems or structures with designs that are robust for the applicable hazard(s) are available.
- Normal access to the ultimate heat sink (UHS) is lost, but the water inventory in the UHS remains available and robust piping connecting the UHS to plant systems remains intact. The normal motive force for UHS flow, i.e., AC powered pumps, is assumed to be lost with no prospect for recovery. The diesel driven pumps and emergency intake line continue to provide access to the UHS.
- Fuel for FLEX equipment stored in structures with designs that are robust for the applicable hazard(s) remains available.
- Plant equipment that is contained in structures with designs that are robust for the applicable hazard(s) is available.
- Other equipment, such as portable AC power sources, portable pumps, and spare batteries, may be used provided it is reasonably protected from the applicable external hazards per Sections 5 through 9 and Section 11.3 of NEI 12-06 and has predetermined hookup strategies with appropriate procedures/guidance and the equipment is stored in a relative close vicinity of the site.

- Installed electrical distribution systems, including inverters and battery chargers, remain available provided they are protected consistent with current station design.
- No additional events or failures are assumed to occur immediately prior to or during the event, including security events.
- Following the loss of all AC power, the reactor automatically trips and all rods are inserted.
- The main steam system valves (such as main steam isolation valves, turbine stops, atmospheric dumps, etc.) necessary to maintain decay heat removal functions operate as designed.
- The Safety Relief Valves or Power Operated Relief Valves (PORVs) initially operate in a normal manner if conditions in the Reactor Coolant System (RCS) so require. Normal valve reseating is also assumed.
- No independent failures, other than those causing the ELAP/LUHS event, are assumed to occur in the course of the transient.
- Reactor coolant inventory loss consists of unidentified leakage at the upper limit of Technical Specifications, reactor coolant letdown flow (until isolated), and reactor coolant pump seal leak-off at normal maximum rate.
- The initial SFP conditions are; (1) all boundaries of the SFP are intact, including the liner, gates, transfer canals, etc., (2) although sloshing may occur during a seismic event, the initial loss of SFP inventory does not preclude access to the deck around the pool, (3) SFP cooling system is intact, including attached piping, and (4) SFP heat load assumes the maximum normal or design basis heat load dependent upon Mode of operation.

2.2 Strategies

The objective of the FLEX (or coping) strategies is to establish an indefinite coping capability in order to 1) prevent damage to the fuel in the reactors, 2) maintain the containment function, and 3) maintain cooling and prevent damage to fuel in the SFP using installed equipment, onsite portable equipment, and pre-staged offsite resources. This indefinite coping capability will address an ELAP with a simultaneous LUHS. This condition could arise following external events that are within the existing design basis with additional failures and conditions that could arise from a BDBEE.

The plant indefinite coping capability is attained through the implementation of predetermined strategies (FLEX strategies) that are focused on maintaining or restoring key plant safety functions, i.e., core cooling, containment, and SFP cooling. The FLEX strategies are not tied to any specific damage state or mechanistic assessment of external events. Rather, the strategies are developed to maintain the key plant safety functions based on the evaluation of plant response to the coincident ELAP/LUHS event. A safety function-based approach provides consistency with, and allows coordination with, existing plant Emergency

Operating Procedures (EOPs). FLEX strategies are implemented in support of EOPs using FLEX Support Guidelines (FSGs).

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

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

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

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

With the exception of Design-Basis flood events, Sections 2.3, 2.4, and 2.5 describe the strategies when the units are in Modes 1 through 4. The ELAP mitigating strategy when a unit is in Modes 5 and 6 is described in Section 2.16. The ELAP mitigating strategy during a Design Basis flood is described in Section 2.19.

Note that per PINGP Updated Safety Analysis Report (USAR) (Reference 18), Section 12, PINGP classifies structures, systems, and components as Design Class I, II, or III according to their function and importance in relation to the safe operation of the reactor. In some instances the design classification is further refined as Design Class I* or III*. The load combinations for these design classifications include (but are not limited to) the following:

Class I	Dead, Live, Snow, Design Basis Accident (DBA), and Design Basis Earthquake (DBE)
Class I*	Dead, Live, Environmental (wind, snow, if applicable), and DBE
Class II	Dead, Live and Uniform Building Code Earthquake

Class III	Dead, Live, Environmental (wind, snow, if applicable)
Class III*	Dead, Live and Uniform Building Code Earthquake

At PINGP, DBE is synonymous with Safe Shutdown Earthquake (SSE).

2.3 Reactor Core Cooling Strategy

Reactor core cooling involves the removal of decay heat through the secondary side of the Nuclear Steam Supply System (NSSS) and maintaining sufficient RCS inventory to ensure the continuation of natural circulation in the primary side of the NSSS. The FLEX strategy for reactor core cooling and decay heat removal is to release steam from the Steam Generators (SG) using the SG PORVs and the addition of a corresponding amount of Auxiliary Feedwater (AFW) to the SGs via the Turbine Driven AFW Pump (TDAFWP). If the CSTs are available, the tanks will be used as the initial water supply to the TDAFWP. If the CSTs are not available, water will be supplied to the TDAFWP from the safety related Cooling Water (CL) system. In an ELAP event, the CL system will be supplied from two Diesel Driven Cooling Water Pumps (DDCLPs). Each DDCLP has its own dedicated diesel engine and does not rely on AC power. Operator actions to verify, realign, and throttle AFW flow are required by the EOPs following an ELAP event to prevent SG dryout and/or overfill. RCS cooldown will be initiated within the first two hours following an ELAP event. Partial DC bus load stripping will be completed within the first hour and additional DC load stripping completed within the first 90 minutes following an ELAP event to extend the safeguard battery life. Portable generators will be used to repower instrumentation via repowering the battery chargers prior to battery depletion.

RCS makeup and boron addition will be initiated within 32 hours following an ELAP event to ensure natural circulation, reactivity control, and boron mixing is maintained in the RCS.

NOTE: The reactor core cooling strategy descriptions below are the same for both of the two PINGP units.

2.3.1 Phase 1 Strategy

The Phase 1 coping strategy for reactor core cooling involves removing decay heat by releasing steam from the SGs while providing makeup to the SGs from the TDAFWP.

Immediately following the loss of power, the reactor will trip and the plant will initially stabilize at no-load RCS temperature and pressure conditions, with reactor decay heat removal via steam release to the atmosphere through the SG PORVs and/or Main Steam Safety Valves (MSSVs). Natural circulation of the RCS will develop to provide core cooling and the TDAFWP will provide flow from the CSTs (if available) to the SGs to make-up for steam release.

At the initiation of the event, operators will enter the station's EOP 1[2]ECA-0.0 (Reference 40) for the loss of all safeguards AC power. This procedure declares an ELAP after the control room staff has determined that no alternate AC source is available. PINGP has two safety related Emergency Diesel Generators (EDG) per unit. The capability exists to cross-tie the EDGs between the units. As described in the PINGP USAR (Reference 18), it has been demonstrated by testing that alternate AC from the non-SBO unit's EDG can be manually cross-tied within ten minutes of the realization that an SBO condition exists to provide power to the required loads on the SBO unit. Based on this information, it is expected that an ELAP will be declared within 20 minutes of the initiating event. The loss of all AC EOP directs entry into the FSGs and other Abnormal Operating Procedures (AOP) as appropriate.

Steam is initially released automatically from the SGs through the SG PORV until the air accumulator associated with each SG PORV depressurizes. When the SG PORV becomes unavailable due to lack of control air supply, heat will be removed by steam release through the MSSVs.

A rapid RCS cooldown (near 100°F per hour) is initiated within the first two hours of the event. This minimizes the adverse effects of high temperature RCS coolant on Reactor Coolant Pump (RCP) shaft seal performance and reduces SG pressure to allow for eventual AFW injection from a portable pump if the TDAFWP becomes unavailable The cooldown is accomplished by using the SG PORVs to release steam. When the PORV air accumulators are exhausted, the valves may be operated locally using the valve handwheels. The cooldown continues until the SG pressure reaches 350 psig. This SG pressure is high enough to prevent nitrogen gas from the safety injection (SI) accumulators from entering the RCS.

Makeup to the SG is supplied from the TDAFWP with flow being controlled locally in the AFW pump rooms. The normal and preferred source of water for the TDAFWPs is from the three cross-connected 150,000 gallon CSTs. The CSTs are expected to survive seismic and flood events, but not tornado missiles. The backup water source is the safety related supply provided by the Design Class I Cooling Water System using the DDCLPs. The suction supply to the DDCLP is from a safeguards bay inside the Plant Screenhouse that is supplied from the Mississippi River through the normal intake or from a dedicated Emergency Cooling Water intake line. With the assumed loss of the CSTs, the TDAFWPs would automatically trip on low suction pressure, protecting the pump from damage due to a loss of the suction water supply. Aligning the CL system to the suction of the TDAFWPs requires local manual operation of two Motor Operated Valves per pump and then locally restarting the TDAFWP. These actions are provided in Abnormal Operating Procedure 1[2]C28.1 AOP3 (Reference 41). Analyses demonstrate that at least 74 minutes are available to restore AFW flow to the SGs

(Reference 33). Each DDCLP has its own dedicated diesel engine and does not rely on AC power. The speed of the DDCLP is reduced within two hours to ensure its associated Fuel Oil Day Tank (FODT) contains sufficient fuel oil to support approximately eight hours of DDCLP operation.

The RCS will be cooled down and depressurized until SG pressure reaches 350 psig, which corresponds to a core inlet temperature of approximately 435°F. Natural circulation will continue to remove decay heat until the RCS inventory deceases (due to RCS leakage) to the point where reflux cooling occurs. Although RCS leakage would be expected to decrease as the RCS is depressurized, the evaluation described in Section 2.3.7 does not credit any decrease in leakage. Without additional RCS inventory makeup, the assumed onset of reflux cooling was conservatively determined not to occur until 32 hours following the event (See Section 2.3.7). Keff is calculated to be less than 0.99 at the described RCS conditions for at least 36 hours (See Section 2.3.9).

The power supply to essential instrumentation is from the inverters, which are powered from the safeguard batteries. Load shedding (Reference 51) will be performed in order to extend battery operational times. The strategy for the load shedding will be to reduce the load on the batteries through use of relatively simple actions (opening DC Panel Breakers and pulling fuses). The load shedding will focus on reducing the overall load while maintaining essential instrumentation and controls. It is expected to commence within 30 minutes of the ELAP with the first portion completed within 60 minutes of the ELAP and the final portion of the load shed completed within 90 minutes of the ELAP. The battery depletion calculation (see Section 2.3.11) showed that shedding these loads will extend the limiting battery life to 11.5 hours.

2.3.2 Phase 2 Strategy

The Phase 2 coping strategy for reactor core cooling involves removing decay heat by releasing steam from the SGs while providing makeup to the SGs from the TDAFWP. AFW flow will be controlled locally in the AFW pump rooms. Water supply to the TDAFWP will be supplied from either the CST (if available) or the CL System using a DDCLP. Availability of the CL supply from a DDCLP is discussed in Section 2.3.1. The fuel oil supply to the DDCLPs is supplied from the associated FODTs, which are located in the Design Class 1 portion of the Screenhouse. The FODT contains sufficient fuel oil to support approximately eight hours of DDCLP operation. Within this eight hour period, a portable 480 volt AC (VAC) FLEX diesel generator will be deployed to repower a Motor Control Center (MCC) (Reference 51) in the Plant Screenhouse (Figure 1). This MCC supplies power to a fuel oil transfer pump that will automatically refill the associated FODT from the associated fuel oil storage tank (FOST).

As a backup to the TDAFWP, a portable FLEX SG/SFP makeup pump may be connected to either of the FLEX connection points (Reference 47) installed downstream of each Motor Drive Auxiliary Feedwater Pump (MDAFWP) (Figure 2). A FLEX submersible pump provides the required lift to supply the suction of the SG/SFP makeup pump. The pumps were designed to provide the required flow rate (less than 100 gpm per unit) to SGs in both units at a backpressure corresponding to a SG pressure of 350 psig plus the SFP makeup requirements. The AFW System cross-connect valves (located downstream of each MDAFWP) will be used to supply flow to the other unit.

PINGP has replaced the Westinghouse RCP seals with Flowserve N-9000 low leakage seal design. With these low leakage seals, Northern States Power Company, a Minnesota corporation (NSPM) has conservatively determined that RCS makeup capability must be established within 32 hours to prevent the onset of reflux cooling. Within this 32 hour period, a single FLEX 480 VAC portable diesel generator will be connected to a MCC on each unit (Reference 52) that supplies an installed charging pump (Figure 3). The water supply to the charging pumps will be from the installed Refueling Water Storage Tanks (RWST).

A power supply to essential instrumentation is maintained using the same 480 VAC portable diesel generator used to repower the DDCLP fuel oil transfer pump. This will be accomplished by connecting the portable diesel generator to a battery charger (Reference 51) on each unit (Figure 1). Repowering a battery charger will be accomplished within the 11.5 hour battery life. These battery chargers then feed the inverters, which supply power to the instrument buses.

2.3.3 Phase 3 Strategy

The Phase 3 coping strategy for reactor core cooling involves continuing the Phase 2 strategy described in Section 2.3.2.

The additional equipment listed in Section 2.10 will also be available from the National Strategic Alliance for FLEX Emergency Response (SAFER) Response Center (NSRC). This equipment provides redundancy to the on-site FLEX equipment along with additional capabilities such as water treatment and RCS boration (refer to Table 1 for sizing of SAFER equipment). The onsite Emergency Response Organization will determine how to use these additional capabilities.

One capability that is expected to be available is the 1,000 kW 4kV Turbine Generators (TGs). Two 4kV TGs for each unit will be supplied from the NSRC in order to supply power to one of the two safeguard 4kV buses on each unit (Figure 4). By restoring a safeguard 4kV bus, power can be restored to the safeguard 480 VAC buses via the 4160/480 VAC transformers to power selected 480 VAC loads, e.g., SI accumulator isolation valves. This would allow the SG pressure to be reduced below 350 psig. It also provides the option to repower a MDAFWP to supply feedwater to the SG and reduce SG pressure below that required to provide the motive force for the TDAWFP.

2.3.4 Structures, Systems, and Components

The Structures, Systems, and Components (SSCs) discussed in this section provide a direct role in maintaining the key safety functions of reactor core cooling (w/ SGs available) and Reactor/Primary Coolant System inventory control mitigating strategies. Except as discussed below, the SSCs are either qualified as robust (as defined by NEI 12-06) as originally designed or have been qualified as robust through additional evaluations.

Turbine Driven Auxiliary Feedwater Pump
Each unit has a safety related TDAFWP located in the Class 1 portion of the Turbine Building. The steam from the SGs provides the motive force to drive the turbine for the pump. The TDAFWP will automatically start on several signals that would be present during an ELAP event (e.g., low-low water level in either SG, trip of both Main Feedwater pumps, loss of both 4.16 kV normal buses). Furthermore, the TDAFWP can be started locally or remotely from the control room.

Steam Generator Power Operated Relief Valve
During an ELAP event, reactor core cooling and decay heat will be removed from the SGs for an indefinite time period by opening/throttling the SG PORVs. The SG PORVs are safety related, missile protected, seismically qualified valves located in the Design Class 1 Auxiliary Building. The loss of AC power will result in the loss of instrument air supply to the SG PORVs. However, the valves are equipped with backup air accumulators, which enable to valves to be controlled remotely from the main control room. When the PORV air accumulators are exhausted, the valves may be operated locally using the valve handwheels.

Station Batteries, Battery Chargers, and Inverters
The safety related station batteries, chargers, and inverters are located within the Class 1 portion of the Turbine Building designed to meet applicable design basis external hazards. The batteries will be relied upon to initially power required key instrumentation.

Condensate Storage Tanks
There are three 150,000 gallon CSTs located at PINGP. The CSTs are cross-connected, such that the water in the three CSTs is available to both units' TDAFWPs. The CSTs are not seismically designed. However, analyses have been performed that demonstrate there is reasonable assurance the CSTs will be available following a seismic event (References 57 and 60). The 11 CST is located on the opposite side of the Turbine Building from the 21 and 22 CSTs. All tanks are located such that substantial portions of the tanks are protected from tornado missiles by Class I structures.

Diesel Driven Cooling Water Pump
The safety related water supply to the TDAFWP is provided by the Design Class I Cooling Water System. In an ELAP event, the CL system will initially be supplied

from two DDCLPs. Each DDCLP has its own dedicated diesel engine and does not rely on AC power. Within two hours of declaring an ELAP, the speed of one of the DDCLPs is reduced, to ensure its associated FODT contains sufficient fuel oil to support approximately eight hours of DDCLP operation. The other DDCLP is not required and will be shutdown to preserve its fuel supply. The suction supply to the DDCLP pulls from a safeguards bay inside the Plant Screenhouse that is supplied from the Mississippi River through the normal intake or from a dedicated Emergency Cooling Water intake line. As described in the PINGP USAR, the Emergency Cooling Water Intake provides water to maintain safe shutdown for both units after a Design Basis Earthquake. This intake is a 36 inch pipe buried approximately 40 feet below the Circulating Water Intake Canal water level in nonliquefiable soil, connecting the screenwell to a submerged intake crib in a branch channel of the Mississippi River. This Emergency Cooling Water Intake is a Class I structure as is the Approach Canal that supplies the intake crib from the main channel of the Mississippi River. The intake crib is designed to exclude trash. If the 36 inch pipe is the only source of water available to the DDCLPs, operator actions are necessary to reduce the system flow demand to within the capacity of the line. Operators would initiate actions to reduce CL system flow demand based on lowering bay water level. As described in the PINGP USAR, there are 3.3 hours available to perform these actions.

Aligning the CL system to the suction of the TDAFWPs requires local manual operation of one Motor Operated Valve per pump and then locally restarting the TDAFWP. These actions are provided in Abnormal Operating Procedure 1[2]C28.1 AOP3 (Reference 41). Analyses demonstrate that there is at least 74 minutes available to restore AFW flow to the SGs.

<u>Charging Pumps</u>
The installed charging pumps (with a nominal flow capacity of 60 gpm each) are contained in the Auxiliary Building, which is a Class 1 structure with a design that is robust with respect to seismic events, floods, and high winds and associated missiles. Therefore, the charging pumps would be available in an ELAP scenario to provide RCS makeup water.

<u>Refueling Water Storage Tanks</u>
There are two safety related RWSTs (one per unit) with 265,000 gallons per tank. The RWSTs are located within the Auxiliary Building, which is a Class 1 structure. The boron concentration in the RWST is maintained between 2600 and 3500 ppm.

2.3.5 FLEX Strategy Connections

<u>AFW Connections</u>
New FLEX connection points have been installed downstream of each MDAFWP within the AFW pump room (Figure 2), i.e., Design Class 1 portion of Turbine Building. The discharge from the portable FLEX SG/SFP makeup pump will provide flow into either one of the FLEX connection points (Reference 47). The

AFW System cross-connect valves (located downstream of each MDAFWP) will be used to supply flow to the other unit. This configuration provides the capability to feed the SGs for one or both of the units from either of the two FLEX connection points (i.e., one connection may be considered the primary while the other may be considered an alternative connection point).

Screenhouse MCC Connections

New FLEX safety related breakers were installed in the MCCs that supply power to the fuel oil transfer pumps for each DDCLP. The load side of the FLEX breakers is connected to FLEX power receptacles. These MCCs and receptacles are located within the Design Class 1 portion of the Screenhouse. During an ELAP, cables from the portable FLEX 480 VAC diesel generator will be connected (Reference 51) to the receptacle (Figure 1). The mitigating strategies only require one of the two DDCLP and the associated fuel oil transfer pump to be in operation. Therefore, the MCC receptacle for supplying power to the fuel oil transfer pump for the other DDCLP is the alternate connection. Testing was performed to ensure that the wiring of the receptacles provided the proper phase rotation. Color coded cables are used to ensure proper phase rotation when connected to the generator.

Battery Charger MCC Connections

New FLEX safety related breakers were installed in the MCCs that supply power to battery chargers (one MCC per train per unit for a total of four). The load side of the FLEX breakers is connected to FLEX power receptacles. These MCCs and receptacles are located within the Design Class 1 portion of the Turbine Building. During an ELAP, cables from the portable FLEX 480 VAC diesel generator will be connected (Reference 51) to one receptacle for each unit (Figure 1). The mitigating strategies only require one train of instruments per unit. Therefore, the receptacle/MCC that would repower the battery charge for the other train is the alternate connection. Testing was performed to ensure that the wiring of the receptacles provided the proper phase rotation. Color coded cables are used to ensure proper phase rotation when connected to the generator.

Charging Pump MCC Connections

New FLEX safety related breakers were installed in the MCCs that supply power to charging pumps (one MCC per train per unit for a total of four). The load side of the FLEX breakers is connected to FLEX power receptacles. These MCCs and receptacles are located within the Design Class 1 portion of the Auxiliary Building. During an ELAP, cables from the portable FLEX 480 VAC diesel generator will be connected (Reference 52) to one receptacle for each unit (Figure 3). The mitigating strategies only require one charging pump per unit. Therefore, the receptacle/MCC that would repower the charging pump(s) for the other train is the alternate connection. Testing was performed to ensure that the wiring of the receptacles provided the proper phase rotation. Color coded cables are used to ensure proper phase rotation when connected to the generator.

<u>4kV SAFER Turbine Generators for Phase 3</u>
The SAFER 4kV TGs are connected directly to the safeguard buses (Figure 4), i.e., no permanent modifications were made. This is accomplished by reconfiguring the bus (e.g., removing current transformers, replacing portions of the bus bars, and attaching mounting blocks). As shown on Figure 4, the SAFER 4kV TGs may be connected to either safeguard bus for each unit. Therefore, either is considered the primary or alternate connection. The procedures for connecting the TGs to the buses (References 42, 43, 44, and 45) include guidance to verify phase rotation by bumping a motor (or other means). At a minimum, the first motor started should be checked for proper rotation.

<u>SAFER Mobile Boration and RCS Makeup for Phase 3</u>
As a backup to the primary and alternate charging pumps, PINGP will be receiving two mobile boration units with bags of boron and two high pressure injection pumps. The high pressure injection pumps will be capable of injecting borated makeup into the RCS via reconfigured safety injection pump discharge check valves.

2.3.6 Key Reactor Parameters

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

- Auxiliary Feedwater Pump Flow
- SG Water Level
- SG Pressure
- RCS Hot Leg Temperature
- RCS Cold Leg Temperature
- Core Exit Thermocouples
- CST Level
- Pressurizer Level
- Reactor Vessel Level
- Neutron Flux/Startup Rate
- RCS Wide Range Pressure
- RWST Level
- DC Bus Voltage

In the unlikely event that the instrument bus infrastructure is damaged, a FSG provides guidance on obtaining critical parameters locally (Reference 54).

The portable FLEX equipment is supplied with the local instrumentation needed to operate the equipment.

2.3.7 Thermal - Hydraulic Analyses

Secondary Makeup Water Requirements

Although the preferred water supply for the TDAFWP is the CSTs, they are not being relied upon as the credited water source in an ELAP event. This is because the CSTs are not protected from all external hazards. The CL System, which is a safety related system, will provide the credited source of water to the TDAFWPs. Aligning the CL system to the suction of the TDAFWPs requires local manual operation of two Motor Operated Valves per pump and then locally restarting the TDAFWP. These actions are provided in Abnormal Operating Procedure 1[2]C28.1 AOP3 (Reference 41). An analysis demonstrated that there is at least 74 minutes available to restore AFW flow to the SGs (Reference 33). The water in the CL system is supplied from the DDCLPs. The suction supply to the DDCLP is from a safeguards bay inside the Plant Screenhouse that is supplied from the Mississippi River through the normal intake or from a dedicated Emergency Cooling Water intake line. This line-up provides an unlimited supply of water to extend decay heat removal capability.

As a backup to the TDAFWP, a portable FLEX SG/SFP makeup pump may be connected to either of the FLEX connection points installed downstream of each MDAFWP. A FLEX submersible pump provides the required lift to supply the suction of the SG/SFP makeup pump. A hydraulic evaluation (Reference 39) confirmed that the combination of FLEX submersible pump, the FLEX SG/SFP makeup pump, and associated hoses is capable of delivering the required flow to each unit's SGs and the SFP.

RCS Response

Pressurized Water Reactor Owners Group (PWROG) report PWROG-14027-P (Reference 11) contains a summary of analyses performed to determine the onset of reflux cooling. However, the analyses were based on seal leakage rates corresponding to the Westinghouse style RCP seals and not the Flowserve RCP seals installed at PINGP. A site specific calculation was performed to determine the time to the onset of reflux cooling with the Flowserve RCP seal packages.

NSPM's calculation (Reference 36) relied upon the reference two-loop analysis contained in PWROG-14027-P for the determination of the net RCS mass loss prior to the onset of reflux cooling (i.e., when the one hour centered moving average of SG U-bend flow quality has increased to 0.1 in any loop). The 2-loop reference case analysis in PWROG-14027-P showed that the onset of reflux cooling occurred 28 hours into the event. However, to be consistent with the recommendations in PWROG-14064-P (Reference 12) the site specific calculation used the net mass loss at 17 hours into the event as the basis for determining when reflux cooling would occur. The calculation performed a mass balance to determine when this net RCS mass loss would occur. The mass balance included the minimum water volume injected from the SI accumulators, a mass loss rate from the Flowserve seal package, and a mass loss rate from unidentified RCS leakage. The calculation determined that reflux cooling would not occur until after 32 hours from initiation of the event. This calculation is the basis for the 32 hour time constraint for repowering a charging pump (i.e., establishing RCS makeup capability) during an ELAP event.

2.3.8 Reactor Coolant Pump Seals

The RCPs at PINGP are equipped with the Flowserve N-9000 seal package. Information on the design and qualification testing of the N-Seal package, and the expected seal performance during an ELAP, is contained in the Flowserve White Paper (Reference 13). The PWROG submitted this White Paper to the NRC staff, for information only, in support of NRC staff efforts to provide guidance for review of licensee submittals. The NRC staff reviewed the information and concluded that the leakage rates proposed for the N-Seal design, as documented in Table 3 in the white paper, are acceptable for use in beyond-design-basis ELAP evaluations for demonstrating compliance with Order EA-12-049, with limitations and conditions (Reference 14). NSPM documented how PINGP complied with these limitations and conditions in Reference 10.

The calculation for determining when RCS makeup must be re-established (Section 2.3.7) used a volumetric flow rate slightly higher than the Controlled-Bleed-Off listed in the Flowserve white paper. This calculation determined that RCS makeup must be re-established within 32 hours of the event. This time constraint provides significant margin to the time to exceed the thermal margin determined in the white paper.

2.3.9 Shutdown Margin Analyses

A Shutdown Margin (SDM) Analysis (Reference 35) was performed for a representative core design for PINGP. The analysis determined that xenon would maintain K_{eff} less than 0.99 for at least 36 hours following a reactor trip from full power with a cooldown to 420°F. As described in Section 2.3.1, the RCS will be initially cooled down and depressurized to a SG pressure of 350 psig, which corresponds to a core inlet temperature of approximately 435°F. Therefore, SDM is maintained for at least the first 36 hours of the event.

It is recognized that the rapid RCS cooldown will result in a steam bubble in the reactor vessel head and that this bubble will control RCS pressure (rather than being controlled by the SG pressure) such that it will delay SI accumulator injection. However, within the 36 hour period discussed above, it is expected that the reactor vessel head will cooldown sufficiently such that the SI accumulators will inject enough borated water (conservatively determined to be 8,900 gallons at the Technical Specification minimum concentration of 2300 ppm) to maintain SDM down to a RCS temperature of 350°F. As an additional defense in depth measure, the ELAP response procedure and guidelines (Reference 46) include steps to be completed prior to the 36 hour time period that ensure SDM is maintained by either

1) verifying sufficient SI accumulator injection has occurred or 2) injecting sufficient borated water from the RWST via a charging pump. As discussed in Section 2.3.2, a FLEX 480 VAC portable diesel generator will be used to repower a charging pump within 32 hours of the ELAP event occurring. This provides sufficient time for the charging pump to inject the required volume of borated water from the RWST and at least one hour for the boron to mix.

Note that exposure dependent cycle specific required SI accumulator injection volumes are available to the Technical Support Center (TSC) and may be used instead of the bounding 8,900 gallons value. In addition, the cycle specific checks are performed to ensure that the 8,900 gallon value remains bounding. Although it is not anticipated to be necessary, if RCS venting is necessary to support sufficient injection, the procedures (Reference 46) call for using the repowered reactor head vent valves.

2.3.10 FLEX Pump and Water Supplies

FLEX Submersible Pump and SG/SFP Makeup Pump
The combination of the FLEX submersible pump in series with the FLEX SG/SFP makeup pump is designed to provide 500 gpm flow at 500 psig under the limiting event (i.e., a seismic event resulting in the loss of the Lock and Dam No. 3). Reference 39 is the hydraulic evaluation demonstrating that this combination of pumps is capable of meeting the flow requirements for simultaneously supplying SG makeup to both units plus SFP makeup. These trailer-mounted, diesel driven pumps are stored in the FLEX building. The pumps are deployed by towing the trailers to the designated locations as described in Section 2.9.

AFW Water Supplies
The credited water source for SG makeup is the intake canal (if available) or the intake bay within the Screenhouse. In the event the normal water flow from the Mississippi River to the intake canal is lost (e.g., a seismic event), Mississippi River water will be supplied to the intake bay through the seismically qualified Emergency Intake Line.

Borated Water Supply
The credited source of borated water for the charging pumps is the RWSTs. There are two safety related RWSTs (one per unit) with 265,000 gallons per tank located within the Design Class 1 Auxiliary Building. The boron concentration in the RWST is maintained between 2600 and 3500 ppm.

Phase 3 Water Treatment & Mobile Boration
As shown in Table 1, the equipment being supplied from the NSRC includes a water treatment and storage system. This equipment could be used as a source of clean water to the SGs and the NSRC supplied mobile boration equipment.

If needed, the mobile boration unit could be used to mix boron for RCS makeup.

2.3.11 Electrical Analysis

Battery Depletion

The power supply to the essential instruments is from the inverters, which are powered from the safeguard batteries. To extend the life of the batteries, non-essential loads are shed. The battery depletion calculation (Reference 34) shows that battery life can be extended to at least 11.5 hours for the limiting battery with the assumed load shedding. The calculation assumes that the loads in the battery rooms are shed within 60 minutes following the event initiation and loads outside the battery rooms are shed within 90 minutes following the event initiation. The battery depletion calculation was performed in accordance with the IEEE-485 methodology using manufacturer discharge test data applicable to the FLEX strategy as outlined in the NEI white paper on Extended Battery Duty Cycles (Reference 17).

480 VAC Portable Diesel Generator for Screenhouse and Battery Charger MCCs

The ELAP mitigating strategies call for a single 480 VAC 300 kW portable diesel generator to repower a MCC within the Screenhouse (to repower the DDCLP fuel transfer pump) and a MCC on each unit in the battery rooms (to repower a battery charger on each unit). A calculation (Reference 27) was performed demonstrating that the portable diesel generator will be capable of supplying the required loads, i.e., a starting kW load of 171.9 kW. Before the portable diesel generator is connected to the MCCs, the MCCs are isolated by opening the supply breaker and all load breakers (Reference 51).

480 VAC Portable Diesel Generator for Charging Pump MCCs

The ELAP mitigating strategies call for a single 480 VAC 300 kW portable diesel generator to repower a MCC on each unit within the Auxiliary Building (to repower a charging pump on each unit). A calculation (Reference 27) was performed demonstrating that the generator will be capable of supplying the required loads, i.e., a starting kW load of 236.1 kW. Before the generator is connected to the MCCs, the MCCs are isolated by opening the supply breaker and all load breakers (Reference 52).

4kV SAFER Turbine Generators for Phase 3

Two SAFER 4kV TGs will be available to connect to one of the two safeguard 4kV buses on each unit. By restoring a safeguard 4kV bus, power can be restored to the safeguard 480 VAC buses via the 4160/480 VAC transformers to power selected 480 VAC loads. A calculation (Reference 28) was performed demonstrating that two SAFER TGs will be capable of supplying the desired loads, i.e., 1988.8 kVA versus a capability of 2500 kVA. The specific loads to be repowered will be determined by the Emergency Response Organization based on the recovery needs. Before the TGs are connected to a bus, the bus is isolated by racking-out the supply and load breakers (References 42, 43, 44, and 45).

2.4 Spent Fuel Pool Cooling/Inventory

The PINGP SFP is a common two compartment pool designed for both Unit 1 and Unit 2. The basic coping strategy for maintaining SFP cooling is to monitor SFP level and provide sufficient makeup water to the SFP to maintain the normal SFP level.

2.4.1 Phase 1 Strategy

The Phase 1 coping strategy for SFP cooling/Inventory involves monitoring SFP level using the instrumentation installed as required by NRC Order EA-12-051 (Reference 5).

Non-Outage Conditions
Under non-outage conditions, the evaluation discussed in Section 2.4.6 below shows that there is at least 33 hours before the SFP will start to boil. Although additional time would be available before the SFP level would decrease to the top of the active fuel, NSPM has conservatively selected 33 hours as the time constraint for pre-staging makeup water source hoses in the vicinity of the SFP.

Outage Conditions
Under outage conditions with a full core offload, the evaluation discussed in Section 2.4.6 below shows that boiling may occur in as soon as eight hours. However, additional personnel will be available during an outage to install hoses in the vicinity of the SFP. Per the PINGP USAR Section 10.2.2.3, the maximum boil-off rate when a full core offload condition exists in the SFP is 66 gpm. Assuming this boil-off rate, the SFP level will remain above the top of the fuel assemblies for greater than 56 hours (Reference 62).

2.4.2 Phase 2 Strategy

Non-Outage Conditions
Under non-outage conditions (i.e., without a recently discharged full core offload), the evaluation discussed in Section 2.4.6 below shows that there is at least 33 hours before the SFP will start to boil. Although additional time would be available before the SFP level would decrease to the top of the active fuel, NSPM has conservatively selected 33 hours as the time constraint for pre-staging makeup water source hoses in the vicinity of the SFP. These hoses will discharge directly into the SFP pool. If the SFP deck is inaccessible, an alternate connection point through the SFP Skimmer System is provided (Figure 2). The SFP Skimmer connection point is located one floor below the SFP deck. When the SFP reaches an elevation of 752.5 ft, actions will be taken to provide makeup to the SFP. If the SFP level reaches an elevation of 729.16 ft (i.e., Level 3 setpoint, nominally ± 1 foot above the spent fuel), actions to implement make-up water addition will no longer be deferred. Makeup flow is provided by the same FLEX

SG/SFP makeup pump used as a backup to the TDAFWP discussed in Section 2.3.

Outage Conditions
Under outage conditions with a full core offload, the evaluation discussed in Section 2.4.6 below shows that boiling may occur in as soon as eight hours. However, additional personnel will be available during an outage to install hoses in the vicinity of the SFP. Per the PINGP USAR Section 10.2.2.3, the maximum boil-off rate when a full core offload condition exists in the SFP is 66 gpm. Assuming this boil-off rate, the SFP level will remain above the top of the fuel assemblies for greater than 56 hours (Reference 62).

SFP Spray
Revision 2 of NEI 12-06 (Reference 3) no longer called for capability to provide 500 gpm of SFP spray. The NRC endorsed this change provided the SFP integrity is demonstrated as part of the seismic hazard reevaluation (Reference 4). For the PINGP site, the reevaluated seismic hazard is bounded by the existing design-basis safe shutdown earthquake (Reference 20). In addition, a SFP integrity evaluation was performed (Reference 55) following the guidance in Reference 56. Since the PINGP SFP integrity has been demonstrated, SFP spray is not part of the PINGP FLEX strategies.

Monitoring SFP Level
The Phase 2 coping strategy for SFP cooling/inventory includes monitoring level utilizing the instrumentation installed to meet NRC Order EA-12-051.

2.4.3 Phase 3 Strategy

The Phase 3 coping strategy for SFP cooling/inventory involves continuing SFP makeup as described in the Phase 2 strategy (Section 2.4.2) or restoring normal SFP cooling.

The capability to restore normal SFP cooling will be provided by the 1,000 kW 4kV portable TGs provided from SAFER. Two 4kV TGs for each unit will be supplied from the NSRC in order to supply power to one of the two safeguard 4kV buses on each unit. By restoring a safeguard 4kV bus, power can be restored to the safeguard 480 VAC buses via the 4160/480 VAC transformers. This provides the option to repower a component cooling water pump, a SFP cooling pump, and the associated equipment needed to restore normal SFP cooling or makeup. Cooling Water to the Component Cooling Water system would be supplied from the installed DDCLP.

2.4.4 Structures, Systems, and Components

Primary Makeup Method
The primary makeup method utilizes the FLEX SG/SFP makeup pump to discharge directly into the SFP (Reference 53). All equipment is portable and does not require any physical connections to permanent plant equipment.

Alternate Makeup Method
The alternate makeup method utilizes the FLEX SG/SFP makeup pump connected to the SFP skimmer via an existing flanged connection point. This method would involve removing the installed flange, attaching an adaptor, connecting the hoses to the adaptor, and opening the existing installed isolation valve (Reference 53).

SFP Ventilation
Ventilation requirements to prevent excessive steam accumulation are satisfied by opening Auxiliary Building roll-up doors. Airflow through these doors provides adequate vent pathways through which the steam generated by SFP boiling can exit the Auxiliary Building.

2.4.5 Key SFP Parameters

Instrumentation providing the following key parameter(s) is credited for all phases of the SFP cooling/inventory strategy:

- SFP water level instrumentation that was installed in response to Order EA-12-051, *Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Level Instrumentation* (Reference 5).

2.4.6 Thermal - Hydraulic Analyses

As described in Section 2.1, prior to the ELAP event both units are assumed to have been operating at 100 percent rated thermal power for at least 100 days. Under this assumption (i.e., without the presence of a recently discharged full core offload), boiling is not expected to occur until greater than 33 hours from the event. During an outage with a full core offload (i.e., maximum design basis heat load from 1,362 normally discharged fuel assemblies plus a freshly offloaded core), the PINGP USAR Section 10.2.2.3 states that boiling may occur in as soon as eight hours. Although this time is shorter, additional personnel will be available during an outage to install hoses in the vicinity of the SFP. The maximum boil-off rate when a full core offload condition exists in the SFP is 66 gpm. Assuming this boil-off rate, the SFP level will remain above the top of the fuel assemblies for greater than 56 hours (Reference 62).

Deployment of the FLEX submersible pump, FLEX SG/SFP makeup pump, and hoses will provide adequate makeup to restore the SFP level and to maintain an acceptable level of water for shielding purposes. A hydraulic evaluation

(Reference 39) confirmed that the combination of FLEX submersible pump, the FLEX SG/SFP makeup pump, and associated hoses is capable of delivering the required flow to the SFP and each unit's SGs.

2.4.7 FLEX Pump and Water Supplies

FLEX Submersible Pump and SG/SFP Makeup Pump
The combination of the FLEX submersible pump in series with the FLEX SG/SFP makeup pump is designed to provide 500 gpm flow at 500 psig under the limiting event (i.e., a seismic event resulting in the loss of the Lock and Dam No. 3). Reference 39 is the hydraulic evaluation demonstrating that this combination of pumps is capable of meeting the flow requirements for simultaneously supplying SG makeup to both units plus SFP makeup. These trailer-mounted, diesel driven pumps are stored in the FLEX building. The pumps are deployed by towing the trailers to the designated locations as described in Section 2.9.

Water Supplies
The credited water source for SFP makeup is the intake canal (if available) or the intake bay within the Screenhouse. In the event the normal water flow from the Mississippi River to the intake canal is lost (e.g., a seismic event), Mississippi River water will be supplied to the intake bay via the seismically qualified Emergency Intake Line.

Phase 3 Water Treatment
As shown in Table 1, the equipment being supplied from the NSRC includes a water treatment and storage system. This equipment could be used as a source of clean water to the SFP.

2.4.8 Electrical Analysis

The SFP will be monitored by instrumentation installed in response to Order EA-12-051. The power for this equipment has backup battery capacity for seven (7) days. Therefore, the system does not require the batteries to be replaced, or need an external power supply, for one week during a BDBEE.

4kV SAFER Turbine Generators for Phase 3
It is expected that two SAFER 4kV TGs will be connected to one of the two safeguard 4kV buses on each unit. By restoring a safeguard 4kV bus, power can be restored to the safeguard 480 VAC buses via the 4160/480 VAC transformers to power selected 480 VAC loads. A calculation (Reference 28) was performed demonstrating that two SAFER TGs will be capable of supplying the expected loads, i.e., 1988.8 kVA versus a capability of 2500 kVA. Before the TGs are connected to a bus, the bus is isolated by racking-out the supply and load breakers (References 42, 43, 44, and 45).

2.5 Containment Integrity

The PINGP containments consists of a free-standing low-leakage steel vessel, including its penetrations, isolation systems, and heat removal systems. The net free volume is 1.32E6 cubic feet with maximum design limits of 60.7 psia and 268°F.

During an ELAP event, containment pressure and temperature could increase due to the mass and energy release into containment from the RCP seal leakage.

PINGP has installed Flowserve N-9000 seal package on the RCPs. These seals significantly reduce the leakage into containment during an ELAP event. As a consequence, pressure and temperature remain below the containment design values for several days. This ensures that containment and essential instrumentation remains functional during an ELAP event. The analysis described in Section 2.5.6 below shows there is sufficient time to restore safeguards power from the SAFER 4kV TGs and restore active containment cooling (i.e., Phase 3).

NOTE: The containment integrity strategy descriptions below are the same for both of the two PINGP units.

2.5.1 Phase 1 Strategy

The Phase 1 coping strategy for containment involves verifying containment isolation as required and monitoring containment pressure using installed instrumentation.

2.5.2 Phase 2 Strategy

The Phase 2 coping strategy for containment involves verifying containment isolation as required and monitoring containment pressure using installed instrumentation. A phase 2 activity to repower instrumentation (via repowering a battery charger) ensures that the essential containment pressure instrumentation remains available.

2.5.3 Phase 3 Strategy

The Phase 3 coping strategy for containment involves restoring at least one Containment Fan Coil Unit (FCU).

The NSRC will supply two 1,000 kW 4kV portable TGs for each unit. These TGs will be used to repower one of the two safeguard 4kV buses on each unit. By restoring a safeguard 4kV bus, power can be restored to the safeguard 480 VAC buses via the 4160/480 VAC transformers. Once a 480 VAC bus has been repowered, one of the FCU fans may be restarted. Cooling Water to the containment FCU would be supplied from the installed DDCLP.

2.5.4 Structures, Systems, and Components

Cooling Water
Refer to Section 2.3.4 for a discussion on the robustness of the CL system and DDCLP.

Containment Fan Coil Units
The Containment FCUs, ducting, and associated FCU Cooling Water valves are safety related components. All FCU related equipment is located within the Design Class 1 Containment Building or Design Class 1 portion of the Auxiliary Building. Therefore, the equipment is protected from all applicable external events.

Safeguard 4kV and 480 VAC Distribution System
The primary and alternate connection points for the SAFER 4kV TGs are located within the Design Class 1 portions of the Turbine Building and D5/D6 Building. The safeguard electrical distribution system is also located within the Design Class 1 portions of the Turbine Building, D5/D6 building, and Auxiliary Building. Therefore, the equipment is protected from all applicable external events.

2.5.5 Key Containment Parameters

Instrumentation providing the following key parameter(s) is credited for all phases of the Containment Integrity strategy:

- Containment Pressure: Containment pressure indication is available in the main control room throughout the event.

2.5.6 Thermal - Hydraulic Analyses

A containment analysis (Reference 29) for a postulated ELAP event was performed using the CONTEMPT-LT/028 computer code. The analysis models the mass and energy from a full power condition with a complete loss of offsite power and accounts for sensible heat addition from the SGs, pressurizer, reactor vessel, and piping. The mass and energy into containment was modeled as 2.625 gpm per RCP for seal leakage and 1.0 gpm for unidentified RCS leakage. These leakage rates were conservatively held constant for the first 75 hours of the event, i.e., no credit was taken for decease in leakage rates as the RCS is depressurized. At 75 hours into the event, the seal leakage was increased 1.7 gpm per RCP. The analysis also modeled the restoration of a single containment FCU at 75 hours into the event, i.e., containment cooling restored as a Phase 3 activity.

The analysis showed a maximum containment pressure of 35.6 psia and temperature of 218°F occurred at 75 hours. These values are below the containment design limits of 60.7 psia and 268°F. Therefore it is expected that the instrumentation in containment will remain functional. After containment cooling was restored via the FCU, containment pressure and temperature decreased.

2.5.7 FLEX Pump and Water Supplies

The containment coping strategies do not credit a FLEX pump. The water for cooling the containment FCU during Phase 3 is supplied by the installed DDCLP.

2.5.8 Electrical Analysis

4kV SAFER Turbine Generators for Phase 3
It is expected that two SAFER 4kV TGs will be connected to one of the two safeguard 4kV buses on each unit. By restoring a safeguard 4kV bus, power can be restored to the safeguard 480 VAC buses via the 4160/480 VAC transformers to power selected 480 VAC loads. A calculation (Reference 28) was performed demonstrating that two SAFER TGs will be capable of supplying the expected loads, i.e., 1988.8 kVA versus a capability of 2500 kVA. Before the TGs are connected to a bus, the bus is isolated by racking-out the supply and load breakers (References 42, 43, 44, and 45).

2.6 Characterization of External Hazards

2.6.1 Seismic

As described in PINGP USAR Sections 1.2.1 and 12.2, all systems, structures, and components designated Design Class I are designed so that there is no loss of function in the event of the Design Basis Earthquake acting in the horizontal (0.12g) and vertical (0.08g) directions simultaneously. The response spectra are given on Plate 4.6 in USAR Appendix E.

The results of the seismic hazard reevaluations required by the 10 CFR 50.54(f) letter (Reference 16) were submitted to the NRC on March 27, 2014 (Reference 19). The conclusion of the reevaluation was that the current seismic design for the PINGP continues to provide a safety margin to withstand potential earthquakes exceeding the seismic design basis and no further evaluations were required for the PINGP. The NRC staff assessment for PINGP (Reference 20), confirmed that a seismic risk evaluation, a SFP evaluation, and a high frequency confirmation were not merited for PINGP.

2.6.2 External Flooding

As described in PINGP USAR Section 2.4.3.5, the current design bases flood for the PINGP is a flood on the Mississippi River. The flood is a relatively slow developing event, developing over several days with actions based on three-day forecasts of river water level. Finished site grade is at elevation 695 ft (above mean sea level (MSL), 1929 adjustment). Maximum predicted flood water level is 703.6 ft with wave run-up to elevation 706.7 ft. Site grade would be flooded for approximately 13 days. Based on flood analysis information in PINGP USAR Appendix F, access to the site could be flooded for up to approximately 20 days.

The main powerhouse structure consisting of the reactor buildings, the auxiliary and fuel handling building, the Turbine Building, the D5/D6 diesel generator building, and the pump section of the screenhouse structure are protected against the probable maximum flood of 703.6 ft. The top of the substructure and/or superstructure flood protection walls are at 705.0 ft, and are designed to resist the probable maximum flood. These structures are capable of withstanding the hydrostatic forces associated with the probable maximum flood and associated maximum wave run-up to 706.7 ft. Some water leakage would occur whenever wave action exceeds 705 ft on certain portions of the Turbine Building and Auxiliary Building walls. However, this leakage is expected to be minimal and easily managed by sump pumps.

See Section 2.19 for the ELAP mitigating strategy during a design basis flood.

A Flooding Hazard Reevaluation for PINGP, Units 1 and 2 (Reference 23), was submitted in response to the March 12, 2012, 10 CFR 50.54(f) letter (Reference 16). Reference 16 requested licensees provide information on the reevaluation of external flooding hazards using present day methodologies, data, and guidance. The reevaluation results were compared to the current design basis and were found to be bounded with the exception of flooding caused by Local Intense Precipitation (LIP). The LIP flood levels exceeded the finished floor elevation at several critical doors. However, only one door is not normally maintained closed. Based on this, it was determined a LIP could cause approximately 3,700 cubic feet of water to enter the Turbine Building for Unit 2. This is bounded by the internal flooding analysis for this area. No interim actions were deemed necessary in response to the reevaluated flood hazard.

2.6.3 Severe Storm with High Wind

The PINGP site is located at 92° 37.9' west longitude and 44° 37.3' north latitude.

PINGP USAR Section 12.2.1.3 describes the design bases wind loads as follows (Note that the tornado wind velocity exceeds that on Figure 7-2 of NEI 12-06, Rev.2):

- Wind speed for the PINGP site is 100 mph.
- Design bases tornado loadings are a pressure drop equal to 3 psi in 3 seconds, peripheral wind velocity of 300 mph with a forward progression of 60 mph.
- The design tornado driven missile was assumed equivalent to an airborne 4" x 12" x 12'0" plank travelling end-on at 300 mph, or a 4,000 lbs automobile

flying through the air at 50 mph and at not more than 25 feet above ground level.

- The tornado loading used in design of the D5/D6 Building consist of the following:
  - A lateral force caused by a funnel of wind having a rotational speed of 290 mph and maximum translation speed of 70 mph.
  - A pressure drop of 3.0 psi, the rate of pressure drop being 2.0 psi/sec.
  - The design tornado generated missiles as shown on USAR Table 12.2-43.

2.6.4 Ice, Snow, and Extreme cold

As described in PINGP USAR Section 12.2.1.3, the design basis for the PINGP snow load is 50 lbs per sq ft of horizontal projected area for structures and components exposed to snow. The PINGP USAR is not specific with regards to values for design for ice or cold. However, the extreme cold temperature recorded in the Twin Cities is -34°F based on temperature data available from the University of Minnesota (Reference 8).

As described in Section 2.3.4, access to the ultimate heat sink may be accomplished via Emergency Cooling Water Intake line. The top of the intake crib on this line is approximately 10 feet below normal river water elevation assuring that it would not be affected by surface ice. The presence of surface ice will preclude the formation of frazil ice that could impact access to the ultimate heat sink

2.6.5 High Temperatures

The PINGP USAR is not specific with regards to values for design for heat. However, the extreme hot temperature recorded in the Twin Cities is 108°F based on temperature data available from the University of Minnesota (Reference 8).

2.7 Protection of FLEX Equipment

The storage location for the portable FLEX equipment is the FLEX Storage Building. The FLEX Storage Building provides storage and protection for the portable FLEX equipment such that the equipment can be deployed following external events. The FLEX Storage Building is located within the PINGP Owner Controlled Area and outside the Protected Area (PA). It is southwest of the power block.

The FLEX Storage Building is designed to withstand the site-specific design basis loads for high wind hazards (including tornado and tornado missile loads), environmental conditions, and Safe Shutdown Earthquake in accordance with the provisions of NEI 12-06. The FLEX Storage Building is not designed to protect from the site design basis flood. Therefore, the PINGP FLEX strategy during a design basis flood, discussed in the Section 2.19, relies on the expected warning time and pre-deployment of SAFER equipment to the site prior to the site grade flooding.

The building is designed to withstand ambient temperatures from -34°F to 108°F. During extreme cold, the building will maintain a minimum temperature of 40°F using thermostatically controlled unit heaters. No mechanical cooling is provided since the building is designed to only store equipment and the FLEX equipment stored in the building was specified to operate between -40°F and 120°F.

The results of five sets of Cone Penetration Test performed for the FLEX building site were evaluated for liquefaction of the soil in accordance with the requirements of NRC Regulatory Guide (RG) 1.198 for the station's Safe Shutdown Earthquake (Reference 37). Based on the results of the calculation it is concluded that the FLEX Storage Building site is not susceptible to liquefaction.

An evaluation of the components stored in the FLEX Storage Building has been performed to determine appropriate measures to prevent seismic interaction. Non-seismic components within the FLEX Storage Building attached to the ceiling or walls whose failure could result in damage to equipment required for deployment after an event are seismically supported. This includes, but is not limited to, the security camera, fire suppression system, lights, and ventilation equipment. The evaluation also showed that the FLEX equipment and trailers would not fall over (tip over or overturn) nor slide when subjected to the seismic accelerations at PINGP.

The debris removal equipment required to support the implementation of the FLEX strategies is also stored inside the FLEX Storage Building. Therefore, the debris removal equipment is protected from the applicable external hazards and will remain functional and deployable. This debris removal equipment includes a D8 Caterpillar dozer and miscellaneous equipment such as cutters, chain saws, and pry bars.

Deployment of the debris removal equipment and the Phase 2 FLEX equipment from the FLEX Storage Building is not dependent on offsite power. The building equipment doors may be opened manually.

2.8 Planned Deployment of FLEX Equipment

2.8.1 Haul Paths

There are multiple external deployment routes from the FLEX Storage Building to the equipment staging areas inside the PA (Figure 8). One of the paths is through the Southwest Security Gate (this gate does not require power to be opened), which is used for transport of dry casks from PA to the dry cask storage pad. Other deployment paths into the PA are available in addition to this path.

Seismological investigations provide high confidence that the deployment paths are not subject to liquefaction. Therefore, deployment route damage as a result of potential soil liquefaction is expected to be minimal. Repairs to deployment paths can be made by the equipment that is stored in the FLEX Storage Building.

The debris removal and deployment equipment (e.g., D8 Caterpillar dozer, F-450 truck, and F-550 truck with plow) is stored in the FLEX Storage Building. Therefore, the equipment is protected from external events and will be available to clear a path from the FLEX Storage Building to the deployment locations.

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. Delivery of this equipment can be through airlift (e.g., helicopters), or via ground transportation. Debris removal for the pathway between the site and the NSRC receiving Staging Area locations and from the various plant access routes may be required. The same debris removal equipment used for onsite pathways may also be used to support debris removal to facilitate road access to the site once necessary haul routes and transport pathways onsite are clear.

2.8.2 Accessibility

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 initial 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 high energy line break. As barriers, these doors and gates are typically administratively controlled to maintain their function as barriers during normal operations. Following a BDBEE and subsequent ELAP event, FLEX coping strategies require the routing of hoses and cables through various barriers in order to connect FLEX equipment to station fluid and electric systems at connection points within seismically robust structures. For this reason, certain barriers (gates and doors) will be opened and remain open. This violation of normal administrative controls is acknowledged and is acceptable during the implementation of FLEX coping strategies.

Security doors and gates that rely on electric power to operate opening and/or locking mechanisms will be opened using keys that are provided to duty operations personnel. Extra keys are also located within the control room. The Security force will initiate an access contingency upon loss of power as part of the Security Plan.

2.9 Deployment of Strategies

2.9.1 AFW Makeup Strategy

The credited makeup supply to the TDAFWP is the installed DDCLP. The suction supply to the DDCLP is from a safeguards bay inside the Plant Screenhouse that is supplied from the Mississippi River through the normal intake or from a dedicated Emergency Cooling Water intake line. As described in the PINGP USAR, the Emergency Cooling Water Intake provides water to maintain safe shutdown for both units after a DBE. The fuel oil supply to the DDCLPs is supplied from the associated FODT. The FODT contains sufficient fuel oil to support approximately eight hours of DDCLP operation. Within this eight hour period, a portable 480 VAC FLEX diesel generator will be deployed to repower a MCC in the Plant Screenhouse. This MCC supplies power to a fuel oil transfer pump that will automatically refill the associated FODT from the associated FOST.

The deployment of the 480 VAC FLEX diesel generator involves transporting the generator from the FLEX Storage Building to a location near the Screenhouse (Figure 5). The preferable location is between the Screenhouse and the Turbine Building. Cables are then connected to the generator and the FLEX power receptacle located near the MCC. The MCC and receptacle are located within the Design Class 1 (i.e., robust) portion of the Screenhouse. In order to access the connection point from the FLEX diesel generator, the cabling will be routed through part of the Screenhouse that is not designed for Class I loads. However, the structural steel framing main load carrying members of this portion of the Screenhouse are Design Class I* and are analyzed for the DBE Condition. Debris removal equipment will be available to clear debris in the Screenhouse to facilitate access.

As a backup AFW supply, a portable FLEX SG/SFP makeup pump may be connected to either of the FLEX connection points installed downstream of each MDAFWP. A FLEX submersible pump provides the required lift to supply the suction of the SG/SFP makeup pump. The submersible pump will deployed from the FLEX Storage Building to a location near the selected water source (Figure 6). The preferable location is near the Intake Canal adjacent to the Screenhouse, or through a manhole inside the Screenhouse to provide communication with the water source from the Emergency Intake Bay. A third location would be the discharge basin. Similarly the SG/SFP makeup pump will be deployed to a location outside one of the Turbine Building roll-up doors (either the East or West roll-up door). Hoses will be connected from the submersible pump to the SG/SFP makeup pump. From the SG/SFP makeup pump, hoses will be routed to the Design Class 1 AFW pump room where it will be connected to one of the FLEX connection points located down stream of either MDAFWP.

Deployment of the hoses to the FLEX connection point requires access in areas of the Turbine Building. The Turbine Building main frame is designed as a Class I* steel structure that is designed for DBE loads. Therefore, the Turbine Building itself will not collapse in a seismic event. Other portions of the Turbine Building have also been analyzed for DBE loads (i.e., portions of the concrete floors). The remaining internal areas of the Turbine Building structure are classified as Design Class III*, which meets Uniform Building Code (UBC) Zone 1 seismic requirements of 0.05g. Thus, the design includes some level of seismic capability but less than the DBE, and therefore, does not meet the NEI 12-06 definition of a "robust structure". However, there are multiple deployment paths in the Turbine Building to each connection point. The paths are spatially diverse. In areas where a seismically robust path does not exist, there is a path that is adjacent to the exterior wall of the Class I structure.

As stated above, Class I structures are seismically robust and capable of withstanding the DBE condition. The Class I design provides protection against failure of the wall, which in turn lessens the potential debris in the areas that are adjacent to the exterior of the Class I walls. It is judged there is also a likelihood that equipment attached to or running through the Class I wall will remain intact during and after a seismic event, further lessening the potential debris in the areas adjacent to the exterior of the wall. The use of a path that is adjacent to the exterior wall of a Class I structure, along with diverse pathways, provides reasonable assurance that the cables and hoses can be deployed.

Due to the mixed classification of the Turbine Building, none of the multiple deployment paths through the Turbine Building are fully compliant with the NEI 12-06 definition of a "robust" structure, and therefore, are also not fully compliant with NEI 12-06, Section 5.3.2, Consideration 2. Based on not being fully compliant with the endorsed NEI 12-06 guidance, the deployment of hoses through the Turbine Building is treated as an alternative method of compliance with Order EA-12-049. Additional discussion regarding the alternative is provided in Section 2.20.1.

2.9.2 RCS Makeup Strategy

The credited RCS makeup strategy is to repower an installed charging pump on each unit. The deployment of the 480 VAC FLEX diesel generator to repower the charging pumps involves transporting the generator from the FLEX Storage Building to a location outside one of the Turbine Building roll-up doors (either the East or West roll-up door) or alternatively outside a Auxiliary Building roll-up door (either the East or West roll-up door) (Figure 5). Cables are then connected to the generator and a receptacle located near the MCC to be repowered. The MCC and receptacle are located within the Auxiliary Building, a Design Class 1 structure.

The preferred and shortest deployment route to the MCCs in the Auxiliary Building is through the Turbine Building. This route is along the exterior of a Class I structure (see Sections 2.9.1and 2.20.1 for discussion of robustness of routes through Turbine Building). Alternate paths exist to route the cables through either of the two Auxiliary Building roll-up doors in the Fuel Receipt area of the Auxiliary Building. The alternate paths are entirely through Class I* and Class I structures. The route through the Class I* area is relatively open and includes a small amount of potential debris sources. If necessary, any debris generated from the event can be moved or the cables deployed around the debris.

2.9.3 Spent Fuel Pool Makeup

The strategy for SFP makeup utilizes the same submersible and SG/SFP makeup pumps discussed in Section 2.9.1.

Deployment paths for hoses from the SG/SFP makeup pump to the SFP run through the Auxiliary Building Roll-Up Doors in the Fuel Receipt area of the Auxiliary Building. This area is a Class I* structure designed for DBE loads. The hoses are then routed up the stairs to the SFP or, alternatively, to the SFP skimmer connection. If for some reason these stairwells were not passable, another option would be to access the SFP area through the Class I and Class I* areas of the Auxiliary Building and route the hoses down through the drop area opening. The route through the Class I* area is relatively open and includes a small amount of potential debris sources.

2.9.4 Electrical Strategy

The strategy for maintaining power to essential instrumentation involves using the same 480 VAC FLEX diesel generator discussed in Section 2.9.1 to repower a battery charger on each unit. Cables are connected to the generator and a receptacle located near the MCC to be repowered. The MCC and receptacle are located within the Design Class 1 aisle of the Turbine Building.

There are three paths evaluated through the Turbine Building to the battery rooms. Each route traverses an area that has been analyzed for DBE loads with the exception of a small area near the battery room doors. This area of the deployment route is adjacent to the exterior wall of a Class I structure (see Sections 2.9.1and 2.20.1 for discussion of robustness of routes through Turbine Building), which lessens the potential debris sources for the pathway.

Due to the small area near the battery room doors not being analyzed for DBE loads, none of the multiple deployment paths through the Turbine Building to the battery rooms are fully compliant with the NEI 12-06 definition of a "robust" structure, and therefore, are also not fully compliant with NEI 12-06, Section 5.3.2, Consideration 2. Based on not being fully compliant with the endorsed NEI 12-06 guidance, the deployment of cables through the Turbine Building is treated as an alternative method of compliance with Order EA-12-049. Additional discussion regarding the alternative is provided in Section 2.20.1.

2.9.5 Fueling of Equipment

All FLEX equipment and support equipment with onboard fuel tanks are fueled while in standby so that the equipment is available without any required fueling at the initiation of the event. The fuel tanks on the major pieces of equipment have been specified to provide enough fuel to run for approximately 12 hours without refueling. The equipment tanks contain #1 diesel fuel to support startup operations during cold weather conditions.

The primary source for refueling the FLEX equipment during non-flood conditions is the Heating Boiler Fuel Oil Storage Tanks, if available. These tanks are below grade and have a nominal capacity of 35,000 gallons each. Access to the tanks is through manhole covers to the pits and then through manhole covers on the tanks. These tanks are non-safety related and are not documented as seismically robust. In the event that these tanks are not available, fuel will be extracted from the safety related (i.e., seismically robust, protected from high winds and associated missiles) Diesel Generator Oil Storage Tanks, for the EDGs D1 and D2. These four FOSTs are below grade and have a nominal capacity of 19,500 gallons each. Since the fuel consumption rate for all the Phase 2 diesel engines is approximately 75 gallons per hour (Reference 38), these tanks provide a sufficient supply to allow time to arrange replenishment from off-site sources. The access to these tanks is through manhole covers to the tank pits and then through the manhole covers on the tanks. Equipment is available to remove both sets of manhole covers. The fuel in these tanks is #2 diesel and provisions exist to add cold weather additives to the fuel that is extracted for refueling of FLEX equipment during cold weather. The diesel fuel in the fuel oil storage tanks is routinely sampled and tested to assure fuel quality is maintained to ASTM standards.

The strategies for delivery of the fuel to the FLEX equipment involves extracting the fuel from one of the tanks through a diesel driven pump and transferring it to a 264 gallon transportable container on the bed of a truck. The truck is then moved near the FLEX equipment and the fuel transferred to the fuel tank of the equipment through a separate transfer pump that is integral to the transportable container. Based on the maximum fuel consumption rate (i.e., 22.7 gal/hr for the 480 VAC portable generators) and refueling a minimum of 200 gallons, the frequency of refueling the equipment is greater than eight hours.

The FLEX equipment, transfer pumps, hoses, and equipment needed to extract the fuel from the storage tanks and transfer it to the FLEX equipment is stored in the FLEX Storage Building. Thus, this refueling equipment is protected from seismic events and high winds and associated missiles.

The plan for refueling the equipment during an ELAP that occurs during a design basis flood is discussed in Section 2.19.

2.9.6 Phase 3 4KV SAFER Turbine Generator Deployment

It is expected that during Phase 3 two SAFER 4kV TGs will be connected to one of the two safeguard 4kV buses on each unit to power selected 480 VAC loads.

The deployment of the SAFER 4kV Turbine Generators will be determined by the onsite Emergency Response Organization depending on conditions at the time. The anticipated deployment strategy (Figure 7) involves transporting the generator from the site designated staging area B (e.g., the ball field across the site entrance) to a location outside the Turbine Building West roll-up door and North of the Unit 1 Turbine Building. Cables are connected to the 4kV distribution panel and routed to the 4kV safeguard bus. However, if conditions warrant, the TGs could be connected to both safeguard buses on one unit (either Unit 1 or Unit 2) and the 4kV bus cross ties could be used to reenergized the other unit's safeguard buses.

2.9.7 Internal Flooding

The large non-robust internal water sources at PINGP are Condenser Hot Well, the Reactor Makeup Water Tanks, Lube Oil Reservoir, Heater Drain Tank, and the Backwash Storage and Receiving Tanks. These sources are located in the Turbine Building. The total volume of these tanks is less than the available volume of the condenser pit.

PINGP does not utilize dewatering systems to mitigate groundwater in-leakage.

Therefore, rupture of the internal non-robust tanks and the potential for ground water in-leakage will not affect the mitigating strategies.

2.10 Offsite Resources

2.10.1 National SAFER Response Center

The industry established two NSRCs that house backup equipment that may be used by the sites and additional equipment for long term recovery to support utilities needs during BDBEE events. One facility is located in Phoenix, Arizona, and the other is in Memphis, Tennessee. NSPM has established contracts with the Pooled Equipment Inventory Company (PEICo) to participate in the process for support of the NSRCs as required. Upon request, PEICo will provide one complete set of equipment listed in Section 2.10.2 from a NSRC to the PINGP site. In addition, the PINGP onsite FLEX equipment hose and cable end fittings are standardized or provided with transitions fittings to accommodate the equipment supplied from the NSRC.

In the event of a BDBEE and subsequent ELAP/LUHS condition, equipment will be moved from the NSRC to a local assembly area established by the SAFER team. NSRC equipment will begin arriving at the PINGP designated site staging locations within 24 hours from the initial request.

2.10.2 Equipment List

The equipment stored and maintained at the NSRC for transportation to the local assembly area to support the response to a BDBEE at PINGP is listed in Table 1.

2.11 Equipment Operating Conditions

2.11.1 Ventilation

During an ELAP event, ventilation providing cooling to occupied areas and areas containing FLEX strategy equipment will be lost. The primary concern with regard to loss of ventilation is the heat buildup that occurs when forced ventilation is lost in areas that continue to have heat loads. A loss of ventilation evaluation was performed to assess temperatures expected in specific areas related to FLEX implementation to ensure the environmental conditions remain acceptable for personnel habitability and remain within equipment qualification limits. The key areas identified for all phases of the FLEX strategies are the main control room, AFW pump room, battery room, and DDCLP room.

Main Control Room

A control room heatup calculation (Reference 31) with no forced cooling demonstrates that control room temperature would increase to 119°F in approximately 11.7 hours. The calculation demonstrates that opening the doors between the control room and Turbine Building at 11.7 hours initially reduces the temperature to 106F, after which the temperature slowly increases with time. The acceptance criterion in the calculation is 120°F with the limitations identified as the equipment in the control room. Steps performed early in the loss of all AC procedure 1[2]ECA-0.0 (Reference 40) instruct the operators to open the doors. Therefore, the action would be expected to be performed much earlier than the 11.7 hour time frame.

AFW Pump Room

The calculation for a loss of AFW pump room cooling shows that without cooling, the temperature in the rooms does not exceed 133°F (Reference 58). The heat load in the calculation is bounding for an ELAP event. Therefore, the equipment in the room will not be adversely impacted.

In addition to equipment capability, operator actions are required in the AFW pump rooms for an ELAP. To be conservative, doors will be opened, as necessary, between the AFW pump rooms and the Turbine Building in order to maintain room temperatures acceptable for personnel.

Battery Rooms
The calculation (Reference 30) for the battery rooms (which is where the batteries, chargers, and inverters are located) demonstrates that opening the doors between the battery rooms and the Turbine Building at approximately 18 hours maintains the temperature in the battery rooms less than the limiting value of 120°F. Steps performed early in the loss of all AC procedure 1[2]ECA-0.0 (Reference 40) instruct the operators to open the doors. Therefore, the action would be expected to be performed much earlier than the 18 hour time frame. This action will also provide sufficient natural circulation to prevent the hydrogen concentration from reaching the 4% flammability limit when the batteries are being charged from the portable generator (Reference 59).

For cold temperature conditions during Phase 1, the heat generated by equipment operation in the battery room was determined to be sufficient to ensure the batteries remain above the minimum temperature used in the battery depletion calculation (Reference 34), i.e., 60°F. During Phase 2, the instrument inverters are powered from a 480VAC FLEX diesel generator (via a battery charger) rather than the safeguard batteries. Therefore, no actions are required to maintain a minimum temperature in the battery rooms.

DDCLP Room
DDCLP Room temperature response with the ventilation system not functioning has been determined through testing. The testing was conducted over a 90 minute period and demonstrated that with outside ambient air temperature of approximately 85°F, the room temperature did not exceed 100°F. The temperature limit for the DDCLP Room is 135°F. Therefore, there is reasonable assurance that, even with elevated outside air temperatures, the temperature in the pump rooms will not reach unacceptable levels during Phase 1.

During Phase 2 operation, the portable diesel generator being used to repower the fuel oil transfer pump will also be used to repower the Screenhouse Roof Exhaust Fan for the DDCLP room.

2.11.2 Heat Tracing

Major components for FLEX strategies are provided with cold weather packages to protect the equipment from damage due to extreme cold weather and help assure equipment reliability. To prevent water hoses from freezing, the procedures (References 47, 48, and 49) provide instructions to maintain flow through the lines.

2.12 Habitability

Habitability was evaluated as discussed in Section 2.11.1 in conjunction with equipment operability and determined to be acceptable.

2.13 Lighting

Lighting is required for operator actions and access in the plant to implement actions associated with the procedures. Available lighting will be the battery backed Appendix R light units. These lights have an 8-hour capacity battery power supply and are located in areas having equipment needed to safely shut down the plant and along access routes to this equipment. In addition, portable lighting such as head lamps and flashlights will be available for personnel to use.

2.14 Communications

<u>On-site</u>

Dedicated sets of sound-powered phone headsets and cords are available for the implementation of the FLEX strategies between the main control room and areas which implement the FLEX strategies (e.g., TDAFWP room and near SG PORVs). The operation of this sound-powered phone subsystem is not dependent on the availability of the electric power system.

Indoor and outdoor locations where temporary FLEX equipment is used may also be served with private branch exchange (PBX) telephone system (as long as power is available) or sound-powered phone headsets connected with extension cords to nearby jacks. In addition, a portable 120/240 VAC diesel generator is used to repower the plant internal PBX telephone system. This allows use of the telephones inside the powerhouse for internal communications.

<u>Off-site</u>

PINGP's offsite communications has been enhanced with the installation of a Satellite phone system. The system consists of twenty-three (23) new satellite phones with docking stations that are contain uninterruptible power supplies and has been integrated into the PBX system. Four (4) of the phones were installed in the main control room, nine (9) in the Technical Support Center, seven (7) in the Emergency Operations Facility, and three (3) in the Operational Support Center. Some of these phones have been designated for Emergency Notification system, Health Physics Network, and offsite communication among the assigned Emergency Response Organization functions and roles.

2.15 Water Sources

2.15.1 Water Sources – Secondary Side

During an ELAP, the preferred water supply to the SGs is from the CSTs. There are three CSTs located at PINGP. The combined minimum useable volume is 100,000 gallons per operating unit per the plant Technical Specifications. Nominal volume of the CSTs is 150,000 gallons per tank. The CSTs are located on the east side of the Unit 1 Turbine Building (11 CST) and the west side of the Unit 2 Turbine Building (21 CST and 22 CST), and are approximately 400 feet apart. The CSTs are cross-connected, such that the water in the three CSTs is available to both units' TDAFWPs. The CSTs are not seismically designed. However, analyses have been performed that demonstrate there is reasonable assurance that the CSTs will be available following a seismic event (References 57 and 60). All tanks are located such that substantial portions of the tanks are protected from tornado missiles by Class I structures.

If the CSTs are not available, the CL system (safety related system) would provide water from the Mississippi River to the TDAFWPs. In an ELAP event, the CL system is supplied from one of the two DDCLP. Each DDCLP has its own dedicated diesel engine and does not rely on AC power. The speed of the DDCLP is reduced within two hours, to ensure its associated FODT contains sufficient fuel oil to support approximately eight hours of DDCLP operation. The suction supply to the DDCLP is from a safeguards bay inside the Plant Screenhouse that is supplied from the normal intake or from a dedicated Emergency Cooling Water Intake Line. As described in PINGP USAR Section 10.4.1.2.2, the Emergency Cooling Water Intake Line provides water to maintain safe shutdown for both units after a DBE. This intake is a 36 inch pipe buried approximately 40 feet below the Circulating Water Intake Canal water level in nonliquefiable soil, connecting the screenwell to a submerged intake crib in a branch channel of the Mississippi River. This Emergency Cooling Water Intake Line is a Class I structure as is the Approach Canal that supplies its intake crib from the main channel of the Mississippi River. If the Emergency Cooling Water Intake Line is the only source of water available to the DDCLPs, operator actions are necessary to reduce the system demand to within the capacity of the line. Operators would initiate actions to reduce CL system flow demand based on decreasing bay water level. As described in PINGP USAR Section 10.4.1.2.2, there are 3.3 hours available to perform these actions.

As a backup to the TDAFWP, the capability to connect a portable diesel driven pump (i.e., the SG/SFP makeup pump) has been installed. The water source for this portable diesel driven pump is the Mississippi River via the intake canal or intake bay.

2.15.2 Water Sources – Primary Side

The credited source of water for RCS makeup is the RWST. PINGP has one RWST tank per unit. These tanks contain a minimum of 265,000 gallons of borated water at a minimum concentration of 2600 ppm.

2.15.3 Water Sources – Spent Fuel Pool

The credited makeup source to the SFP during an ELAP is the same portable diesel driven pump (i.e., the SG/SFP makeup pump) that is used as a backup to the TDAFWP. The water source for this portable diesel driven pump is the Mississippi River via the intake canal or intake bay.

2.16 Shutdown and Refueling Modes Analysis

PINGP is abiding by the NEI position paper entitled "Shutdown/Refueling Modes," dated September 18, 2013, addressing mitigation strategies in shutdown and refueling modes (Reference 21). This position paper has been endorsed by the NRC staff (Reference 22). The guidance in the position paper has been incorporated into Section 3.2.3 of NEI 12-06 (Reference 3).

PINGP has enhanced its shutdown risk process by including ELAP functions in its Shutdown Safety Assessment process. These enhancements ensure that contingency plans will be developed if the outage work places the plant in a configuration that would impact the mitigating strategies. In addition, the availability of FLEX equipment during Modes 5 and 6 is maintained the same as when the units are operating at full power, i.e., as described in Section 2.18.7. The mitigating strategies described below do not call for the pre-deployment/pre-staging of FLEX equipment.

The core cooling and RCS inventory strategies in Modes 5 and 6 are dependent upon the RCS/SG configuration. When the RCS is intact, at least one SG will be maintained available and the strategies described in Section 2.3 will be effective in mitigating an ELAP event. When the RCS is not intact (but the reactor vessel head is on) core cooling (and RCS inventory) will initially be maintained by gravity feed from the robust RWST through the Safety Related Residual Heat Removal (RHR) train that was aligned for shutdown cooling. Prior to losing the ability to provide makeup/cooling via gravity feed, a charging pump will be repowered from one of the two connection points as described in Section 2.3. Under ELAP conditions while in Modes 5 and 6, a charging pump is capable of delivering sufficient borated water from the RWST for long term decay heat removal. When the reactor vessel head has been removed, core cooling is accomplished by maintaining the refueling cavity level. Makeup to the cavity will be from the SFP.

The strategies for maintaining SFP cooling and inventory are the same as those described in Section 2.4.

The strategy for maintaining containment integrity is dependent upon the configuration of the RCS. If the RCS is intact (or is capable of being made intact), the strategies for maintaining containment integrity are the same as those described in Section 2.5. If the RCS is not intact, containment is protected from over pressurization by opening either the Maintenance Airlock doors or the Personnel Airlock doors when an ELAP is declared.

2.17 Sequence of Events

Table 2 presents a Sequence of Events Timeline for an ELAP/LUHS event from full power at PINGP.

The projected start and completion times provided in Table 2 are based on the table top exercise that was performed as part of the staffing assessment discussed in Section 2.18.3. Time to clear debris external to the buildings to allow equipment deployment is assumed to be 2 hours. This time is considered to be reasonable based on site reviews and the location of the of the FLEX Storage Building. Debris removal equipment is stored in the FLEX Storage Building as previously discussed in Section 2.8. Additional time is allocated for the clearing of debris within the buildings to allow deployment of hoses and cables.

Validation of each of the FLEX time constraint actions has been completed in accordance with the FLEX Validation Process in NEI 12-06.

2.18 Programmatic Elements

2.18.1 Overall Program Document

The FLEX Program Document provides a description of the Diverse and Flexible Coping Strategies Program for PINGP. 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, and
- The basis for the ongoing maintenance and testing programs chosen for the FLEX equipment.

In addition, the program description includes a list of the FLEX basis documents that will be kept up to date for facility and procedure changes.

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

Future changes to the FLEX strategies may be made without prior NRC approval provided:

a) The revised FLEX strategy meets
   i) the provision of NEI 12-06, or
   ii) the change to the strategies and guidance implement an alternative or exception approved by the NRC, provided that the bases of the NRC approval are applicable to the PINGP, or
   iii) an evaluation demonstrates that the provisions of Order EA-12-049 continue to be met.

b) 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 function) are met.

2.18.2 Procedural Guidance

The inability to predict actual plant conditions that require the use of FLEX equipment makes it impossible to provide specific procedural guidance. As such, the FSGs 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 AOPs strategies, the EOP or AOP directs the entry into and exit from the appropriate FSG procedure.

FSGs have been developed in accordance with PWROG guidelines. The FSGs provide instructions for implementing available, pre-planned FLEX strategies to accomplish specific tasks in the EOPs or AOPs. FSGs are used to supplement (not replace) the existing procedure structure that establishes command and control for the event.

Procedural interfaces have been incorporated into the loss of AC power EOP to include appropriate kick-outs to FSGs to implement the mitigating strategies. The loss of AC power EOP 1[2]ECA-0.0 (Reference 40) will remain the controlling procedure for an ELAP event.

FSGs have been reviewed and validated by the involved groups to the extent practical to ensure that implementation of the associated FLEX strategy is feasible. Specific FSG validation was accomplished via table top evaluations and walk-throughs of the guidelines when appropriate.

2.18.3 Staffing

Using the methodology of NEI 12-01, *Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities* (Reference 25), an assessment of the capability of the PINGP on-shift staff and augmented Emergency Response Organization to respond to a BDBEE was performed. The results of the Phase 2 Staffing Assessment were submitted to the NRC on May 28, 2015 (Reference 26).

The NRC staff reviewed the May 28, 2015 submittal and confirmed that the existing emergency response resources, as described in the emergency plan, are sufficient to perform the required plant actions and emergency plan functions, and implement the multi-unit event response strategies that were developed in response to Order EA-12-049 without the assignment of collateral duties that would impact the performance of assigned emergency plan functions (Reference 24).

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

- an extended loss of AC power
- an extended loss of normal access to ultimate heat sink
- impact on both units (both units are 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 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, Training, Radiation Protection, Chemistry, Security, Emergency Planning, and the FLEX Project Team performed a tabletop exercise in March of 2015. The participants reviewed the assumptions and applied existing procedural guidance, including applicable draft FSGs for coping with a BDBEE using minimum on-shift staffing. Particular attention was given to the sequence and timing of each procedural step, its duration, and the on-shift individual performing the step to account for both the task and the estimated time to prepare for and perform the task.

The Phase 2 Staffing Assessment concluded that no conflicts or overlaps in functions or tasks required to be performed by on-shift operations and support personnel were identified. Additionally, the staffing assessment demonstrated that all plant specific time constrained actions were met. Therefore, the existing on-shift staff structure and size as described in the PINGP Emergency Plan are sufficient to carry out the FLEX mitigating strategies for the most resource limiting BDBEE situations. No additional resources need to be added to the PINGP minimum on-shift staffing requirements and no changes need to be made to the PINGP Emergency Plan based on this Phase 2 Staffing Assessment.

2.18.4 Training

NSPM'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 a graded approach to Systematic Approach to Training process.

Initial training has been provided and periodic training will be provided to site emergency response leaders on BDBEE 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, instructions, and mitigating strategy time constraints.

Per ANSI/ANS 3.5, Nuclear Power Plant Simulators for use in Operator Training (Reference 15), 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 necessary for the implementation of the FLEX strategies in response to a BDBEE and stored in the PINGP FLEX Storage Building is listed in Table 3. Table 3 identifies the equipment, the quantity, and capacity/rating for the major FLEX equipment components only. Specific details regarding fittings, tools, hoses, cables, consumable supplies, debris removal equipment, etc., are not provided in Table 3.

2.18.6 N+1 Equipment Requirement

NEI 12-06 invokes an N+1 provision for the major FLEX equipment that directly performs a FLEX mitigation strategy for core cooling, containment, or SFP cooling in order to assure reliability and availability of the FLEX equipment required to meet the FLEX strategies. Sufficient equipment has been purchased to address all functions at both units on-site, plus one additional spare, i.e., an N+1 capability, where "N" is the number of equipment required by FLEX strategies for all units on-site. Therefore, where two resources are sized to support the required functions of both units a third resource has been purchased to meet the N+1 capability. Table 3 identifies the number of components needed to satisfy the N and N+1 provision for each major FLEX component.

The PINGP FLEX strategies for portable power supplies is different than that outlined in NEI 12-06 in that the sets are not divided by unit, but rather are divided by functions across both units. Therefore, the number of 480 VAC portable generators needed to satisfy the N+1 provision is considered an alternative method for complying with Order EA-12-049. Additional discussion regarding the alternative is provided in Section 2.20.2.

The N+1 provision for hoses and cables is satisfied by providing additional hose and cable equivalent to at least 10% of the total length of each type/size of hose or cable necessary for the "N" capability. For each type/size of hose or cable needed for the "N" capability, at least 1 spare of the longest single section/length is provided. Table 3 identifies the length of cables or hoses needed to satisfy the N and N+1 provision.

Other FLEX support equipment provided for mitigation of BDBEE, but not directly supporting a credited FLEX strategy for maintaining a key safety function, is not required to have N+1 capability. However, these items are covered by procedures that subject them to inventory checks, requirements, and any maintenance and testing that are needed to ensure they can perform their required functions.

2.18.7 Equipment Maintenance and Testing

Initial Component Level Testing, consisting of Factory Acceptance Testing and Site Acceptance Testing, was conducted to ensure the portable FLEX equipment can perform its required FLEX strategy design functions. Factory Acceptance Testing verified that the portable equipment performance conformed to the manufacturers rating for the equipment as specified in the Purchase Order. Verification of the vendor test documentation was performed as part of the receipt inspection process for each of the affected pieces of equipment and included in the applicable Vendor Technical Manuals. Site Acceptance Testing confirmed portable equipment delivered to the site functioned and was not damaged in transport to the site.

The portable BDBEE equipment that directly performs a FLEX mitigation strategy for the core cooling, containment, or SFP cooling is subject to periodic maintenance and testing in accordance with the provisions in NEI 12-06 and Institute of Nuclear Power Operations (INPO) AP 913, *Equipment Reliability Process Description* (Reference 9). Additional FLEX support equipment that requires maintenance and testing will have Preventive Maintenance (PM) to ensure it will perform its required functions during a BDBEE.

The PM Templates include activities such as:

- Periodic Static Inspections
- Fluid analysis
- Periodic operational verifications
- Periodic performance tests

PM procedures and test procedures are based on the templates contained within the Electric Power Research Institute (EPRI) Preventive Maintenance Basis Database. Manufacturer provided information/recommendations was used when templates were not available from EPRI. The corresponding maintenance strategies were developed and documented. The performance of the PMs and test procedures are controlled through the site work order process. FLEX support equipment not falling under the scope of INPO AP 913 will be maintained as necessary to ensure continued reliability. Performance verification testing of FLEX equipment is scheduled and performed as part of the PINGP PM process.

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

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

2.19 Flood Strategy

As discussed in the Unit 2 Compliance Letter (Reference 32), the strategy to mitigate an ELAP during a design basis flood involves using the SAFER 4kV TGs and the equipment associated with operation of the generators to repower installed equipment. The SAFER equipment would be requested in time to ensure delivery to the PINGP site staging area prior to the site access road flooding. The SAFER 4kV TGs and associated equipment would be moved to the Turbine Building deck prior to the site grade flooding. The site's flood procedure AB-4 (Reference 50) places both units in Cold Shutdown prior to flooding of the site grade. If an ELAP occurs during the design basis flood, the RCS and SGs would heat-up and natural circulation would develop. Decay heat removal would be through the SGs with makeup from the TDAWFP supplied from the CSTs. Two of the SAFER 4kV TGs would be used to repower a safeguards bus on each unit. The two remaining TGs are available as spares for redundancy and defense-in-depth. Once the safeguards bus is repowered, one train of installed plant equipment (e.g., component cooling, residual heat removal, charging, SFP cooling, containment FCUs, fuel oil transfer) will be available for normal shut down operations. This effectively returns the operation of systems to within their design basis during a design basis flood. Cooling water needed to remove heat from the component cooling systems and containment FCU would be supplied by the DDCLP. The strategy does not require the use of the PINGP FLEX portable pumps or 480 VAC generators. However, PINGP fuel oil transfer equipment and the 4kV TG exhaust ducting stored in the FLEX building would be used.

All connection points for the SAFER 4kV TGs are located within the flood protected area. No connection points require permanent modification to accommodate this FLEX strategy. However, connecting the SAFER 4kV TGs directly to the safeguards bus does require reconfiguring the bus (e.g., removing current transformers, replacing portions of the bus bars, and attaching mounting blocks). Reconfiguring the bus for this connection is incorporated into the FSG. Additional resources will be on site to perform this work based on the procedural preparations in place for a flood. A total of four connection points (two per unit) are available to connect the SAFER 4kV TGs to each of the safeguards buses, thus providing multiple ways to repower a train of installed equipment. The safeguard buses include unit cross-ties further enhancing flexibility and reliability.

Diesel fuel will be supplied from the safety related Unit 1 EDG day tanks to the fuel cubes for the SAFER 4kV TGs located on the Turbine Building deck. The diesel fuel will be transferred from the day tanks by portable fuel oil transfer pumps. The fuel oil transfer pumps will be located within the flood protected area of the Turbine Building. A check valve off the Unit 1 EDG day tanks will be reconfigured during the ELAP to provide connection to the fuel transfer pumps. Once the 4kV safeguards buses are repowered, the installed fuel transfer pumps will be repowered and fuel will be transferred from the Unit 1, safety related FOSTs to the Unit 1 EDG day tanks to provide fuel for continuous operation.

The site's flood procedure AB-4 (Reference 50) contains provisions to maintain all safeguards fuel oil storage tanks full until the access road becomes impassable. Prior to the bulkheads installation, the flood procedure calls for provision to be made for entry into the Power Block and Screenhouse, e.g., scaffolding, moving the circulating water pump equipment hatch on the Screenhouse roof.

The flood strategy relies on offsite SAFER equipment to repower the installed plant equipment and does not rely on the majority of the PINGP portable onsite FLEX equipment. Based on repowering of installed equipment, no portable pumps are used for SG and SFP makeup. Additionally, the strategy requires reconfiguration of the primary connection to repower the installed equipment through the safeguards bus. The repowered installed plant equipment will maintain the functions of core cooling, SFP cooling, and containment integrity. Therefore, the strategy meets the Order requirements. However, the strategy is considered an alternative to NEI 12-06, Section 3.2.2, from the standpoint of meeting the baseline capabilities. Additional discussion regarding the alternative is provided in Section 2.20.3.

2.20 Alternate Methods of Compliance with Order EA-12-049

2.20.1 Turbine Building Deployment Paths

NEI 12-06, Section 5.3.2, identifies the considerations for the deployment of FLEX equipment following a seismic event. Consideration 2 states:

> "At least one connection point of FLEX equipment will only require access through seismically robust structures. This includes both the connection point and any areas that plant operators will have to access to deploy or control the capability."

NEI 12-06 further defines "robust" as:

> "the design of an SSC either meets the current plant design basis for the applicable external hazard(s) or the current NRC design guidance for the applicable hazard (e.g., Regulatory Guide 1.76, Revision 1); or has been shown by analysis or test to meet or exceed the current design basis."

Based on the mixed classification of the Turbine Building described in Section 2.9.1 and 2.9.4, the mitigating strategies (deployment paths for FLEX equipment, cables and hoses) require access to areas of the Turbine Building that do not meet the above definition of robust and are not in full compliance with NEI 12-06, Section 5.3.2, Consideration 2. Therefore, the deployment paths internal to the Turbine Building are being treated as an alternative method of compliance to NEI 12-06, Section 5.3.2, Consideration 2. Based on the robust design of the main structures, the multiple and spatially diverse deployment paths, the use of paths that are adjacent to the exterior wall of the Class I structure, and the debris removal equipment available for clearing the path in these internal structures, sufficient access and timely deployment are ensured for the hoses and cables for Phase 2 portable equipment following a seismic event (Reference 61).

2.20.2 N+1 Requirement for the 480 VAC Generators

NEI 12-06, Section 3.2.2, contains the provision that a site should have sufficient equipment to address all functions at all units onsite plus one additional spare and states that a two-unit site would nominally have at least three sets of portable AC/DC power supplies (i.e., N+1 = 3). NEI 12-06 also provides that it is acceptable to have a single resource that is sized to support the required functions for multiple units at a site with the example of a single pump capable of providing all water supply functions for a dual unit site. The PINGP FLEX strategies for portable power supplies is different than that outlined in NEI 12-06 in that the sets are not divided by unit, but rather are divided by functions across both units. The PINGP FLEX strategy for portable power supplies is considered an alternative method for complying with Order EA-12-049.

The strategy requires two 480 VAC generators that are each capable of supplying either:

1. the battery rooms and Screenhouse MCCs for both units or
2. the charging pumps for both units.

Since the generators are identical in capacity, a total of two generators is sufficient to address all functions for all units and three generators are sufficient to meet the N+1 criteria.

2.20.3 Mitigating Strategy During a Design Basis Flood

NEI 12-06, Section 3.2.2, contains the provision that each Pressurized Water Reactor (PWR) plant will establish capabilities consistent with NEI 12-06, Table 3-2. In the flood strategy, the Safety Functions of Table 3-2, and Tables D-1, D-2 and D-3 (of NEI 12-06), will be provided by installed equipment rather than the portable PINGP FLEX equipment for the design basis flood ELAP mitigating strategy. In addition, NEI 12-06, Section 3.2.2, states that at a minimum, the primary connection point should be an installed connection suitable for both the on-site and off-site equipment. In the flood strategy, the connection of the SAFER 4kV TGs to any of the safeguards buses requires reconfiguration of the bus (e.g., removing current transformers, replacing portions of the bus bars, and attaching mounting blocks). Therefore, this strategy is an alternate to the NEI 12-06 guidance. However, the strategy meets the Order EA-12-049 requirements in that:

- Based on the flood condition, there will be a sufficient amount of time to plan to have adequate resources on site for the bus reconfiguration.
- Reconfiguration of the safeguards bus and connecting of the SAFER 4kV TGs, can be completed in time to supply power to the safeguards buses prior to the depletion of the safeguards batteries.
- The repowered installed plant equipment maintains the functions of core cooling, SFP cooling, and containment integrity.

3.0 References

1. SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," July 12, 2011 (ML11186A950)

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

3. NEI 12-06, Revision 2, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Nuclear Energy Institute, December 2015

4. NRC Interim Staff Guidance JLD-ISG-2012-01, Revision 1, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," January 22, 2016 (ML15357A163)

5. NRC Order Number EA-12-051, "Issuance of Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," March 12, 2012 (ML12054A682)

6. NEI 12-02, Revision 1, "Industry Guidance for Compliance with NRC Order EA-12- 051, 'To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation'," Nuclear Energy Institute, August 2012

7. NRC Interim Staff Guidance JLD-ISG-2012-03, Revision 0, "Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation," August 29, 2012 (ML12221A339)

8. University of Minnesota (http://climate.umn.edu/) via link to Twin Cities Climate Data/Al-Time Records/Twin Cites Extreme Temperatures and Temperature Streaks
http://files.dnr.state.mn.us/natural_resources/climate/twin_cities/alltimet.html

9. INPO AP 913, Revision 4, "Equipment Reliability Process Description," October, 2013

10. NSPM Letter (L-PI-16-001) to NRC, "Notification of Compliance with NRC Order EA-12-049, 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,' Prairie Island Nuclear Generating Plant Unit 2 (TAC No. MF0835)," January 14, 2016 (ADAMS Accession Nos. ML16014A754, ML16014A755, and ML16014A756)

11. PWROG-14027-P, Revision 3, "No. 1 Seal Flow Rate for Westinghouse Reactor Coolant Pumps Following Loss of All AC Power, Task 3: Evaluation of Revised Seal Flow Rate on Time to Enter Reflux Cooling and Time at Which the Core Uncovers," April 2015

12. PWROG-14064-P, Revision 0, "Application of NOTRUMP Code Results for Westinghouse Designed PWRs in Extended Loss of AC Power Circumstances," September 2014

13. PWROG, OG-15-313, "PWR Owners Group Transmittal for Information Only: Flowserve White Paper on the Response for the N-Seal Reactor Coolant Pump (RCP) Seal Package to Extended Loss of AC Power (ELAP), Revision A, dated August 3, 2015," August 5, 2015 (ML15222A356 (proprietary) and ML15222A357 (non-proprietary))

14. Letter to Mr. J. Stringfellow (PWROG) from Mr. J. R. Davis (NRC), "Letter to the PWROG Regarding Endorsement of Flowserve N-Seal Reactor Coolant Pump Seal White Paper for ELAP Applications," November 12, 2015, (ML15310A094)

15. ANSI/ANS 3.5-2009, "Nuclear Power Plant Simulators for use in Operator Training and Examination"

16. U.S. Nuclear Regulatory Commission Letter to All Power Reactor Licensees, "Request for Information Pursuant to Title 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 Daiichi Accident," March 12, 2012, (ML12053A340)

17. Letter to Mr. Jack R. Davis (NRC) from Mr. Nicholas Pappas (NEI), "EA-12-049 Mitigating Strategies Resolution of Extended Battery Duty Cycles Generic Concern, August 27, 2013 (ML13241A186)

18. Prairie Island Updated Safety Analysis Report, Revision 34

19. NSPM letter (L-PI-14-028) to NRC, "PINGP 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," March 27, 2014 (ML14086A628)

20. NRC Letter to NSPM, "Prairie Island Nuclear Generating Plant, Units 1 and 2 – Staff Assessment of Information Provided Pursuant to Title 10 of the Code of Federal Regulations Part 50, Section 50.54(f), Seismic Hazard Reevaluations for Recommendation 2.1 of the Near-Term Task Force (NTTF) Review of Insights From the Fukushima Dai-Ichi Accident and Staff Closure of Activities Associated with NTTF Recommendation 2.1, "Seismic" (TAC NOS. MF3784 and MF3785)," December 15, 2015 (ML15341A162)

21. NEI Position Paper, "Shutdown/ Refueling Modes," September 18, 2013 (ML13273A514)

22. Letter to Mr. J.E. Pollock (NEI) from Mr. J. R. Davis (NRC), "Endorsement letter: Mitigation Strategies Order EA-12-049, NEI Position Paper Shutdown/Refueling Modes," September 30, 2013 (ML13267A382)

23. NSPM letter (L-PI-16-039) to NRC, "Prairie Island Nuclear Generating Plant, Units 1 and 2, Response to March 12. 2012, Request for Information Enclosure 2, Recommendation 2.1, Flooding, Required Response 2, Flood Hazard Reevaluation Report," May 9, 2016 (ML16133A030)

24. NRC Letter to NSPM, "Prairie Island Nuclear Generating Plant, Units 1 and 2 – Response Regarding Phase 2 Staffing Submittals Associated With Near-Term Task Force Recommendation 9.3 Related to The Fukushima Dai-Ichi Nuclear Power Plant Accident (TAC Nos. MF6321 and MF6322)," December 1, 2015 (ML15320A465)

25. NEI 12-01, Revision. 0, "Guidelines for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities," April, 2012

26. NSPM letter (L-PI-15-044) to NRC, "Prairie Island Nuclear Generating Plant Phase 2 Staffing Assessment in Response to March 12, 2012, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident. Enclosure 5, Recommendation 9.3, Emergency Preparedness- Staffing, Requested Information Items 1, 2, and 6," May 28, 2015

27. Calculation ENG-EE-202, Revision 0, "FLEX 480V Portable Diesel Generator Sizing"

28 Calculation 178599.51.3005, Revision 0, "Prairie Island – 4KV Generator Sizing Evaluation"

29. Calculation CF.PX.OPS.046, Revision 0 "Prairie Island Containment Pressure and Temperature for a RCP Small Seal Leak during an Extended Station Blackout"

30. Calculation EVAL-XCELPI11-01, Revision 1, "Battery Rooms 11, 12, 21 and 22 and Bus Rooms 15, 16, 111 and 121 Room Heat-Up Evaluations with Loss of HVAC for PRA and SDP"

31. Calculation EVAL-XCELPI12-02, Revision 1, "Main Control Room, Cable Spreading Room and Computer Room PRA Room Heat Up Evaluation with Loss of HVAC"

32. NSPM Letter (L-PI-16-001) to NRC, "Notification of Compliance with NRC Order EA-12-049, 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,' Prairie Island Nuclear Generating Plant Unit 2 (TAC No. MF0835)," dated January 14, 2016 (ML16014A754, ML16014A755, and ML16014A756)

33. Calculation NSP-07-33, Revision 0A, "Loss of Offsite Power With Delayed AFW Analysis Results"

34. Calculation ENG-EE-199, Revision 0, "FLEX Strategy Battery Depletion Calculation"

35. Xcel Energy Internal Correspondence OC-PX-2012-021, "Prairie Island Subcritical Cooldown," 12/26/2012

36. Calculation ENG-ME-825, Revision 2, "Time to Onset of Reflux Cooling During ELAP."

37. Calculation GD-031315 Revision 0, "Geotechnical – Liquefaction Evaluation for the FLEX Storage Building"

38. Calculation ENG-ME-830, Revision 2 "Prairie Island - Determination of Diesel Fuel Oil Consumption of FLEX Portable Equipment to Support FLEX Phase 2 Refueling Strategies"

39. Evaluation EC22374-09, Revision 2, "Evaluation of the SFP Spray and Steam Generator Make-Up for a Post-Seismic Event"

40. 1[2]ECA-0.0, "Loss Of All Safeguards AC Power"

41. 1[2]C28.1 AOP3, "Aux Feedwater System Operation When AC Power is Lost"

42. FSG-15, "Isolation and Repower Bus 15 During ELAP"

43. FSG-16, "Isolation and Repower Bus 16 During ELAP"

44. FSG-25, "Isolation and Repower Bus 25 During ELAP"

45. FSG-26, "Isolation and Repower Bus 26 During ELAP"

46. 1[2]FSG-8, "Alternate RCS Boration"

47. 1[2]FSG-3, "Alternate Low Pressure Feedwater"

48. FSG-6, "Alternate CST Makeup"

49. FSG-11, “Alternate SFP Makeup and Cooling”

50. AB-4, “Flood”

51. 1[2]FSG-4, “ELAP DC Bus Load Shed/Management”

52. 1[2]FSG-1, “Long Term RCS Inventory Control”

53. FSG-5, “Initial Assessment and FLEX Equipment Staging”

54. 1[2]FSG-7, “Loss of Vital Instrumentation or Control Power”

55. EC 27057, “Reconciliation of Unit 1 and Unit 2 FLEX Strategies Implementation EC 24559 AND EC 22374 with NEI 12-06 Rev. 2”

56. EPRI 3002007148, “Seismic Evaluation Guidance: Spent Fuel Pool Integrity Evaluation,” February 2016

57. Calculation ENG-CS-277, Revision 0, “Seismic Analysis of 21/22 Condensate Storage Tanks”

58. Calculation ENG-ME-021, Revision 2D, “Auxiliary Feedwater Pump Room Heat-Up”

59. Calculation 178599.51.2019, Revision 0, “Prairie Island Battery Room Hydrogen Removal”

60. Calculation V.SPA.08.008 – Addendum 4, “External Event Fragilities for Seismic and Tornado Events”, June 1, 2009

61. Evaluation 178599.50.2200-04, Revision 2, “Prairie Island Debris Removal Assessment”

62. Calculation ENG-ME-477, Revision 2, “Spent Fuel Pool Time to Boiling”

Table 1: PWR Portable Equipment From NSRC

Equipment	Quantity
Medium Voltage Generator (1MW, 4160 VAC)	4
Medium Voltage Generator Cables	14 reels (350 feet per reel)
Low Voltage Three-Phase Generator (1,000kW, 480 VAC)	2
Low Voltage Three-Phase Generator Cables	40 reels (100 feet per reel)
High Pressure Injection Pump (2,000 psi, 60 gpm)	2
High Pressure Injection Pump Suction Hose (150 psi)	4 rolls (100 feet each)
High Pressure Injection Pump Discharge Hose (2,500 psi)	16 rolls (8-50 foot rolls and 8-100 foot rolls)
SG/RPV Makeup Pump (500 psi, 500 gpm)	2
SG/RPV Pump Suction Hose (150 psi)	8 rolls (10 feet per roll)
SG/RPV Pump Discharge Hose (500 psi)	18 rolls (100 feet per roll)
Low Pressure / Medium Flow Pump (300 psi, 2500 gpm)	2
Low Pressure / Medium Flow Pump Suction Hose (150 psi)	16 rolls (10 feet per roll)
Low Pressure / Medium Flow Pump Discharge Hose (300 psi)	36 rolls (50 feet per roll)
Low Pressure / High Flow (Dewatering) Pump (150 psi, 5,000 gpm)	2
Low Pressure / High Flow (Dewatering) Pump Suction Hose (150 psi)	24 rolls (10 feet per roll)
Low Pressure / High Flow (Dewatering) Pump Discharge Hose (300 psi)	60 rolls (50 feet per roll)
Mobile Lighting Tower (440,000 Lumens)	6
Fuel Air-Lift Containers (500 gal)	2
On-Site Diesel Transfer (60 gpm pump, 10 feet suction hose, and 25 feet discharge hose)	2

Equipment	Quantity
Portable Diesel Fuel Tank and Attached Pumps (264 gal)	2
4160 Vac Distribution System (4160 VAC, 1,200 AMP)	2
Water Treatment (Pre-filter) (500 gpm)	2
Water Treatment (Reverse Osmosis) (250 gpm)	2
Water Treatment Connection Hoses	4 rolls (2–50 foot rolls of 5 inch and 2-100 foot rolls of 2-1/2 inch)
Portable Submersible Pump (75 psi, 1,400 gpm)	2
Portable Submersible Pump Discharge Hose (150 psi)	2 rolls (200 feet per roll)
Water Storage (20,000 gal)	2
Mobile Boration (1,000 gal)	2
Boron (55 lbs bags)	130
Suction Booster Lift Pump (One Hydraulic Unit / Two Pods) (5,000 gpm, 26 foot lift)	3

Table 2: Sequence of Events Timeline

Action Item	Projected Start	Projected Completion	Activity	Time Constraint (Y/N)	Remarks
0	0	0	Event starts	N/A	Both units initially at 100% power
1	0	60 sec	TDAFWPs start supplying AFW to all SGs	N	Design Basis for SBO event requires AFW flow to SGs within 60 secs.
2	-	20 min	Determination made that AC Power is lost and cannot be recovered - ELAP Declared	Y (20 min)	ELAP declared within 20 minutes
3	10 min	40 min	Align Cooling Water to TDAWP	Y (74 min)	With the assumed loss of the CSTs at event initiation analyses demonstrate that at least 74 minutes are available to restore AFW flow to the SG.
4	20 min	40 min	Reduce speed on running DDCLP	Y (2 hr)	To ensure sufficient fuel oil in day tank, DDCLP speed must be reduced within 2 hrs.
5	20 min	2.0 hr	Reduce Cooling Water flow	Y (3.3 hr)	To ensure that flow demand does not exceed capacity of Emergency Intake Line, flow must be reduced within 3.3 hrs.
6	30 min	50 min	DC load shed from the battery rooms	Y (60 min)	Battery Depletion calculation assumes initial DC loads are shed within 60 min.
7	50 min	90 min	DC load shed from the relay room, D5/D6 Bldg, & Aux Bldg	Y (90 min)	Battery Depletion calculation assumes remaining DC loads are shed within 90 min.
8	1 hr	1 hr 10 min	Open doors to control room to establish cooling	Y (11.7 hr)	Alternate room cooling established by blocking doors open
9	1 hr	1 hr 10 min	Open doors to battery room to establish cooling	Y (18 hr)	Alternate room cooling established by blocking doors open
10	1 hr	3 hr	Cool RCS/SG down to a SG pressure of 350 psig	N	Assumed cooldown rate of approximately 70°F per hr
11	40 min	2 hr 10 min	Open disconnects and disengage 345 kV overhead power lines in switchyard	N	Assumed high voltage powers lines need to be cleared out of way to deploy equipment

Action Item	Projected Start	Projected Completion	Activity	Time Constraint (Y/N)	Remarks
12	40 min	2 hr 10 min	Move debris within Screenhouse to allow deployment of cables to Screenhouse MCC	N	Resources and time (1.5 hr) are allocated to clearing debris within the Screenhouse
13	40 min	2 hr 40 min	Move external debris and establish external access routes	N	Time to clear debris to allow deployment of equipment is assumed to be 2 hrs.
14	3 hr	4 hr	Stage 480 VAC DG and cables for Screenhouse MCC	N	This action stages the equipment but does not connect the generator to the MCC
15	4 hr	4 hr 45 min	Connect cables to 480 VAC DG and Screenhouse MCC	N	Power source for the DDCLP fFuel oil transfer pump
16	4.75 hr	5 hr	Start 480 VAC DG and energize selected Screenhouse loads	Y (8 hr)	Fuel Oil consumption calculation shows that the DDCLP fuel oil transfer pumps must be repowered within 8 hrs to support continued operation of the DDCLP
17	4 hr	6 hr	Move debris within Turbine Building to allow deployment of cables to battery room MCCsb	N	Resources and time (2 hr) are allocated to clearing debris within the Turbine Building
18	4 hr	4 hr 10 min	Open doors to AFW pump room to establish cooling	N	Alternate room cooling established by blocking doors open
19	6 hr	7 hr	Stage cables for battery room MCCs	N	This action stages the equipment but does not connect the generator to the MCC. Note DG has previously been staged in Action 13.
20	7 hr	8 hr	Connect cables to 480 VAC DG and battery room MCCs	N	Power source for battery chargers
21	8 hr	9 hr	Restart associated battery chargers and inverters	Y (11.5 hr)	Battery Depletion calculation shows that power to the battery chargers/inverters must be restored in 11.5 hrs to maintain instrumentation power.
22	6 hr	8 hr	Move debris within Turbine/Aux Buildings to allow deployment of cables to charging pump MCCs	N	Resources and time (2 hr) are allocated to clearing debris within the Turbine and Auxiliary Buildings

Action Item	Projected Start	Projected Completion	Activity	Time Constraint (Y/N)	Remarks
23	8 hr	10 hr	Stage 480 VAC DG and cables for charging pump MCCs	N	This action stages the equipment but does not connect the generator to the MCC
24	10 hr	11 hr	Connect cables to 480 VAC DG and charging pump MCCs	N	Power source for the charging pump
25	11 hr	11 hr 30 min	Start 480 VAC DG and energize charging pumps MCCs	N	Power source for the charging pump
26	11.5 hr	As needed	Establish charging pump flow and maintain RCS inventory	Y (32 hr)	Calculations show that RCS makeup should be established within 32 hrs to prevent the onset of Reflux cooling
27	After 12 hr	Before 24 hr	Deploy submersible pump, SG/SFP makeup pump, and hoses to the FLEX AFW connections	N	As a backup to the TDAWP, the FLEX strategies call for a portable diesel driven pump to be connected to the AFW system piping
28	After 12 hr	Before 24 hr	Deploy hoses to provide SFP makeup.	Y (33 hr)	To avoid concerns related to habitability during installation, SFP makeup hose will be deployed prior to pool boiling, which is expected to be greater than 33 hours
29	24 hr	72 hr	Deploy the SAFER 4kV Turbine Generators	N	Repowers a 4kV safeguard bus on each unit
30	72 hr	-	Restore safeguard loads as desired/needed	N	Normal SFP and containment cooling may be re-established

Table 3: PINGP FLEX Equipment

Equipment	N Quantity	+1 Quantity	Function				Capacity/Rating
			Core	SFP	Containment	Support	
Submersible Diesel Driven Pump	1	1	X	X			500 gpm at 105 ft total dynamic head
SG/SFP Diesel Driven Makeup Pump	1	1	X	X			500 gpm at 500 psig
Portable Diesel Generator	2	1	X			X	480 VAC, 300 kW
Cables for 480 VAC Generators	3,000 ft	400 ft	X			X	2/0 AWG, 200 ft lengths**
2 ½" Hose	200 ft	100 ft					400 psi 100 ft lengths**
3" Hose	1,800 ft	200 ft	X	X			500 psi 100 foot lengths**
6" Hose	500 ft	50 ft	X	X			300 psi 50 foot lengths**
Portable Diesel Generator	1	N/R*				X	120 / 240VAC, 12 kw
Diesel Driven Portable Fuel Oil Transfer Pump	1	N/R*				X	85 gpm
Portable Fuel Oil Storage Tank	1	N/R*				X	265 gal, w/ AC and DC pumps
Debris Removal Tractor	1	N/R*				X	D8 Dozer
Equipment Deployment Truck	1	N/R*				X	F-450 or (F-550 w/plow)
High Temp Exhaust Ducting	2	N/R*				X	1500°F 24" ID, x 20ft

* Equipment does not directly supporting a credited FLEX strategy for maintaining a key safety function. Therefore, +1 requirement is not required (N/R).

** This is the longest single section/length provided.

Figure 1: 480V Portable Diesel Generator Connections to Screenhouse and Battery Room MCCs

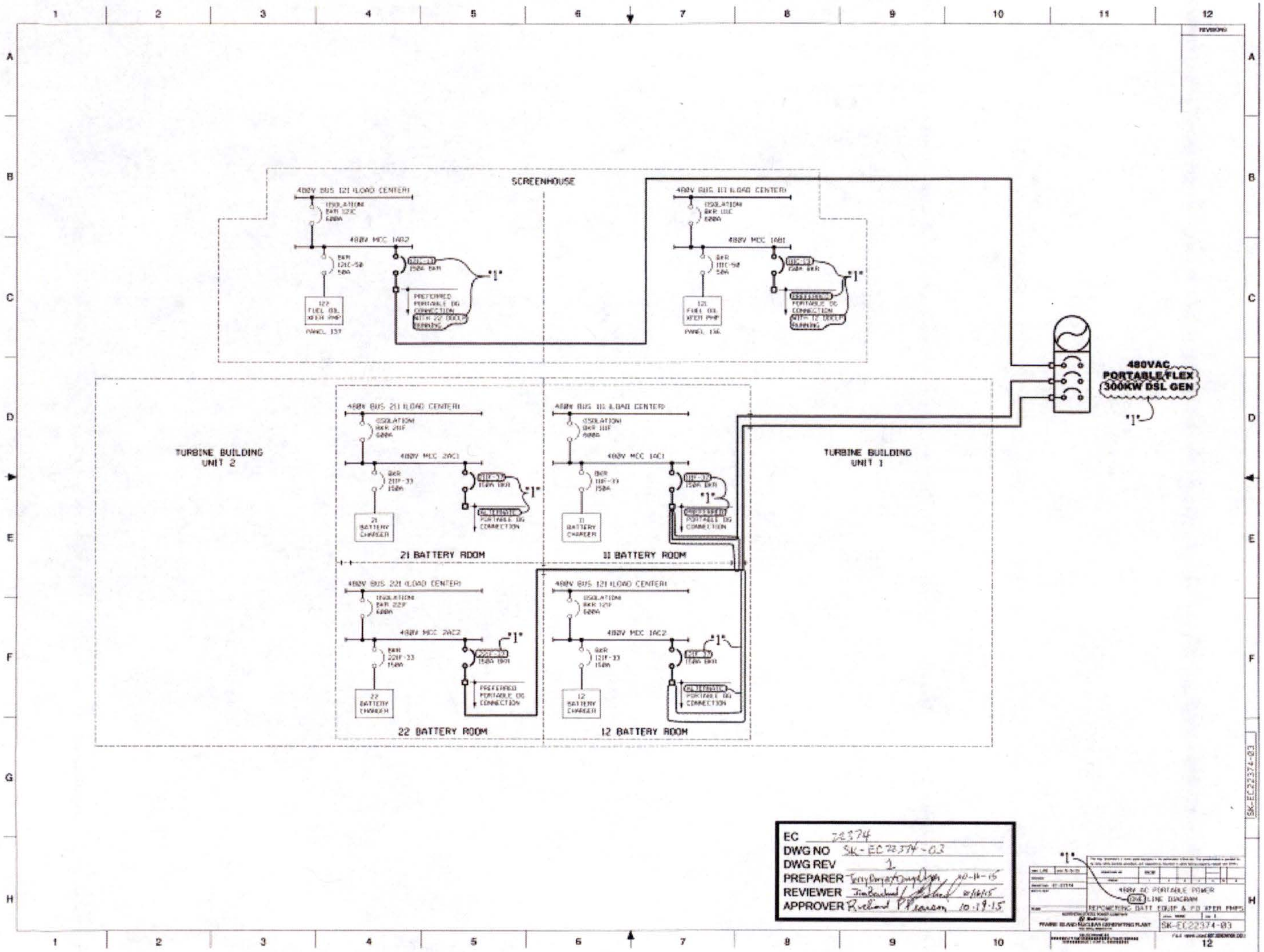

Figure 2: Submersible and SG/SFP Pumps Connections

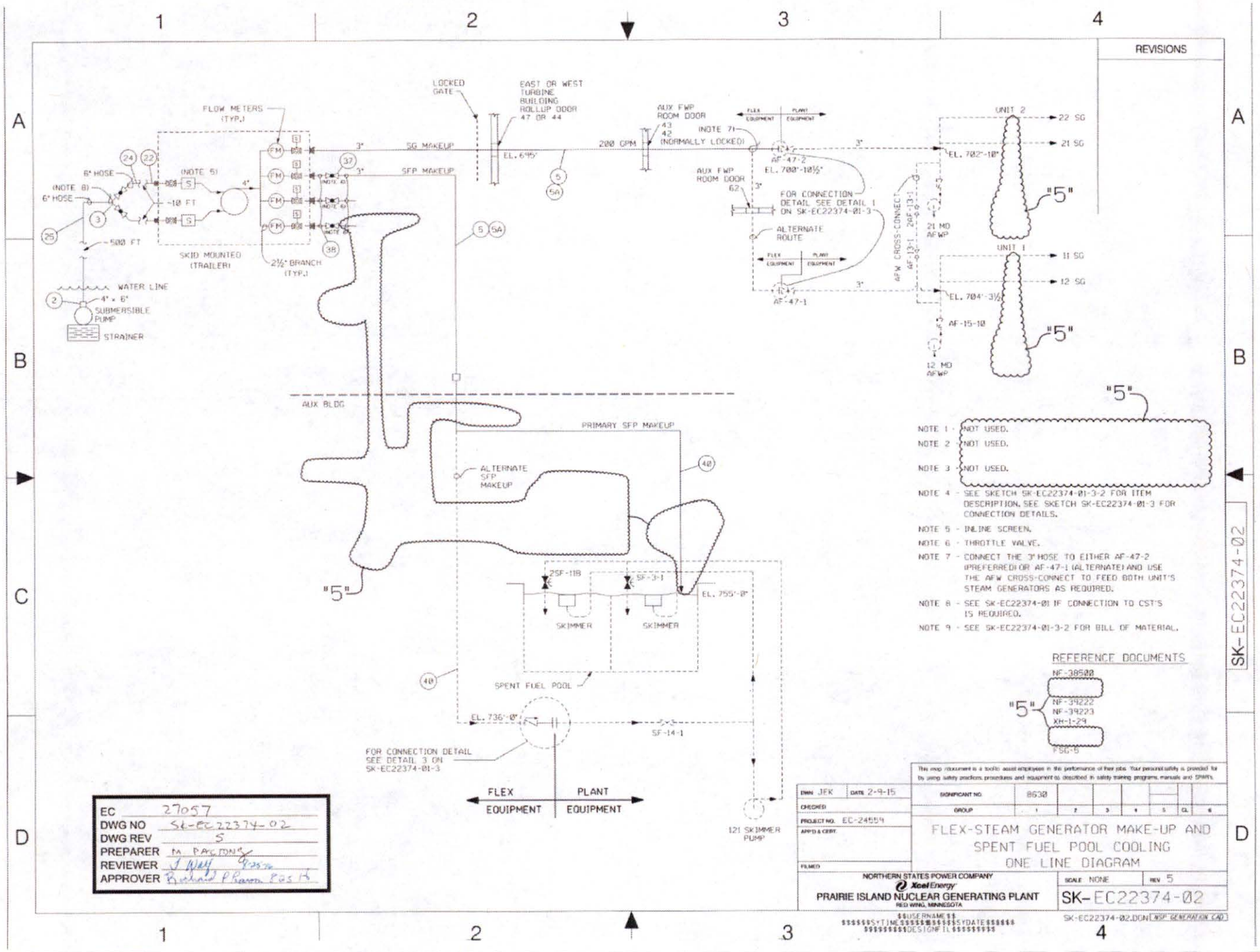

Figure 3: 480V Portable Diesel Generator Connections to Charging Pump MCCs

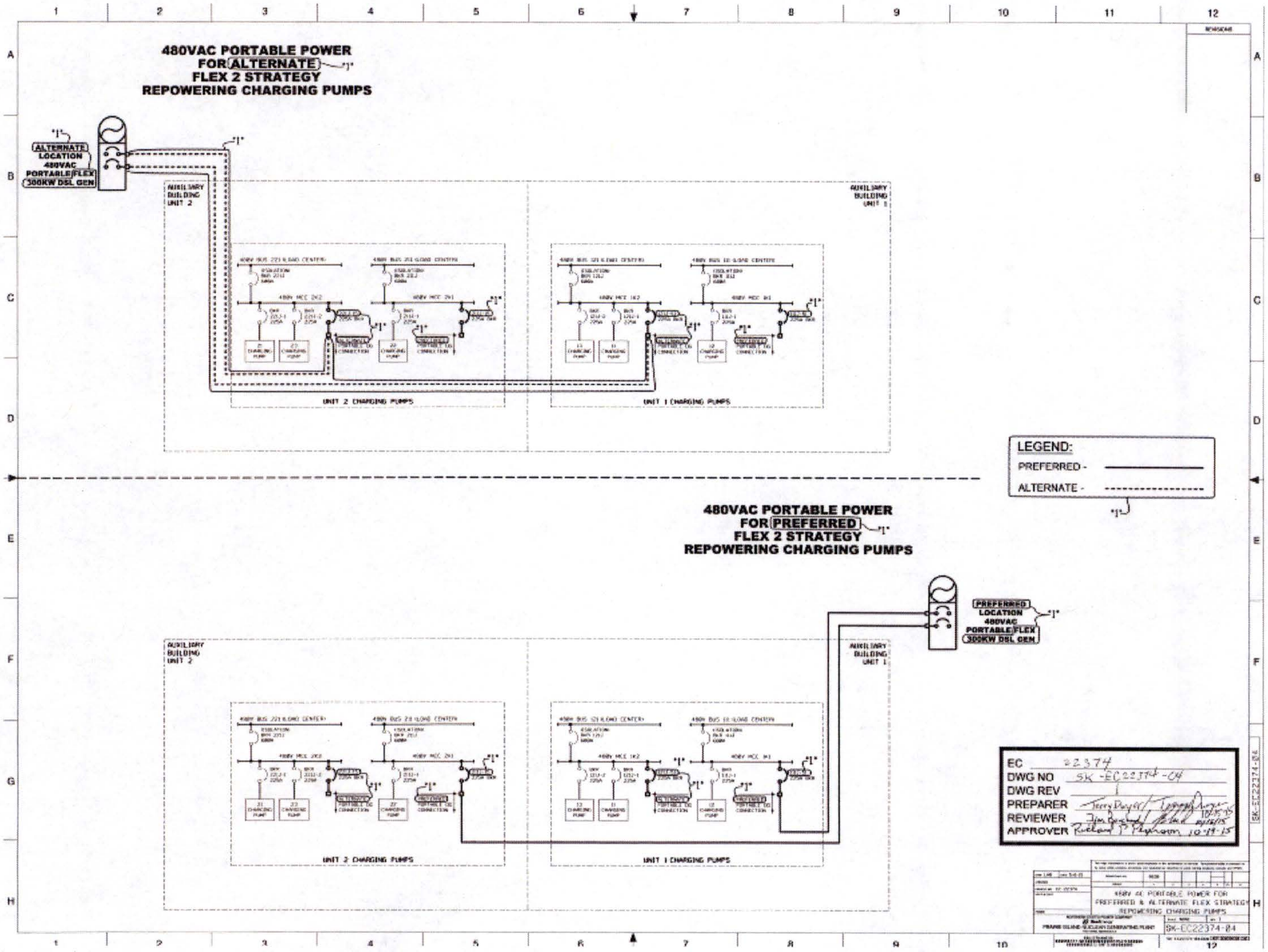

Figure 4: 4kV SAFER Turbine Generator Connections to Safeguard Buses

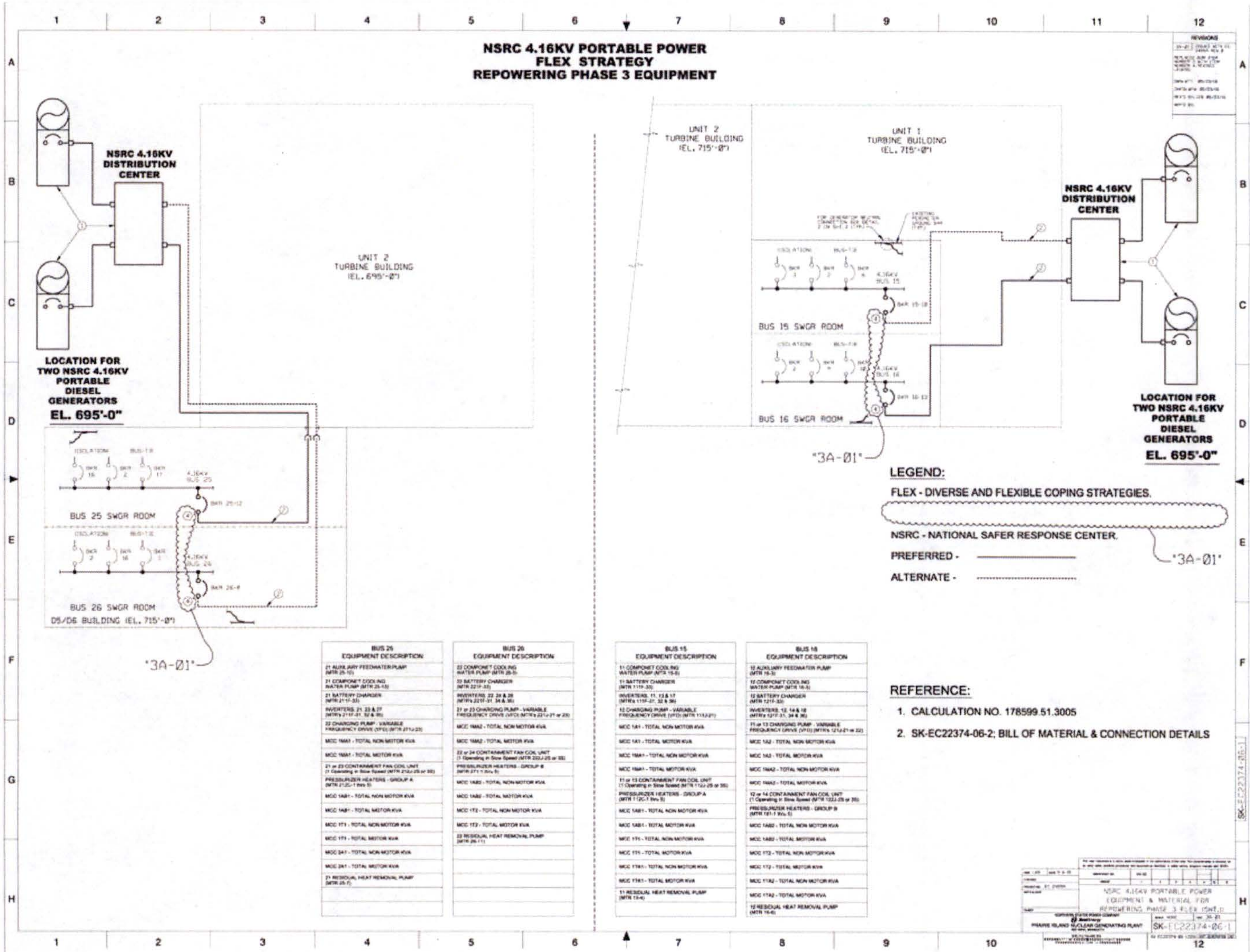

Figure 5: Deployment Locations for 480V Portable Diesel Generators

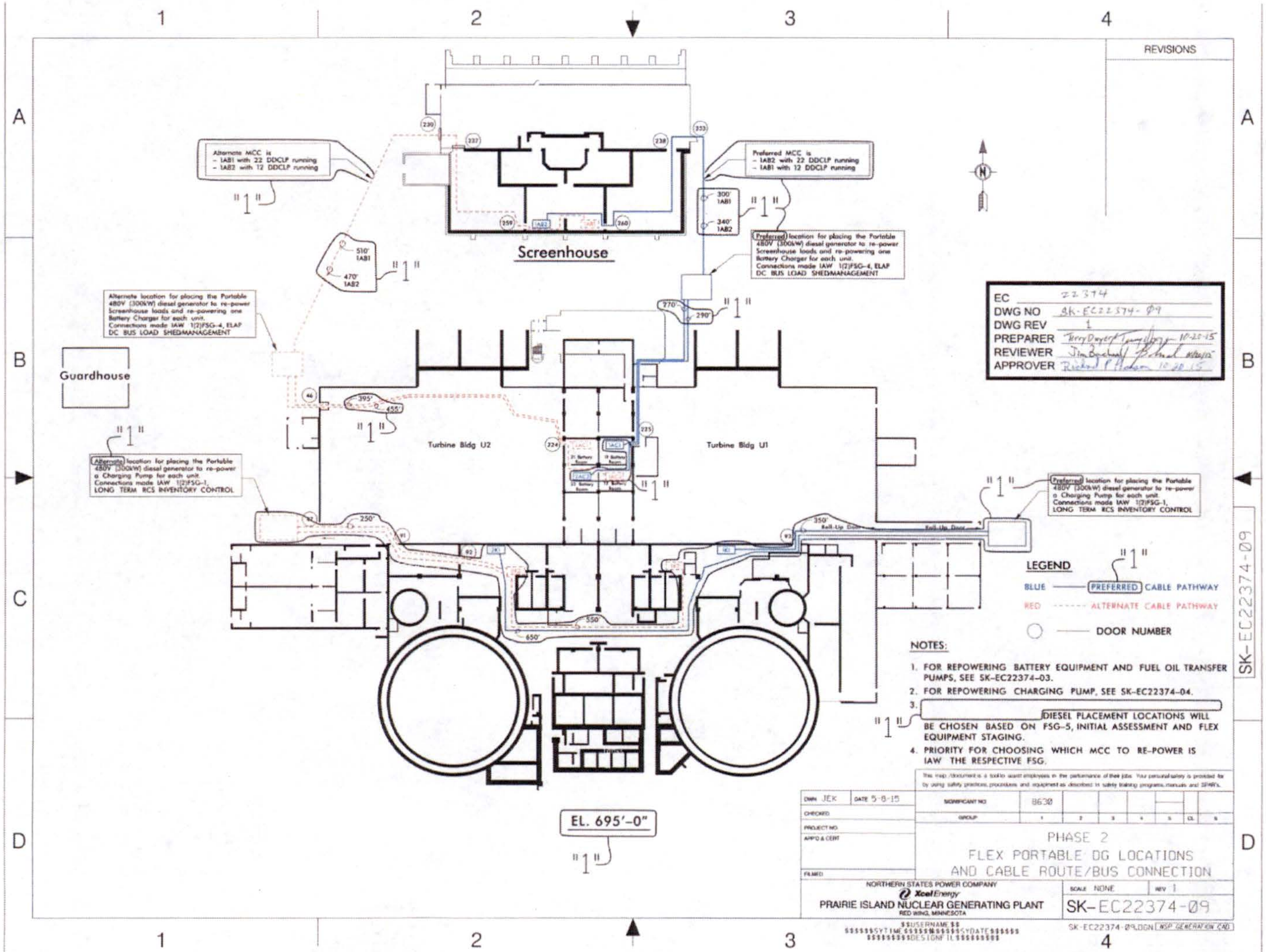

Figure 6: Deployment Locations for Submersible and SG/SFP Pumps

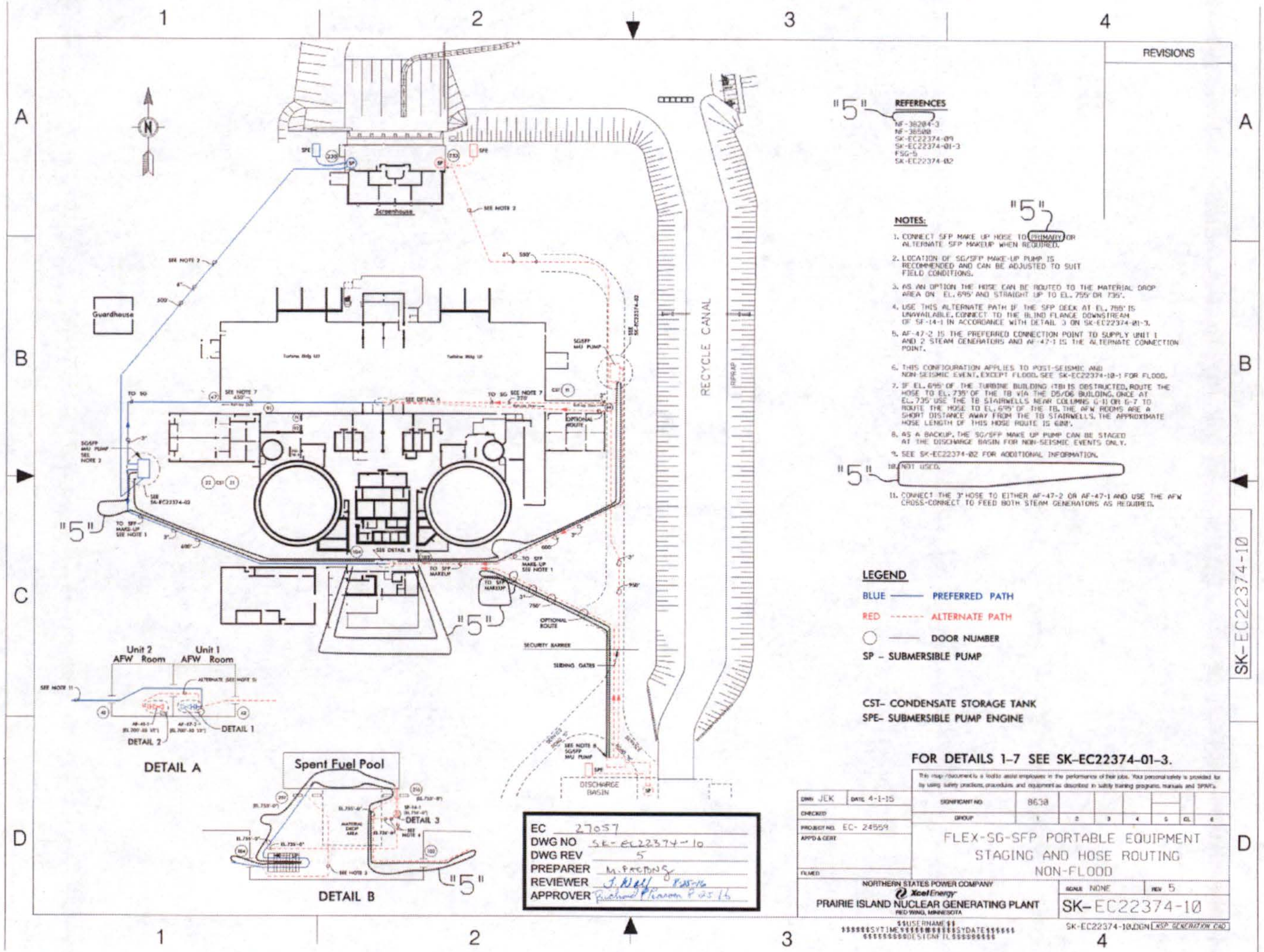

Figure 7: Deployment Locations for SAFER 4kV Turbine Generators

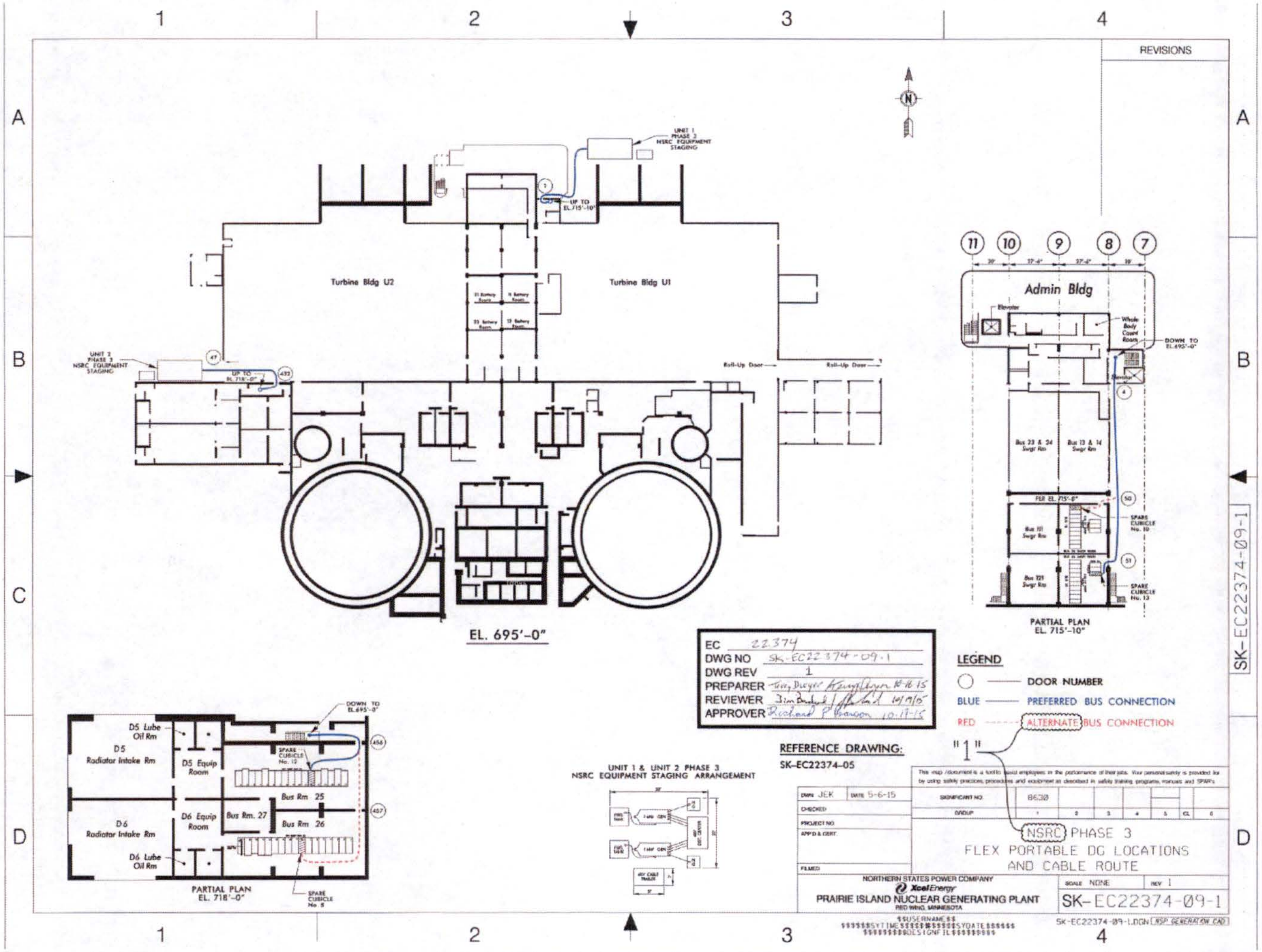

Figure 8: FLEX Deployment Paths