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Dominion®

DEC 29 2015

10 CFR 2.202
EA-12-049

Attention: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Serial No.:	14-393F
NLOS/DEA:	R0
Docket No.:	50-336
License No.:	DPR-65

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2
COMPLIANCE LETTER AND FINAL INTEGRATED PLAN IN RESPONSE TO THE MARCH 12, 2012 COMMISSION ORDER MODIFYING LICENSES WITH REGARD TO REQUIREMENTS FOR MITIGATING STRATEGIES FOR BEYOND-DESIGN-BASIS EXTERNAL EVENTS (ORDER NUMBER EA-12-049)

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Order EA-12-049, "Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" [the Order]. The Order requires a three-phase approach for mitigating beyond-design-basis external events. The initial phase requires the use of installed equipment and resources to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities. The transition phase requires providing sufficient, portable, onsite equipment and consumables to maintain or restore functions until they can be accomplished with resources brought from offsite. The final phase requires obtaining sufficient offsite resources to sustain these functions indefinitely. Condition C.3 of the Order requires all Licensees to notify the Commission when full compliance with the requirements of the Order is achieved.

This letter provides notification that Dominion Nuclear Connecticut, Inc. (DNC) has completed the requirements of the Order and is in full compliance with the Order for Millstone Power Station Unit 2. The attachments to this letter provide: 1) a summary of how the requirements of the Order were met, 2) responses to the additional items identified in Attachment 3 of the Millstone Onsite Audit Report, and 3) the Final Integrated Plan (FIP) for Millstone Power Station Unit 2.

A151
NRR

If you have any questions, please contact Ms. Diane Aitken at (804) 273-2694.

Sincerely,

John R. Daugherty
Site Vice President - Millstone

WM. E. BROWN
NOTARY PUBLIC
MY COMMISSION EXPIRES MAR. 31, 2016

STATE OF CONNECTICUT)
)
COUNTY OF NEW LONDON)

The foregoing document was acknowledged before me, in and for the County and State aforesaid, today by John R. Daugherty who is Site Vice President - Millstone of Dominion Nuclear Connecticut, Inc. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of the Company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 29 day of December, 2015.

My Commission Expires: Mar. 31, 2016.

Notary Public

(SEAL)

Attachments:

1. Millstone Power Station Unit 2 Order EA-12-049 Compliance Requirements Summary
2. Response to Additional Items Identified in Attachment 3 of Millstone Power Station Units 2 and 3 Onsite Audit Report dated November 17, 2014
3. Final Integrated Plan (FIP), Millstone Power Station - Unit 2

Commitments contained in this letter: None

cc: Director of Office of Nuclear Reactor Regulation
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NRC Senior Resident Inspector
Millstone Power Station

Attachment 1

Millstone Power Station Unit 2

Order EA-12-049 Compliance Requirements Summary

Dominion Nuclear Connecticut, Inc.

Millstone Power Station Unit 2
Order EA-12-049 Compliance Requirements Summary

Dominion Nuclear Connecticut, Inc. (DNC) developed an Overall Integrated Plan (OIP) (Reference 1), documenting the diverse and flexible strategies (FLEX) for Millstone Power Station Unit 2 (MPS2), in response to NRC Order Number EA-12-049 (the Order) (Reference 2). The OIP for MPS2 was submitted to the NRC on February 28, 2013 and was supplemented by Six-Month Status Reports (References 3, 4, 5 6, and 7), in accordance with Order EA-12-049, along with an additional supplemental letter that was submitted on April 30, 2013 (Reference 8).

Full compliance with the Order was achieved for MPS2 on November 6, 2015. This date corresponds to the end of the MPS2 second refueling outage after submittal of the OIP as required by the Order. Completion of the elements identified below, as well as References 1, 3, 4, 5, 6, 7, and 8, document full compliance with the Order for MPS2.

NRC ISE AND AUDIT ITEMS COMPLETE

During the ongoing audit process (Reference 12), DNC provided responses for the following items for Millstone:

- Interim Staff Evaluation (ISE) Open and Confirmatory Items (Reference 14)
- Licensee Identified Open Items (Reference 1)
- Audit Questions
- Safety Evaluation Review Items (Reference 13)

The NRC report, "Millstone Power Station, Units 2 and 3 – Report for the Onsite Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Instrumentation Related to Orders EA-12-049 and EA-12-051" (Reference 13) delineated the items reviewed during the Millstone Power Station onsite audit. The report also identified additional audit items, specified as Safety Evaluation Review Items, which were added during and following the audit and required supplemental information to address.

DNC's responses or references to the source document for responses, to the NRC's Open and Confirmatory Items have been provided in Reference 7.

Attachment 2 to this letter provides the responses to Audit Questions and Licensee Identified Open Items related to Order EA-12-049 that were not closed for MPS2 following the Millstone Power Station onsite audit performed July 21-25, 2014 (Reference 13). It is DNC's position that no further actions related to any of the above items are required.

MILESTONE SCHEDULE – ITEMS COMPLETE

Unit 2 Milestone	Completion Date
Submit Integrated Plan	February 2013
Develop Strategies	April 2014
Develop Modifications	March 2015
Implement Modifications	October 2015
Develop Training Plan	April 2014
Implement Training	September 2015
Issue FSGs and Associated Procedure Revisions	November 2015
Develop Strategies/Contract with National SAFER Response Center (NSRC)	August 2014
Purchase Equipment	February 2014
Receive Equipment	September 2014
Validation Walk-throughs or Demonstrations of FLEX Strategies and Procedures	February 2015
Create Maintenance Procedures	August 2014
Outage Implementation	November 2015

STRATEGIES - COMPLETE

Strategy related ISE Open Items and Confirmatory Items have been addressed as documented in Reference 7, Attachment 2. Various Audit Questions and Licensee Identified Open Items requiring additional DNC input are addressed in Attachment 2 of this letter. The MPS2 strategies are in compliance with Order EA-12-049.

MODIFICATIONS - COMPLETE

The plant modifications required to support the FLEX strategies for MPS2 have been completed in accordance with the station design control process. The plant modification design changes (DCs) implemented in support of the FLEX strategies for MPS2 are as follows:

- BDB FLEX Atmospheric Dump Valve Support Modification (MP2-14-01094)
- BDB FLEX Mechanical Connections to ECCS (RCS Injection) (MP2-12-01172)
- BDB FLEX Mechanical Connections to the Spent Fuel Pool Cooling System (MP2-12-01173)
- Turbine Driven AFW Pump Exhaust Line Modifications (MP2-13-01147)
- BDB FLEX Storage Building Millstone Power Station Units 2 and 3 (MPG-13-00010)
- BDB FLEX Strategy Support Modifications (MPG-13-01131)
- BDB Integrated FLEX Strategy – Electrical Connections (MP2-12-01170)
- BDB Satellite Communications Infrastructure (MPG-14-01080)
- Beyond Design Basis Event Emergency Equipment (MPG-12-01123)
- Beyond Design Basis Spent Fuel Pool Level Instrument Installation (MP2-13-01011)
- BDB FLEX Mechanical Connections to Auxiliary Feedwater System (MP2-12-01174)
- Millstone Unit 2 BDB FLEX Connection to the Primary Water Storage Tank (MP2-14-01029)

Copies of these DCs have previously been provided electronically to the NRC staff and are available for their review.

EQUIPMENT - PROCUREMENT AND TESTING – COMPLETE

The equipment required to implement the FLEX strategies for MPS2 has been procured in accordance with NEI 12-06 (Reference 15), Sections 11.1 and 11.2, received onsite, tested, performance verified in accordance with NEI 12-06, Section 11.5, and is available for use.

Maintenance and testing will be conducted through the use of the Millstone Power Station Preventative Maintenance program such that equipment reliability is maintained and is in compliance with EPRI guidelines where applicable to the FLEX equipment.

PROTECTED STORAGE - COMPLETE

The storage facility required to protect Beyond-Design-Basis (BDB) equipment has been completed for Millstone Power Station. The BDB equipment is protected from the applicable site hazards and will remain deployable to assure implementation of the FLEX strategies for MPS2.

PROCEDURES - COMPLETE

FLEX Support Guidelines (FSGs) for MPS2 have been developed and integrated with existing procedures. The FSGs and affected existing procedures have been approved and are available for use in accordance with the site procedure control program.

TRAINING – COMPLETE

Training of personnel responsible for the mitigation of BDB events at MPS2 has been completed in accordance with an accepted training process as recommended in NEI 12-06, Section 11.6.

STAFFING – COMPLETE

The staffing study for Millstone Power Station has been completed in accordance with "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," Enclosure 5 pertaining to Recommendation 9.3, dated March 12, 2012 (Reference 16). The staffing assessment was submitted by letter dated June 12, 2014, "Millstone Power Station Units 2 and 3, March 12, 2012 Information Request, Phase 2 Staffing Assessment Report" (Reference 10), and in the "Response to Request for Additional Information Regarding Phase 2 Staffing Assessment Report, Recommendation 9.3," dated September 22, 2014 (Reference 9). The final staffing assessment report was submitted on July 30, 2015 (Reference 18). Operator training for MPS2 was completed by September 30, 2015 and no issues were identified that would affect the results documented in References 9, 10, and 18. The FSG strategies can be successfully implemented using the current minimum on-shift staffing. Therefore, the conclusions reached by the NRC following their review of the Phase 2 Staffing Study remain valid (Reference 11).

NATIONAL SAFER RESPONSE CENTERS - COMPLETE

DNC 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 Millstone Power Station with Phase 3 equipment stored in the National SAFER Response Centers in accordance with the site-specific SAFER Response Plan (Reference 17).

VALIDATION - COMPLETE

DNC has completed validation of the FLEX strategies for MPS2 in accordance with industry developed guidance. The validations assure that required tasks, manual actions, and decisions for FLEX strategies may be executed within the constraints identified in the Overall Integrated Plan (OIP)/Final Integrated Plan (FIP) for Order EA-12-049. The FIP for MPS2 is provided as Attachment 3 to this letter.

FLEX PROGRAM DOCUMENT - ESTABLISHED

The DNC FLEX Program Document has been developed in accordance with the requirements of NEI 12-06 and is in effect for MPS2.

REFERENCES

The following references support the MPS2 FLEX Compliance Summary:

1. DNC'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 28, 2013 (Serial No. 12-161B)(ML13063A012).

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

3. DNC's 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 23, 2013 (Serial No. 12-161D)(ML13242A011).

4. DNC's 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 28, 2014 (Serial No. 12-161E)(ML14069A013).

5. DNC's Six Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated August 28, 2014 (Serial No. 14-393)(ML14251A016).

6. DNC's 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 March 2, 2015 (Serial No. 14-393B)(ML15069A231).

7. DNC's 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 27, 2015 (Serial No. 14-393E)(ML15246A123).

8. Supplement to Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis Events (Order Number EA-12-049), dated April 30, 2013 (Serial No. 12-161C)(ML13126A206).

9. DNC Letter to NRC, "Millstone Power Station Units 2 and 3 – Response to Request for Additional Information Regarding Phase 2 Staffing Assessment Report, Recommendation 9.3," dated September 22, 2014 (Serial No. 14-443)(ML14268A245).

10. DNC Letter to NRC, "Millstone Power Station Units 2 and 3, March 12, 2012 Information Request, Phase 2 Staffing Assessment Report," dated June 12, 2014 (Serial No. 14-198)(ML14168A218).

11. NRC Letter to DNC, "Millstone Power Station, Units 2 and 3 – 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," dated December 15, 2014 (ML14302A356).

12. NRC letter from Jack R. Davis, Director Mitigating Strategies Directorate to All Operating Reactor Licensees and Holders of Construction Permits, "Nuclear Regulatory Commission Audits of Licensee Responses to Mitigating Strategies Order EA-12-049," dated August 28, 2013 (ML13234A503).

13. NRC letter from Stephen Monarque, Project Manager, JLD, Office of NRR, to David A. Heacock, President and Chief Nuclear Officer, Dominion Nuclear Connecticut, Inc., "Millstone Power Station, Units 2 and 3 – Report for the Onsite Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Instrumentation Related to Orders EA-12-049 and EA-12-051," dated November 17, 2014.

14. NRC Letter to DNC, "Millstone Power Station, Units 2 and 3 - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigating Strategies)," dated January 31, 2014 (ML13338A433).

15. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0, dated August 2012.

16. 10 CFR 50.54(f), "Request for Information Pursuant to Title 10 of the Code of Federal Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," Recommendation 9.3, dated March 12, 2012 (ML12073A348).

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

18. DNC Letter to NRC, "Millstone Power Station Units 2 and 3 – March 12, 2012 Information Request Revision to Phase 2 Staffing Assessment Report," dated July 30, 2015 (Serial No. 15-364).

Attachment 2

Response to Additional Items Identified in Attachment 3 of Millstone Power Station Units 2 and 3 Onsite Audit Report dated November 17, 2014

Dominion Nuclear Connecticut, Inc. (DNC)
Millstone Power Station Unit 2

Response to Additional Items Identified in Attachment 3 of Millstone Power Station Units 2 and 3 Onsite Audit Report dated November 17, 2014

NOTE: Documents identified in this attachment as having been previously provided to the Nuclear Regulatory Commission (NRC) staff for their review were provided in accordance with NRC letter to All Operating Reactor Licensees and Holders of Construction Permits, "Online Reference Portal for Nuclear Regulatory Commission Review of Fukushima Near-Term Task Force Related Documents," dated August 1, 2013 (ML13206A427).

OIP Open Item #4:

A study is in progress to determine the design features, site location(s), and number of equipment storage facilities. The final design for BDB equipment storage will be based on the guidance contained in NEI 12-06, Section 11.3, Equipment Storage. A supplement to this submittal will be provided with the results of the equipment storage study.

DNC Response:

Overall Integrated Plan (OIP) Open Item # 4 for Millstone Power Station Unit 2 (MPS2) is identical to OIP Open Item #6 for Millstone Power Station Unit 3 (MPS3). Responses stating the completion of these Open Items were provided in the Six-Month Status Reports dated February 28, 2014 for both units (Reference 1). OIP Open Item # 6 for MPS3 was not included in Attachment 4 of the November 17, 2014 NRC Onsite BDB Audit Report indicating that no additional information was required. Since MPS2 and MPS3 use a common onsite Beyond-Design-Basis (BDB) Storage Building, the response to these Open Items is identical. Therefore, it is Dominion Nuclear Connecticut, Inc.'s (DNC's) position that no additional information is required for the MPS2 OIP Open Item #4.

OIP Open Item #5:

FSGs will be developed in accordance with PWROG guidance. Existing procedures will be revised as necessary to implement FSGs.

DNC Response:

FLEX Support Guidelines (FSGs) have been developed in accordance with Pressurized Water Reactor Owners Group (PWROG) guidance. Existing Emergency Operating Procedure (EOP) 2530, "Station Blackout," has been revised to diagnose and declare an Extended Loss of AC Power (ELAP) and implement FSGs. The following MPS2 FSGs and associated Abnormal Operating Procedures (AOPs) required for implementation of the MPS2 FLEX Mitigating Strategies have been approved and issued for use:

FSG-1, Long Term RCS Inventory Control

FSG-2, Alternate AFW Suction Source

FSG-3, Alternate Low Pressure Feedwater

FSG-4, ELAP DC Bus Load Shed / Management

FSG-5, Initial Assessment and FLEX Equipment Staging

FSG-6, Alternate DWST Makeup

FSG-7, Loss of Vital Instrumentation or Control Power

FSG-8, Alternate RCS Boration

FSG-9, Low Decay Heat Temperature Control

FSG-10, SI Accumulator Isolation

FSG-11, Alternate SFP Makeup and Cooling

FSG-12, Alternate Containment Cooling

FSG-13, Transition From FLEX Equipment

FSG-14, Shutdown RCS Makeup (new FSG from PWROG 6/23/14)

FSG-15, 4160V Repowering Using NSRC Generator

FSG-20, Appendices

AOP-2560, Storms, High Winds and High Tides

AOP-2578, Loss of Refuel Pool and Spent Fuel Pool Level

AOP-2583, Loss of All AC Power During Shutdown Conditions

The documents referenced in the above response have previously been provided to the NRC staff and are available for their review.

Audit Question #2:

NEI 12-06 Section 5.3.3 Consideration 1 specifies that seismically qualified electrical equipment can be affected by beyond-design-basis seismic events, therefore guidance should be available for determining instrument reading for both main control room (MCR) and non-control room readouts regarding how and where to measure key instrument readings at containment penetrations for example, where applicable, using a portable instrument. Dominion's integrated plan did not include providing guidance for this situation. Provide a discussion of how plant staff will determine required key instrument readings if MCR instrumentation is not functioning following a seismic event. (Reference Item 3.1.1.3.A)

DNC Response:

FSG-7, "Loss of Vital Instrumentation or Control Power" enables plant personnel to obtain instrument readings locally at the Containment penetrations. The guideline indicates the penetration number and cable contacts to be used to determine a parameter's value. Portable meters are used to display an electrical output, which is then compared to a conversion chart included in the guideline to determine the converted parametric value of the readout. Key instrumentation required to implement the FLEX strategies can be accessed using this method. The guideline includes conditions required to access the areas needed to get the readings and special tools and equipment required to take the readings. DNC has a total of six dedicated BDB meters (Fluke Meters or equivalent) available onsite. There are two meters with extra batteries stored in each Control Room and there are two spare meters with extra batteries stored in the BDB Storage Facility.

Audit Question #3:

NEI 12-06 Section 5.3.3 consideration 2 and 3 require providing guidance regarding seismic hazards related to large internal flooding sources that are not seismically robust and do not require ac power, and the use of ac power to mitigate ground water in critical locations. Provide a discussion regarding of the need for any guidance to deal with potential large internal flooding sources and the potential need for AC power to mitigate ground water intrusion. (Reference Item 3.1.1.3.B)

DNC Response:

The discussion of large internal flooding sources for MPS2 was included in the response to ISE CI 3.1.1.3.A that was provided to the NRC staff in Attachment 2 of the Six-Month Status Report dated August 27, 2015 (Reference 2).

MPS2 does not have a subsurface groundwater removal system installed.

Audit Question #6:

NEI 12-06, Section 6.2.3.2 requires addressing nine consideration regarding deployment of FLEX equipment during flooding conditions. Dominion did not specifically address consideration 5 regarding the potential for a flooding limiting access to portable equipment connection points, consideration 7 regarding the need for dewatering or extraction pumps, and consideration 8 regarding the need for temporary flood barriers. Provide a complete discussion that addresses all deployment considerations and concerns during flooding including the two noted above. (Reference Item 3.1.2.2.A)

DNC Response:

The considerations from NEI 12-06, Section 6.2.3.2 are addressed in Chapter 12 of ETE-CPR-2012-0009. A discussion of consideration 5 dealing with the access to connection points during a flood is provided in Sections 12.3.1 and 12.3.2.5. The majority of the BDB equipment connections are accessible for use during a flooding event. However, the maximum storm surge level may be above the plant grade which is at elevation 14.5' mean sea level (msl) for up to a maximum of eight hours during a storm surge. During this time, deployment of BDB equipment to MPS2 connection points outside of the flood gates may be delayed until flood waters have receded below plant grade level.

The BDB connection points located inside the MPS2 flood gates are protected to a flood level of 22' msl. The Unit 3 Final Safety Analysis Report (FSAR), which is the limiting evaluation for the Millstone site, notes the expected maximum stillwater flood level for the site would not exceed 19.7' msl. The potential exists for some flood water intrusion past the flood gates into the site structures which may impact the accessibility of some lower level connection points, however, the BDB strategy provides alternate locations for all connections. In no instance are both the primary and alternate connections unavailable due to flood hazard conditions.

A discussion of consideration 7 dealing with dewatering and extraction pumps is provided in Sections 12.3.2.7 and 12.3.3.3. The stillwater level of 19.7' msl is below the flood gate and wall protection of 22' msl; however, with this stillwater level, wave action can approach 24' msl. Wave action at this level will generate some leakage past the corrugated siding barriers and at the tops of some flood gates, which are not sealed at the top edge. In most cases, this water is captured by sumps and equipment pits but also can accumulate in the lower level of site structures. Extraction pumps may be required if installed flood protection barriers are breached by conditions beyond the design flood levels. Should this occur, water will collect in the various lower level sumps, pits, or basement levels in the Turbine and Auxiliary Buildings. Several small extraction pumps and hose lengths are currently available onsite. Current storm preparation procedures require that when the MPS2 flood gates are closed, self-powered sump pumps and hose lengths are staged in the Turbine Building condenser pit area. These pumps are not designated as BDB equipment.

A discussion of consideration 8 dealing with temporary flood barriers is provided in Sections 12.3.2.8 and 12.3.3.3. MPS2 flood protection is provided by flood gates and stop logs which are permanently installed features that provide temporary barriers in the event of a hurricane with significant storm surge. In most cases, the temporary barriers are flood gates which are installed at the doorways they protect and need only be closed and secured. No transport or deployment is required. Two additional flood barriers (stop logs) are staged by the door locations where they are used. Several small flood protection drain plugs and caps are also staged at the locations that they are needed. Finally, a temporary barrier (fiberglass can) is installed over a Service Water pump motor for flood protection. The fiberglass can is staged in the Intake Structure pump room and the necessary equipment to install and secure the barrier is available at that location.

Due to the significantly higher flood levels associated with a hurricane surge, no specific additional flood protection for a local intense precipitation (LIP) event is needed for MPS2. If localized accumulation from precipitation occurs and threatens intrusion into the site structures, the flood gates and drain plugs and caps for hurricane preparation are available for use.

Additionally, consideration 6 from NEI 12-06, Section 6.2.3.2 addresses adequacy of baseline deployment strategies under the conditions associated with a hurricane and storm surge. As previously stated, MPS2 could potentially be impacted by a storm surge once it rises to and above the plant grade elevation of 14.5' msl. Under these conditions, deployment of BDB equipment and refueling of deployed equipment around MPS2 would not be possible. Based on the MPS3 FSAR flood surge analysis (which is the limiting site evaluation) the maximum time at which Maximum Probable Hurricane (MPH) storm surge would exceed the plant grade elevation would be approximately 8 hours. The only BDB component that may require deployment and operation during that time is the diesel powered BDB Auxiliary Feedwater (AFW) pump. This component will be pre-deployed prior to closure of the MPS2 flood gates (See response to Audit Question #9 below). Per the specification for the pump, a 24 hour fuel tank is provided with the pump and the pump is stored in the fueled condition in the BDB Storage Building. 24 Hours is more than sufficient time to allow the storm surge to subside and will facilitate refueling from available onsite fuel sources when required.

Audit Question #7:

NEI 12-06, Section 6.2.3.3 requires addressing three considerations regarding flood deployment procedures, alternate connection points, and guidance for temporary flood barriers. Dominion did not discuss the need for guidance for the potential deployment of temporary flood barriers and use of extraction pumps, per consideration 3 above. Provide a discussion regarding the potential need for temporary flood barriers and extraction pumps if needed. (Reference Item 3.1.2.3.A)

DNC Response:

The considerations from NEI 12-06, Section 6.2.3.3 are addressed in Chapter 12 of ETE-CPR-2012-0009. A discussion of consideration 3 dealing with the potential deployment of temporary flood barriers and use of extraction pumps is provided in Sections 12.3.2.7, 12.3.2.8, and 12.3.3.3 and is summarized above in the response to Audit Question # 6. Guidance for temporary barriers required for the hurricane preparation is in plant procedure (AOP 2560) as well as instructions to pre-stage extraction/sump pumps. The use of self-powered extraction/sump pumps, if needed to remove water, is a routine maintenance activity and does not require specific guidance.

Audit Question #8:

NEI 12-06, Section 8.3.3 requires addressing procedural interfaces associated with a snow, ice and extreme cold hazard. Dominion did not specifically address the amount, location and storage of snow removal equipment and procedures required for snow and ice conditions at the plant, although Dominion plans to revise several extreme event procedures, it is not clear that this will include snow removal actions or the ability to transport equipment under these conditions. Provide a discussion regarding the location and type of snow removal equipment and procedures required for snow and ice conditions at the plant. (Reference Item 3.1.4.3.A)

DNC Response:

FLEX equipment includes two cab tractors and one front-end loader. These three pieces of equipment have buckets that are capable of snow and ice removal. The loader and tractors are stored in the BDB Storage Building to provide protection from external events.

FSG-5, provides direction to clear the haul route to facilitate deployment of FLEX equipment. The John Deere tractors and Caterpillar front-end loader used to deploy FLEX equipment would also be used to remove snow and ice, ensuring pathways are cleared for movement of BDB equipment. Additional procedural guidance for the various uses of the tractors and front-end loader in snow and ice conditions (a typical winter condition at Millstone Power Station) has been incorporated into the site snow removal plan.

Audit Question #9:

NEI 12-06, Section 9.3.3 requires providing procedural enhancements that involve addressing the effects of high temperatures on the portable equipment. Dominion did not provide any information regarding operation of portable equipment at the high temperatures that may be experienced due to the ELAP, i.e., would the equipment have to operate in any high temperature areas of the plant when deployed. A review of the diagrams provided in Figures 1-8 of the integrated plan appear to show that all portable FLEX equipment, (BDB pumps and ac generators) will be set up in areas outside of the buildings where the connections will be made. This would allow operation only in the high ambient temperatures external to plant buildings. Dominion plans on storing BDB equipment so that it will be protected from high temperature events while stored in the BDB Storage Building(s) or in protected areas of the plant. However as noted on page 27 of the integrated plan Dominion plans on locating the BDB AFW pump inside the Turbine Building for the specific case of imminent flooding for the installed TDAFW pump. In this situation the portable pump would be operating inside a confined space, subject to high temperatures due to lack of ventilation. Provide a discussion regarding the ability of FLEX equipment to operate at potentially high ambient temperatures for placement of portable FLEX equipment in the situation where the portable BDB AFW pump is operated inside the Turbine Building. (Reference Item 3.1.5.3.A)

DNC Response:

The strategy identified in the initial OIP for having the BDB AFW pump pre-staged at elevation 31.5' msl inside the Turbine Building was revised and is no longer applicable. This strategy change was identified and information provided in the Six-Month Status Report dated February 28, 2014 for MPS2 (Reference 1). The current strategy for all scenarios, except hurricane storm surge flooding, is for the BDB AFW pumps to be kept in the BDB Storage Building and deployed per the FSGs. In the event of a potential hurricane storm surge, one BDB AFW pump will be pre-deployed into the Turbine Building truck bay area prior to closure of the Turbine Building flood gates. The site hurricane preparation procedures have been revised to include this action.

High temperature at the BDB AFW pump will not be a problem for any BDB external event other than hurricane flooding since the pump will be located either outdoors or just inside the Turbine Building truck bay with the large rollup door open, as needed. In the case where the pre-deployed BDB AFW pump is inside the Turbine Building flood gates, provisions to vent the diesel exhaust and increase ventilation are required.

To support the operation of the AFW pump in the Turbine Building truck bay, the large rollup (Railroad Access) door located on the 14.5' msl elevation of the Turbine Building will be opened and extended at least four feet above the top elevation of the flood gate. Additionally, a door located on the 72' msl elevation of the Turbine Building will be opened allowing air to circulate through the Turbine Building at the location of the pre-deployed BDB AFW pump via FSG-3, "Alternate Low Pressure Feedwater."

BDB AFW pump exhaust shall be directed outside (over the closed flood gate and through the door opening) using high temperature flexible duct prior to operating the pump in the Turbine Building truck bay. The exhaust hose must be extended sufficiently away from the door opening to prevent blowback into the Turbine Building.

Under the above conditions with available vent and exhaust pathways, an evaluation has determined that BDB AFW pump operation inside of the Turbine Building with the Turbine Building flood gates closed, is not a habitability or equipment operability concern.

Audit Question #32:

NEI 12-06, Section 3.2.2, Paragraph (3) provides that plant procedures/guidance should specify actions necessary to assure that equipment functionality can be maintained (including support systems or alternate method) in an ELAP/[LNUHS] or can perform without ac power or normal access to the UHS. Dominion's plans and strategies to provide cooling and ventilation to areas of the plant affected by loss of AC power during the ELAP are not finished. Dominion will provide strategies for ventilation of areas of the plant affected by ELAP at a later date and noted an open item regarding this issue. The areas of the plant that would most likely be affected by loss of ventilation and cooling systems are the ones that will be necessary to be occupied (e.g., Main Control Room (MCR), TDAFW pump room) during the ELAP or will require ventilation for situations like hydrogen generation in the battery rooms. When developing strategies for cooling and ventilation for areas of the plant affected by ELAP, ensure that strategies include the above areas as a minimum. Provide a discussion of these issues in the appropriate update to the integrated plan. In addition, this strategy should provide information on the adequacy of the ventilation provided in the battery room to protect the batteries from the effects of elevated or lowered temperatures, especially if the ELAP is due to high or low temperature hazard. (Reference Item 3.2.4.2.A)

DNC Response:

The response to Audit Question #32 regarding the MPS2 plans and strategies to provide cooling and ventilation to areas of the plant affected by loss of AC power during the ELAP was provided in the response to Interim Staff Evaluation (ISE) Confirmatory Item 3.2.4.2.A in Attachment 2 of the MPS2 Six-Month Status Report dated August 27, 2015 (Reference 2).

Audit Question #35:

In the integrated plan Dominion did not discuss the effects of loss of power to heat tracing. Provide a discussion and analysis of the effects of the loss of heat tracing for equipment required to cope with an ELAP. (Reference Item 3.2.4.3.A)

DNC Response:

The response to Audit Question #35 was provided to the NRC staff in Attachment 3 of the MPS2 Six-Month Status Update Letter dated February 28, 2014 (Reference 1).

Audit Question #44:

Section 3.2 of WCAP-17601-P discusses the PWROG's recommendations that cover following subjects for consideration in developing FLEX mitigation strategies: (1) minimizing RCP seal leakage rates; (2) adequate shutdown margin; (3) time initiating cooldown and depressurization; (4) prevention of the RCS overfill; (5) blind feeding an SG with a portable pump; (6) nitrogen injection from SITs, and (7) asymmetric natural circulation cooldown (NCC). Discuss Dominion's position on each of the recommendations discussed above for developing the FLEX mitigation strategies. List the recommendations that are applicable to the plant, provide rationale for the applicability, address how the applicable recommendations are considered in the ELAP analysis, and discuss the plan to implement the recommendations. Also, provide rationale for each of the recommendations that are determined to be not applicable to the plant.

DNC Response:

1. The emergency procedure for the response to Station Blackout (SBO) has been revised to provide the necessary guidance to accomplish the Phase 1 strategy for a rapid cooldown and depressurization consistent with the OIP and WCAP-17601, as indicated in OIP Open Items #5 and #9. As stated in Section 3.2 of WCAP-17601, performing a plant cooldown early in the ELAP and reducing Reactor Coolant System (RCS) pressure greatly increases the ELAP coping time relative to RCS inventory control by reducing the RCS inventory loss from any leak.

2. Studies have been completed in calculation MISC-11791 on the reactivity effects of early cooldown. The studies show that for a typical MPS2 core, no boron addition is required to maintain the core with at least a 1% shutdown margin at a 350°F inlet temperature, xenon-free condition. For long-term cooldown to cold shutdown conditions, only small amounts of boration (<100 ppm at end-of-cycle core conditions) will be required.

Core reload checks have been developed which confirm that the guidance remains applicable for future core reloads.

3. This item is addressed in the response for Recommendation 1.

4. MPS2 has adopted the new PWROG strategy of early cooldown and depressurization of the unit. A target condition of approximately 350°F and 120 psia secondary pressure is anticipated. The studies in WCAP-17601-P show that with the plant in a solid condition, if the Steam Generator (SG) and RCS temperatures are kept constant, with continued heat removal via the SGs, then maintaining RCS pressure control is not difficult. In addition, the initial cooldown will drain the pressurizer due to RCS inventory volume shrinkage. Once the BDB RCS injection pump is deployed (at ~16 hours) and pressurizer level is restored, operators can prevent RCS overfill and control pressure by limiting RCS inventory through injection flow control.

5. The MPS2 FLEX strategies do not include blind feeding of a SG with a portable pump, therefore, this recommendation is not applicable for MPS2.

6. As described in Section B.1 of the OIP, Phase 1 coping following an ELAP / Loss of Ultimate Heat Sink (LUHS) will be accomplished using the installed Turbine Driven Auxiliary Feedwater (TDAFW) pump to feed the SGs, Main Steam (MS) Atmospheric Dump Valves (ADVs) to provide SG steam release to control RCS temperature and effect an RCS cooldown, and the Condensate Storage tank (CST) to provide the AFW water source to the TDAFW pump. The Phase 1 coping strategy provides reactor core cooling and decay heat removal for a minimum of 7.2 hours and is sufficient to stabilize the plant at 120 psia SG pressure, which will result in RCS cold leg temperature of approximately 350°F with pressure greater than the Safety Injection Tanks (SITs) nitrogen injection pressure.

The SITs would either be isolated or vented prior to depressurizing the RCS below the point where nitrogen injection could occur.

7. The MPS2 core cooling and heat removal strategy utilizes a symmetrical natural circulation cooldown of the RCS. The AFW system is aligned for flow to both SGs from the TDAFW pump and the operators will manually control the MS ADVs for steam release from both SGs. This allows for a symmetric natural circulation cooldown of the RCS.

Audit Question #80:

Generic Open Item: The licensees' plans for equipment maintenance and testing which endorses the Electric Power Research Institute (EPRI) industry program for maintenance which is currently under development does not provide reasonable assurance that guidance and strategies developed and implemented under them will conform to the guidance of NEI 12-06, Section 11.5 with respect to maintenance and testing. Please provide details of the EPRI industry program for maintenance and testing of FLEX electrical equipment such as batteries, cables, and diesel generators.

DNC Response:

The Response to Audit Question #80 was provided to the NRC staff in Attachment 3 of the MPS2 Six-Month Status Update Letter dated February 28, 2014 (Reference 1).

Reference:

1. DNC's 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 28, 2014 (Serial No. 12-161E)(ML14069A013).

2. DNC's 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 27, 2015 (Serial No. 14-393E)(ML15246A123).

Attachment 3

FINAL INTEGRATED PLAN

Beyond Design Basis
FLEX Mitigation Strategies

Dominion Nuclear Connecticut, Inc.
Millstone Power Station - Unit 2

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1. Background

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

The US Nuclear Regulatory Commission (NRC) assembled a Near-Term Task Force (NTTF) to advise the Commission on actions the US nuclear industry should take to preclude core damage and a release of radioactive material after a natural disaster such as that seen at Fukushima. The NTTF report (Reference 1) contained many recommendations to fulfill this charter, including assessing extreme external event hazards and strengthening station capabilities for responding to beyond-design-basis external events.

Based on NTTF Recommendation 4.2, the NRC issued Order EA-12-049 (the Order) (Reference 2) on March 12, 2012 to implement mitigation strategies for Beyond-Design-Basis external events. The order provided the following requirements for strategies to mitigate BDB external events:

1. Licensees shall develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and Spent Fuel Pool (SFP) cooling capabilities following a BDB external event.

2. These strategies must be 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.

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

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

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

The Order specifies a three-phase approach for strategies to mitigate BDB external events:

- Phase 1 - Initially cope relying on installed equipment and onsite resources.
- Phase 2 - Transition from installed plant equipment to onsite BDB 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 (Reference 2) required licensees of operating reactors to submit an overall integrated plan, including a description of how compliance with these requirements would be achieved by February 28, 2013. The Order also required licensees to complete implementation of the requirements no later than two refueling cycles after submittal of the overall integrated plan or December 31, 2016, whichever comes first.

The Nuclear Energy Institute (NEI) developed NEI 12-06 (Reference 3), which provides guidelines for nuclear stations to assess extreme external event hazards and implement the mitigation strategies specified in NRC Order EA-12-049. The NRC issued Interim Staff Guidance JLD-ISG-2012-01 (Reference 4), dated August 29, 2012, which endorsed NEI 12-06 with clarifications on determining baseline coping capability and equipment quality.

NRC Order EA-12-051 (Reference 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 (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 is an acceptable method for satisfying the requirements in Order EA-12-051.

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

2.1 General Elements - Assumptions

The assumptions used for the evaluations of a Millstone Unit 2 ELAP/LUHS event and the development of FLEX strategies are stated below. The assumptions conservatively recognize that Millstone is a two unit site and that available resources must address both units.

Boundary conditions consistent with NEI 12-06 Section 3.2.1, *General Criteria and Baseline Assumptions* are established to support development of FLEX strategies, as follows:

- The BDB external event occurs impacting both Millstone Units 2 and 3 at the site.

- Both reactors are initially operating at full power, unless there are procedural requirements to shut down due to the impending event. The reactors have been operating at 100% power for the past 100 days.

- Each reactor is successfully shut down when required (i.e., all rods inserted, no Anticipated Transient Without Scram (ATWS)). Steam release to maintain decay heat removal upon shutdown functions normally, and reactor coolant system (RCS) overpressure protection valves respond normally, if required by plant conditions, and reseat.

- Onsite staff is at site administrative minimum shift staffing levels.

- No independent, concurrent events, e.g., no active security threat.

- All personnel onsite are available to support site response.

- The reactor and supporting plant equipment are either operating within normal ranges for pressure, temperature and water level, or available to operate, at the time of the event consistent with the design and licensing basis.

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

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

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

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

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

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

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

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

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

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

- Exceptions to the site security plan or other requirements of Title10 of the Code of Federal Regulations (10 CFR) may be required.

- Deployment resources are assumed to begin arriving at hour 6 and unlimited resources available after 24 hours.

- This plan defines strategies capable of mitigating a simultaneous loss of all alternating current power and loss of normal access to the ultimate heat sink resulting from a BDB external event by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities at all units on a site. Though specific strategies have been developed, due to the inability to anticipate all possible scenarios, the strategies are also diverse and flexible to encompass a wide range of possible conditions to protect the public health and safety. Millstone Unit 2's Emergency Operating Procedures (EOPs) have been revised, in accordance with established EOP change processes, to clearly reference and identify appropriate entry and exit conditions for these pre-planned strategies. The EOPs retain overall command and control of the actions responding to a BDB external event. Also, the impact of these strategies on the design basis capabilities of the unit have been evaluated under 10 CFR 50.59.

- The plant Technical Specifications contain the limiting conditions for normal unit operations to ensure that design safety features are available to respond to a design basis accident and direct the required actions to be taken when the limiting conditions are not met. The result of the BDB external event may place the plant in a condition where it cannot comply with certain Technical Specifications and/or with its Security Plan, and, as such, may warrant invocation of 10 CFR 50.54(x) and/or 10 CFR 73.55(p). This position is consistent with the previously documented Task Interface Agreement (TIA) 2004-04, *Acceptability of Proceduralized Departures from Technical Specifications (TSs) Requirements at the Surry Power Station*, (TAC Nos. MC4331 and MC4332), dated September 12, 2006 (Accession No. ML060590273). This position has also been endorsed by the NRC via NRC Letter to NEI dated April 17, 2015 Endorsing the NEI/Industry position on Change Process with regard to BDB Applications (ML14147A073).

2.2 Strategies

The objective of the FLEX strategies is to establish an indefinite coping capability in order to 1) prevent damage to the fuel in the reactors, 2) maintain the containment function and 3) maintain cooling and prevent damage to fuel in the SFP using installed equipment, onsite portable equipment, and pre-staged offsite resources. This indefinite coping capability addresses an ELAP – loss of offsite power, emergency diesel generators and any alternate AC source, but not the loss of AC power to buses fed by station batteries through inverters – with a simultaneous LUHS. This condition could arise following a BDB external event.

The plant indefinite coping capability is attained through the implementation of pre-determined strategies (FLEX strategies) that are focused on maintaining or restoring key plant safety functions. The FLEX strategies are not tied to any specific damage state or mechanistic assessment of external events. Rather, the strategies are developed to maintain the key plant safety functions based on the evaluation of plant response to an ELAP/LUHS event. A safety function-based approach provides consistency with, and allows coordination with, existing plant 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 BDB 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 BDB external event by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities for Millstone Unit 2. 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 Millstone Unit 2 EOPs in accordance with established EOP change processes and their impact on the design basis capabilities of the unit evaluated under 10 CFR 50.59.

An overall diagram of the following FLEX strategies showing the staging locations of BDB equipment and general hose routing is provided in Figures 1 and 2. A schematic representation of the FLEX strategy connections is provided in Figure 3.

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 Atmospheric Dump Valves (ADVs) and the addition of a corresponding amount of Auxiliary Feedwater (AFW) to the SGs via the turbine driven AFW (TDAFW) pump. The AFW system uses the Condensate Storage Tank (CST) as the initial water supply to the TDAFW pump. Operator actions to verify and throttle AFW flow are required by the EOPs following an ELAP/LUHS event to prevent SG dryout and/or overfill.

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

DC bus load stripping is initiated within 45 minutes following a BDB external event to ensure battery life is extended to 29 hours. Portable generators are used to repower instrumentation prior to battery depletion.

RCS makeup and boron addition is initiated by 16 hours following a BDB external event to ensure natural circulation, reactivity control, and boron mixing is maintained in the RCS.

2.3.1 Phase 1 Strategy

Following the occurrence of an ELAP/LUHS event, the reactor trips and the plant is initially stabilized at no-load RCS temperature and pressure conditions, with reactor decay heat removal via steam release to the atmosphere through the SG safety valves (SVs) and/or the ADVs. Natural circulation of the RCS develops to maintain core cooling and the TDAFW pump provides flow from the CST to the SGs to make-up for steam release.

Operators respond to the ELAP/LUHS event in accordance with EOPs to confirm RCS, secondary system, and containment conditions. A transition to EOP 2530, *Station Blackout*, is made upon the diagnosis of the total loss of AC power. This procedure (along with referenced FSGs) directs isolation of RCS letdown pathways, confirmation of natural circulation cooling, verification of containment isolation, reduction of DC loads on the station

Class 1E batteries, and establishment of electrical equipment alignment in preparation for eventual power restoration. The operators establish manual control of the SG ADVs and initiate a rapid cooldown of the RCS to minimize inventory loss through the Reactor Coolant Pump (RCP) seals (See Section 2.3.8 for discussion of RCP seals). EOP 2530 directs local manual control of AFW flow to the SGs and manual control of the SG ADVs to control steam release and the RCS cooldown rate, as necessary.

Secondary Side - The Phase 1 FLEX strategy for reactor core cooling and heat removal relies upon installed plant equipment and water sources for AFW supply to the SGs and steam release to the atmosphere. Following an ELAP/LUHS event, the TDAFW pump is manually started from the control room and delivers more than the design basis AFW flow requirements. There is no auto-start feature on the Millstone Unit 2 TDAFW pump. Should the pump fail to start or trip, operations personnel manually reset and start the pump (which does not require electrical power for motive force or control). Sufficient time is available (Approximately 1 hour) to perform this action prior to dry-out conditions (Reference 8). The AFW system is pre-aligned for flow to both SGs from the TDAFW pump. Manual control of TDAFW pump flowrate to the SGs to establish and maintain proper water levels in the SGs is performed locally at the AFW Valve Cage on level 14'–6" of the Turbine Building above the TDAFW pump room. Throttling of the feedwater flow within approximately 1.8 hours prevents overfilling of the SGs.

Steam release from the SGs is controlled locally from the Millstone Unit 2 Enclosure Building using installed manual control handwheels on the SG ADVs.

In accordance with the existing procedure for response to loss of all AC power, an RCS cooldown with a rate up of to 100°F/hr is initiated to a SG minimum pressure of 120 psia, which corresponds to an RCS core inlet temperature of approximately 350°F. The rapid RCS cooldown minimizes adverse effects of high temperature coolant on RCP shaft seal performance and reduces SG pressure to allow for eventual AFW injection from a portable pump in the event that the TDAFW pump becomes unavailable. The minimum SG pressure of 120 psia is established high enough to prevent nitrogen gas from the Safety Injection Tanks from entering the RCS.

Initially, AFW water supply is provided by the installed CST. This tank has a maximum capacity of 225,000 gallons of water and a TS minimum level requirement of 165,000 gallons (Reference 9). Based on the minimum usable volume of 142,746 gallons, the tank supplies feed water for approximately 8.4 hours for RCS decay heat removal assuming an RCS cooldown to a minimum SG pressure of 120 psia (Reference 8). Prior to depletion of the inventory in the CST, the CST inventory can be replenished from various other onsite sources during Phase 2.

Primary Side (RCS) - The RCS is cooled down and depressurized until SG pressure reaches a minimum of 120 psia. RCS isolation is verified to have occurred automatically, and RCS leakage is assumed to be through the RCP seals (See Section 2.3.8). Natural circulation is maintained until approximately 25 hours (See Section 2.3.7.2) at which time reflux cooling begins. K_{eff} is calculated to remain less than .99 at the RCS conditions corresponding to a SG minimum pressure of 120 psia (See Section 2.3.9).

Electrical/Instrumentation - Load stripping of all non-essential loads begins within 45 minutes after the occurrence of an ELAP/LUHS and is completed within the next 30 minutes. With load stripping, the useable Class 1E station battery life for Millstone Unit 2 is calculated to be 29 hours (See Section 2.3.11).

2.3.2 Phase 2 Strategy

The Operations staff monitors the CST level in the control room or locally using level instruments. Once the CST usable volume is depleted in 8.4 hours, an additional 5.3 hours is available to deploy another makeup source before the steam generators dry out. Therefore, additional water sources as discussed in Section 2.15 have been included in the FLEX strategy procedures.

An AFW pump suction hose connection is installed between the CST and the TDAFW pump for use with the BDB FLEX strategies. This connection provides a path to allow for an AFW supply to the TDAFW pump other than the CST. A second hose connection is installed between the motor-driven AFW pumps and the CST to provide a path for the CST to be refilled using a portable transfer pump, if required. A portable diesel transfer pump, hoses, fittings, and fuel oil has been pre-staged in the Turbine Building to facilitate the transfer of water from various sources to the CST. The CST may be refilled from a variety of sources, including the onsite fire system, city water system, the onsite freshwater pond, and various onsite water storage tanks, if available.

Additionally, as required by NEI 12-06, SG water injection using a portable AFW pump is provided and is available through both primary and alternate connection locations (Figure 4). These connections are described further in Section 2.3.5.

The primary method for make-up to the RCS is the BDB RCS injection pump and is deployed in sufficient time to provide the capability to begin delivery of RCS inventory makeup from the Refueling Water Storage Tank (RWST) or another borated suction source at 16 hours. The alternate method for make-up to the RCS is performed using the installed “B” or “C” Charging Pumps.

For the primary make-up method, a suction hose is connected to the RWST FLEX strategy connection to provide borated RWST water to the suction of the BDB RCS Injection pump. A high-pressure hose is routed from the discharge of the BDB RCS Injection pump to the primary or the alternate RCS injection connection point to provide RCS inventory makeup for the remainder of the ELAP/LUHS event (Figure 5).

In order to utilize the alternate method of a Millstone Unit 2 charging pump, the portable 480 VAC generator is moved onsite from the BDB Storage Building. This generator powers the 480 VAC vital Bus 22F. A charging pump (either pump “B” or “C”) is powered through the Motor Control Center. Either charging pump can take a suction from the RWST or the Boric Acid Storage tanks to replenish the RCS and increase Shutdown Margin. Deployment and connection of the 480 VAC generator can start after augmented staff arrives onsite after six hours. This allows a charging pump to be available in sufficient time to provide the capability to begin delivery of RCS inventory makeup from the RWST or the BASTs at 16 hours in order to prevent the breakdown of natural circulation.

The Phase 2 FLEX strategy also includes re-powering of vital 120 VAC buses within 16 hours using a portable 480 VAC Diesel Generator (DG) stored onsite. Prior to depletion of the Class 1E 125 VDC batteries on Millstone Unit 2, vital 120 VAC circuits are re-powered to provide key parameter monitoring instrumentation. A portable 120/240 VAC DG is available as an alternate to the 480 VAC DG.

The restoration of power to 480 VAC Bus 22F can commence once augmented staff arrives on site after six hours. Assuming debris removal, installation, and cable connections, the 480 VAC generator is available to power Bus 22F on or before 13 hours after the start of an ELAP/LUHS event.

The cabling runs from a breaker on Bus 22F in the East 480 VAC Switchgear Room, through the Millstone Unit 2 cable vault at the 25 feet elevation, through a hole in the east wall to a connection box located on the north wall of the adjacent Millstone Unit 1 Cable Vault. The new connection includes a plug connection rated at 600 amps. (Figure 8)

The portable 480 VAC DG is transported from the BDB Storage Building to their deployed position located outside in the east courtyard between Millstone Units 1 and 2. Color coded cables required for connection are stored in the Millstone Unit 1 Cable Vault and are run from the Millstone Unit 1 Cable Vault to the portable generator through two new exterior penetrations at the 25 feet elevation in the Millstone Unit 1 cable vault. The cables are connected to the plug-in connection box located in the Millstone Unit 1 Cable Vault. (Figure 6).

The alternate strategy for repowering 120 VAC loads is the use of a 120/240 VAC generator as a backup to the 480 VAC generator for instrumentation purposes.

For the 120/240 VAC generator back-up strategy, new breakers were installed in Vital 120 VAC Panels VA20 and VA40 that is connected to the new supply cables from portable generators. These breakers are open when power to the panel is being supplied from in-house inverters. They are closed when supplying power from a portable BDB generator. The new connections include two single-phase, 120V 100 amp plug receptacles feeding an 80 amp breaker in VA20 and a 70 amp breaker in VA40. (Figure 7)

Cables are retrieved from the BDB Storage Building along with the 120/240 VAC DG. The cables are run from the new receptacles, which are connected to the new breakers, through the "B" and "A" DC Switchgear rooms and exit the building through the exterior entrance to the "A" DC Switchgear Room. The 120/240 Volt AC portable generator is deployed to the same general area (courtyard) as the 480 VAC portable generator outside of the exterior east door to this area. (Figure 6).

2.3.3 Phase 3 Strategy

No Phase 3 strategy is required for core cooling and decay heat removal. However, additional pumps are available from the National SAFER (Strategic Alliance for FLEX Emergency Response) Response Center (NSRC) to provide backup to the BDB High Capacity pumps as well as the BDB AFW pumps. The installed TDAFW pump has the capability to operate for an extended period of time to deliver AFW to the steam generators for core cooling and decay heat removal. Unavailability of the TDAFW pump can be mitigated using an onsite BDB AFW pump. Additionally, a Reverse Osmosis/Ion Exchanger system is provided from the NSRC to provide a method to remove impurities from alternate fresh water supplies to the TDAFW pump or the BDB AFW Pump.

Using the steam generators for core cooling and decay heat removal is dependent on sufficient reactor core decay heat generation and the available supply of clean water from onsite sources or from water processing units provided from the NSRC. Restoring Shutdown Cooling (SDC) provides an alternate method for removing decay heat and/or cooling down the RCS to Cold Shutdown.

In order to place SDC in service, FSG-15, "4160 VAC Generator Connection and Operation," directs restoration of SDC by including the necessary steps for establishing flow from the Reactor Building Component Cooling Water (RBCCW) System, filling the SDC System, heating up the SDC system, placing the SDC Heat Exchangers in service, and monitoring the SDC system parameters to confirm proper operation. Various Motor Operated Valves (MOVs) require 480 VAC power for alignment to support SDC operation.

In Phase 3, the FLEX strategy for providing 4160 VAC electrical power is implemented, making power available to a single Low Pressure Safety Injection (LPSI) Pump. The 4160 VAC Generators from the NSRC is connected to the 24D Emergency Bus.

In Phase 3, a large capacity air compressor from the NSRC is on site and is staged in a predetermined area along with sufficient hose to reach the temporary tie in for Instrument Air (IA) system.

2.3.4 Systems, Structures, Components

2.3.4.1 Turbine Driven Auxiliary Feedwater Pump

The TDAFW pump is manually started and delivers AFW flow to both SGs following an ELAP/LUHS event. In the event the TDAFW pump fails to start, procedures direct the operators to manually reset and start the pump (which does not require electrical power for motive force or control). Approximately 1 hour is available to manually start the pump and initiate flow prior to steam generator dryout. The TDAFW pump is sized to provide more than the design basis AFW flow requirements and is located in a safety-related, Class I structure designed for protection against applicable design basis external events.

2.3.4.2 Steam Generator Atmospheric Dump Valves (ADVs)

During an ELAP/LUHS event with the loss of all AC power and instrument air, reactor core cooling and decay heat removal are provided for an indefinite time period by manually controlling the SG ADVs. Manual operation of the SG ADVs is by installed handwheels. The SG ADVs are safety-related, seismic Category I, and are missile protected inside of the Enclosure Building.

The sections of the SG ADV vent pipes and silencer that are located in the East and West Penetration Rooms within the Enclosure Building at elevation 38'-6" and the piping outbound of the silencers have been modified to adequately restrain the silencer and connecting piping such that the boundary anchor sustains seismic and tornado/missile loads within design allowables while maintaining functionality of the downstream piping.

2.3.4.3 Batteries

The safety-related Class 1E batteries and associated DC distribution systems are located within safety-related, Class I structures designed to meet applicable design basis external hazards and are used to initially power required key instrumentation and applicable DC components. With load stripping of non-essential equipment, the usable battery life is has been calculated to be 29 hours of operations.

2.3.4.4 Condensate Storage Tank

The CST provides an AFW water source at the initial onset of the event. The tank is a safety-related structure designed to withstand applicable design basis external events. CST volume is maintained per the Millstone Unit 2 TSs (Reference 9) and is normally aligned to provide emergency makeup to the SGs. The minimum CST usable volume is approximately 143,700 gallons.

2.3.5 FLEX Strategy Connections

2.3.5.1 Primary AFW Pump Discharge Connection

Millstone Unit 2 has a mechanical primary connection for the diverse, flexible AFW injection strategy using a BDB AFW pump as a backup to the TDAFW pump. It is a seismically designed 3-inch diameter pipe connection via a tee into the 6-inch AFW pump discharge header to both SGs. The pipe connection is designed to allow more than 300 gpm of AFW to be delivered by the BDB AFW pump to the SGs at pressures of greater than 300 psig. The pipe connection is located in the AFW Valve Cage (14'- 6" level of the Turbine Building). The pipe connection is below the flood level of 19.17 feet for Millstone Unit 2, but is protected by flood gates to a level of 22 feet. This area of the Turbine Building is a seismically designed and the wall of the valve cage shares a wall with the safety-related Auxiliary Building. The pipe connection terminates in a hose coupling for easy connection to the discharge hose from the BDB AFW pump. The BDB AFW pump discharge can be connected to this hose coupling. A portable BDB AFW pump, stored in the BDB Storage Building, is pulled to a location near the Turbine Building Railway Access roll up door if the TDAFW pump becomes inoperable. A hose is run from the discharge of the BDB AFW pump to the new pipe connection. (Note: The BDB AFW pump is deployed early to be available in the event of projected site flooding).

2.3.5.2 Alternate AFW Pump Discharge Connection

In the event that the primary AFW Pump discharge connection is not available, an alternate connection location is provided. The alternate connection for the diverse, flexible AFW injection strategy using the BDB AFW to supply makeup to the SGs uses two 2-inch flanged connections for the SG pump down skid. This strategy requires removal of two blind flanges and installation of two flanges with a 2 ½-inch hose connection (one connection for each of the two SGs). Flow rate is controlled by manual valves downstream of each connection. Flow rate is controlled by manual valves downstream of each connection. The connections are located at Elevation (-)5' – 6" inches in the east penetration room of the Auxiliary Building. This is not a seismically designed connection, however, it is in a seismic, flood, and missile protected building.

2.3.5.3 CST Connection (AFW Pump Suction)

The primary BDB AFW pump suction is a 5-inch diameter hose connection that is located in the 14' – 6" level of the Turbine Building. The pipe connection is below the flood level of 19.17 feet for Millstone Unit 2, but is protected by flood gates to a level of 22 feet. This suction connection is located on the CST supply to the TDAFW pump. A hose is run from this hose connection to portable BDB AFW pump.

The BDB AFW pump piping connections to the AFW system are safety-related (through the inboard manual isolation valve), seismically designed and located in an area that provides high wind and associated missile protection.

Hydraulic analysis of the flowpath from the BDB CST connection to the primary and the alternate AFW Pump discharge connections has confirmed that the applicable performance requirement of 300 gpm is met.

2.3.5.4 Primary RCS Connection

The connection strategies for make-up to the RCS are applicable to the primary RCS injection method using the BDB RCS Injection Pump. The alternate injection method using the installed charging pumps does not require any piping connections to be made.

The primary connection is a new hose connection located in the AFW valve cage in the Millstone Unit 2 Turbine Building. The primary connection for RCS makeup is a 3-inch stainless steel pipe connection that tees into the existing 3-inch safety injection line located in the West Penetration Room at elevation (-)5' in the Auxiliary Building. The 3-inch pipe RCS makeup connection is routed up to the 14' – 6" floor elevation in the West Penetration Room and through a new penetration into the Turbine Building in the AFW valve cage. Two new safety-related manual isolation valves and a non-safety-related check valve are located in the West Penetration Room at Elevation 14' – 6". The hose connection located in the AFW valve cage is suitable for coupling to the high pressure discharge hose from the BDB RCS Injection pump.

The RCS makeup piping in the Auxiliary Building is safety-related (through the second manual isolation valve), seismically designed and located in an area that provides high wind and associated missile protection. The hose connection is in Turbine Building which is seismically designed, and is located on the shared wall between the Auxiliary and Turbine Buildings which affords adequate wind and missile protection.

The BDB RCS Injection pump is located outside the Turbine Building truck bay and a 1.5-inch hose is run from the discharge of the pump to the new hose connection located in the AFW valve cage.

2.3.5.5 Alternate RCS Connection

The alternate connection for the RCS Injection strategy is to use the Hydrostatic Test Connection in the Charging Header. The discharge valves for all the charging pumps are closed. The blind flange upstream of Charging Hydrostatic Test Connector isolation valve is removed and replaced with a hose adapter. The discharge hose from the BDB RCS Injection Pump is connected to the adapter. This requires approximately 775 feet of 1.5-inch hose. Flow can be directed to the RCS through the normal charging header.

2.3.5.6 RWST Suction Connection

Initial supply for the BDB RCS Injection pump is from a hose connection outside the RWST valve pit in the RWST pipe chase providing RWST water for RCS makeup. The RCS makeup supply piping in the RWST pipe chase is safety-related (through the second manual isolation valve), seismically designed and located in an area that provides high wind and associated missile protection.

Hydraulic analysis of the flowpath from the various borated water sources to the BDB RCS Injection pump and to both the primary and alternate RCS Injection pump discharge connections has confirmed that applicable performance requirements are met.

2.3.5.7 Primary Electrical Connection

The portable 480 VAC DG is transported from the BDB Storage Building to its deployed position located outside in the east courtyard between Millstone Units 1 and 2. The required color coded cables are stored in the Unit 1 Cable Vault. Cables are run from the Millstone Unit 1 Cable Vault to the portable generator through exterior penetrations in the 25 feet level of the Millstone Unit 1 cable vault.

The cables are connected to corresponding color coded plug receptacles which are rated at 600 amps. The receptacles are connected to the 480 VAC vital bus by cables run from a breaker on Bus 22F, through the Millstone Unit 2 cable vault at the 25 feet elevation, through a hole in the east wall to the receptacle connection box located on the north wall of the adjacent Millstone Unit 1 Cable Vault. (Figures 6 and 8)

2.3.5.8 Alternate Electrical Connection

The 120/240 Volt AC portable generator is deployed to a location in the courtyard outside of the exterior east door to this area. Cabling is run from the 120/240 VAC portable generator through the exterior entrance of the "A" DC switchgear room, through the "A" and "B" DC switchgear rooms to a receptacle panel. The cables are connected to two single-phase, 120V, 100 amp plug receptacles feeding an 80 amp breaker in VA20 and a 70 amp breaker in VA40. (Figures 6 and 7).

2.3.5.9 4160 VAC Electrical Connection

Two 1-MW 4160 VAC generators are provided from the NSRC along with a distribution panel and necessary connection cables. Cables are connected to the output breakers of the 1MW 4160 VAC generators to the 4160V distribution panel. Color-coded cables run from the distribution panel through the exterior door of the "B" Emergency Diesel Generator (EDG) room and are connected in the C39 Cabinet in the "B" EDG Room (Figure 9). The output cables from the EDG are lifted from the terminal box and replaced with the portable generator cables. Electrical connections are protected from all hazards due to their location. The 4160 VAC portable generators supply power to 4160 VAC vital Bus 24D.

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:

- AFW Flowrate - AFW flowrate indication is available in the Control Room (CR) and at the Fire Shutdown Panel (C-10). AFW flowrate indication is available throughout the event.

- SG Water Level - SG wide range (WR) and narrow-range (NR) water level indications are available in the CR and at the C-10 panel. SG NR level indication is available for all SGs throughout the event.

- SG Pressure - SG pressure indication is available in the CR and at the C-10 Panel. SG pressure indication is available for all SGs throughout the event.

- RCS Temperature - RCS hot-leg and cold-leg temperature indication are available in the CR and at the C-10 panel. RCS temperature indication is available throughout the event.

- RCS Pressure – RCS wide range (WR) and narrow range (NR) pressure indication is available in the CR and at the C-10 panel. RCS pressure indications are available throughout the event.

- Core Exit Thermocouple Temperature – Core Exit Thermocouple indications are available throughout the event at the Inadequate Core Cooling (ICC) cabinets located in the instrument rack room, adjacent to the CR.

- CST Level - CST water level indication is available in the CR and locally at the tank throughout the event.

- Pressurizer Level: Pressurizer level indication is available in the CR and at the C-10 panel. Pressurizer level indication is available throughout the event.

- Reactor Vessel Level Monitoring System (RVLMS): RVLMS indication is available from the ICC cabinet. RVLMS is available throughout the event.

- Excore Nuclear Instruments: Indication of nuclear source range activity is available in the CR. Indication is available throughout the event.

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

In the unlikely event that 125 VDC and 120 VAC Vital Bus infrastructure is damaged, alternate FLEX strategy guidelines for obtaining the critical parameters locally (e.g., at containment penetration and instrument racks) is provided in FSG-7, *Loss of Vital Instrumentation or Control Power.*

2.3.7 Thermal Hydraulic Analyses

2.3.7.1 Secondary Makeup Water Requirement

Calculations were performed to determine the inventory required to maintain steam generator levels and dryout times associated with the volumes of various onsite water sources. The conclusions from this analysis showed that the existing CST usable volume of approximately 143,700 gallons would be depleted in approximately 8.4 hours at which time another source of water would be required. The additional sources at Millstone Unit 2 consist of the existing fire protection system, various storage tanks onsite, and a 3 million gallon freshwater pond. The additional 3 million gallons of water is split between the two Millstone units and is sufficient for several weeks of decay heat removal. Available water sources are identified in Section 2.3.10.4. Although water quality concerns make it the least preferable choice, Long Island Sound (LIS) could be used as an indefinite but last resort water supply, if required.

2.3.7.2 RCS Response

The model used for determination of RCS response was the same model used in the generic analysis in Section 5.2.2 of WCAP-17601 (Reference 10). DNC performed a site specific applicability review of the analysis and confirmed applicability to Millstone Unit 2. Parameters used in the reference case model were compared to the Millstone Unit 2 plant and the overall results were confirmed to be bounded by the model and inputs used in the WCAP and associated analytical codes.

RCS inventory makeup begins within 16 hours following the onset of the ELAP/LUHS condition. Based on information from WCAP-17601 and WCAP-17792 (Reference 11), reflux cooling is estimated to occur at approximately 25 hours, but is conservatively assumed to occur at 17 hours. Millstone Unit 2 has low leakage Flowserve N-9000 seals, therefore, the leakage is predicted to be less than the 15 gpm/seal assumed by Westinghouse.

Since RCS inventory makeup at 45 gpm makeup capacity begins within 16 hours following the onset of the ELAP/LUHS condition and based on the conservative leakage evaluation with Flowserve N-9000 seals, the reflux cooling condition is avoided.

2.3.8 Reactor Coolant Pump Seals

Millstone Unit 2 is a Combustion Engineering (CE) 2-Loop plant with low leakage Flowserve N-9000 RCP seals. The Controlled Bleedoff (CBO) lines in Millstone Unit 2 are equipped with excess flow check valves which limit the leakage through the CBO lines to no more than 15 gpm per seal.

2.3.9 Shutdown Margin Analysis

A Shutdown Margin (SDM) Analysis was performed for a typical Millstone Unit 2 reactor core and determined that for cooldown and depressurization to a target steam generator pressure of 120 psia (corresponds to core inlet temperature of approximately 350°F), no boration is required to maintain Keff <0.99. The limiting case is an end of cycle (EOC) condition and does not credit boron injection by the Safety Injection Tanks. If further cooldown and depressurization is desired, some boration is needed for core inlet temperatures below 315°F.

Phase 2 boration using the BDB RCS injection pump transported from the BDB Storage Building is required. Longer term reactivity control prior to further cooldown requires approximately 2100 gallons of injected water from the RWST for core inlet temperatures as low as 200°F. This additional boron requirement is met at less than one hour of RCS inventory makeup at 45 gpm based on the use of the RCS Injection pump. This makeup volume can easily be accommodated by RCS volume shrink without venting the RCS.

Since the RCS inventory makeup is initiated no later than 16 hours following an ELAP/LUHS event, the borated water injected into the RCS for inventory makeup bounds the boration requirements for maintaining a core reactivity shutdown margin of 1% following an ELAP/LUHS event.

Dominion Nuclear Connecticut, Inc.'s (DNC's) Nuclear Analysis and Fuel Department performs checks for every reload core to verify that the FLEX inventory management and reactivity control strategy remains adequate to maintain k-eff < 0.99 throughout the ELAP/LUHS event.

The SDM calculation assumes a uniform boron mixing model. Boron mixing was identified as a generic concern by the NRC and was addressed by the PWROG. The NRC endorsed the PWROG boron mixing position paper (Reference 12) with the clarification that a one hour mixing time was adequate provided that the flow in all loops is greater than or equal to the corresponding single-phase natural circulation flow rate (Reference 13). Westinghouse calculated the time for which the single-phase flow becomes less than the two-phase flow, if RCS makeup is not initiated, for the maximum RCS leakage case (CE plant seals leaking at a maximum 15 gpm/seal). For 2-loop CE plants such as Millstone Unit 2, the time to reach this condition (two-phase natural circulation flow is less than single-phase natural circulation flow) is conservatively set at 17 hours. Since RCS makeup is initiated within 16 hours, and the pump capacity of 45 gpm is greater than the maximum RCS leakage, the NRC clarification regarding single-phase flow has been addressed and a one hour mixing time is acceptable. Since additional boron is not required until the unit drops below the minimum target SG pressure, a SDM of at least 1% is maintained.

2.3.10 FLEX Pumps and Water Supplies

2.3.10.1 Beyond Design Basis (BDB) High Capacity Pump

The BDB High Capacity pump is a 150 psid at 1200 gpm pump that is shared between several functions. The pump is sized to provide AFW to both Millstone Unit 2 and Millstone Unit 3 and Spent Fuel Pool make-up to both Millstone Unit 2 and Millstone Unit 3, simultaneously. Hydraulic analysis of the flow path from each water source to the CST, the Millstone Spent Fuel Pools, and to the BDB AFW Pump suction has confirmed that applicable performance requirements are met.

The BDB High Capacity Pump is a trailer-mounted, diesel driven centrifugal pump that is stored in the BDB Storage Building. The pump is deployed by towing the trailer to a designated draft location near the selected water source. Only one BDB High Capacity pump is required to implement the Phase 1 and Phase 2 reactor core cooling and heat removal strategy for both Millstone Unit 2 and Millstone Unit 3. Two BDB High Capacity pumps are available to satisfy the N+1 requirement.

2.3.10.2 <u>BDB AFW Pump</u>

Consistent with NEI 12-06, Appendix D, SG water injection capability is provided using a portable AFW pump through a primary and alternate connection. The BDB AFW pump is a 450 psid at 300 gpm pump. The BDB AFW Pump is a trailer-mounted, diesel engine driven centrifugal pump that is stored in the BDB Storage Building. The portable, diesel-driven BDB AFW Pump (Table 1) provides a back-up SG injection method in the event that the TDAFW pump can no longer perform its function due to insufficient turbine inlet steam flow from the SGs. Hydraulic analyses have confirmed that the BDB AFW pump is sized to provide the minimum required SG injection flowrate to support reactor core cooling and decay heat removal. Three BDB AFW pumps are available to satisfy the N+1 requirement.

2.3.10.3 <u>BDB RCS Injection Pump</u>

The PWROG Core Cooling Position Paper (issued in conjunction with WCAP-17601) recommends that the RCS Injection pump required delivery pressure be established at the saturation pressure of the reactor vessel head + 100 psi driving head to allow RCS injection. Millstone Unit 3 is the limiting unit for this RCS Injection pump sizing determination since the Millstone Unit 3 target SG pressure (and subsequently RCS temperature and pressure) are higher than for Millstone Unit 2.

Following the formula in the position paper, the required delivery pressure for the RCS Injection pump for Millstone Unit 3 is approximately 1243 psia. Accordingly, the BDB RCS Injection pump is capable of delivering a minimum flow of 45 gpm at a discharge pressure of up to 2000 psig. Hydraulic analyses of the BDB RCS Injection pump with the associated hoses and installed piping systems confirm that the BDB RCS Injection pump minimum flow rate and head capabilities exceed the FLEX strategy requirements for maintaining RCS inventory for both Millstone Units 2 and 3.

Millstone Unit 3 relies on one BDB RCS Injection pump for RCS makeup. Millstone Unit 2 has the option to repower a Charging Pump for RCS makeup or use one BDB RCS Injection pump for RCS makeup. Therefore, two RCS Injection pumps, plus a Millstone Unit 2 charging pump, are available at Millstone to satisfy the N+1 requirement for the RCS makeup and reactivity control functions.

2.3.10.4 AFW Water Supplies

– Condensate Storage Tank

The primary water source for the AFW supply is the CST which is a seismic, wind/tornado and missile protected designed tank. The normal volume in the CST is at least 225,000 gallons, with a TS minimum required volume of 165,000 gallons. Note: due to the height of the piping connection, the minimum usable volume is 142,746 gallons.

The CST may be refilled from a variety of sources (see the Table 3), including the onsite fire system, city water system, the onsite freshwater pond, and various other onsite water sources.

– Primary Water Storage Tank

The next preferred source for AFW supply is the primary water storage tank (PWST). The PWST has a 150,000 gallons net capacity with a normal level of 100,000 gallons. This is a non-safety-related water supply which is designed for Seismic Class 2. If the PWST is available, a portable pump would be used to transfer the water to the CST via a new 4-inch hose connection.

– Condensate Hotwell

A limited source of feed water can be obtained from the condenser hotwells. Each of the four hotwells has a 2-inch drain line that can be connected to a portable pump suction. A portable diesel transfer pump with associated hoses, adapters, and fuel oil are pre-staged in the Turbine Building to facilitate the transfer of water from the hotwells to the CST refill connection. In the event of a site flooding situation, this allows replenishment of the CST prior to recession of flood waters from the site. The hotwell is located in a seismic structure, and is robustly protected from winds and missiles.

- <u>Fire Protection/City Water Supply</u>

If the fire water storage tanks are available after an ELAP/LUHS event, the BDB High Capacity pump suction can be aligned to take suction from the two fire water storage tanks via an existing yard fire hydrant. Each tank has a useable volume of 245,000 gallons. This is a non-seismic non-safety-related water supply. If needed, a fire hose adapter can be connected to refill the CST from fire water via a fire hydrant.

The fire water storage tanks are filled through a domestic water line fed from the city water system.

If the fire water storage tanks are not available but the offsite city water supply is intact, the CST can be replenished or the suction side of a portable transfer pump is connected to a fire hydrant that is connected to the city water supply. Refer to Section 2.15 for discussion of water quality.

- <u>Onsite Freshwater Pond</u>

The onsite freshwater pond is an untreated water source and requires the use of a suction strainer. For every foot of depth there are approximately 1.06 million gallons in the pond. Even at the driest times the pond should maintain a 3 feet minimum depth. Therefore, it is assumed that approximately 3 million gallons of storage capacity would be available. Assuming that this water is evenly divided between Millstone Units 2 and 3, 1,500,000 gallons is available for use as an AFW water supply. Refer to Section 2.15 for discussion of water quality.

In event of an extreme storm surge there is a possibility that this water supply may become brackish due to the close proximity and limited elevation change to Long Island Sound. In this event, the onsite pond would be used only after other available clean onsite sources had been expended.

2.3.10.5 Borated Water Supplies

Three sources of borated water have been evaluated for use during a BDB event. Each borated water source is discussed below, in order of preference.

– Refueling Water Storage Tank

Each unit at Millstone is equipped with one RWST located at grade level. The tanks are stainless steel, safety-related, seismic Category I storage tanks, but are not protected from missiles. During "at power" operations, Millstone Unit 2's RWST volume is maintained greater than 370,000 gallons at a boron concentration of approximately 2,700 ppm. The RWST is the preferred borated water source for the RCS Injection strategies.

– Boric Acid Storage Tank (BAST)

Water with a higher boron concentration than the RWST may be available for RCS makeup from the Boric Acid Storage Tanks (BASTs). The BASTs are 6,600 (each) gallons, insulated, temperature-controlled, storage tanks that store water of approximately 2.5 to 3.5 weight percent (4,300 to 6,100 ppm) boric acid concentration. With boric acid concentrations in the BASTs less than or equal to 3.5 weight percent, tank heaters are not required to prevent boron precipitation at Auxiliary Building ambient temperatures. The BASTs are safety-related, seismically designed and located in the missile protected Auxiliary Building at an elevation of (-)5'.

– Portable Boric Acid Mixing Tank

In the event that both RWSTs and the BASTs are unavailable or become depleted, portable Boric Acid Mixing Tanks are available to provide a suction source for the BDB RCS Injection pumps. These mixing tanks are deployed, as needed, from the onsite BDB Storage Building to a position near the Millstone Unit 2 BDB RCS Injection pump. Dilution water is added to the mixing tank by either a portable transfer pump, or from a branch line from the BDB High Capacity pump header (water thief) taking suction from a clean water source. Bags of powdered boric acid are mixed with dilution water to achieve the proper concentration for maintaining adequate shutdown margin while making up RCS inventory. The clean water mixing tank dilution sources are used in the same priority as the potential AFW sources listed in Table 3. The Long Island Sound (or the onsite freshwater pond if it becomes contaminated with water from the Long Island Sound) would only be used for RCS make-up as a last resort.

Each portable borated water tank is equipped with an agitator to facilitate mixing of the boric acid, although complete dissolution of the powdered boric acid is not required since agitation continues throughout the injection process. The maximum boron concentration that is mixed in one of these mixing tanks is less than the concentration at which precipitation concerns occur, even at temperatures down to 32°F, however, a heater is also available to prevent tank freezing, if necessary.

2.3.11 Electrical

The Class 1E battery duty cycle of 29 hours for Millstone Unit 2 was calculated in accordance with the IEEE-485 methodology using manufacturer discharge test data applicable to the licensee's FLEX strategy as outlined in the NEI white paper on Extended Battery Duty Cycles (Reference 14). The time margin between the calculated battery duration for the FLEX strategy and the expected deployment time for FLEX equipment to supply the DC loads is approximately 16 hours for Millstone Unit 2.

The strategy to re-power the stations vital AC/DC buses requires the use of diesel powered generators. Millstone Unit 2 requires one portable 480 VAC portable diesel generator or one120/240 VAC portable diesel generator.

The 480 VAC DG is a 500 KW, 3-phase generator that is trailer-mounted with a 500 gallon double-walled diesel fuel tank built into trailer.

The 120/240 VAC DG is a 23.3 KW, single phase, 60Hz, generator that is trailer-mounted with a 100 gallon double-walled diesel fuel tank built into trailer.

Both 4160 VAC and additional 480 VAC generators are available from the NSRC for the Phase 3 strategy. The specifications and ratings for this equipment are listed in Table 2.

2.4 Spent Fuel Pool Cooling/Inventory

The basic FLEX strategy for maintaining SFP cooling is to monitor SFP level and provide sufficient makeup water to the SFP to maintain the normal SFP level. Millstone Unit 2 has a single dedicated Spent Fuel Pool.

2.4.1 Phase 1 Strategy

A calculation has determined that with no operator action following a loss of SFP cooling at the maximum design heat load, the Millstone Unit 2 SFP reaches 212 °F in approximately 6 hours and boil off to a level 10 feet above the top of fuel in 30 hours from initiation of the event. The Phase 1 coping strategy for spent fuel pool cooling is to monitor spent fuel pool level using instrumentation installed as required by NRC Order EA-12-051 (Reference 5).

2.4.2 Phase 2 Strategy

The Phase 2 strategy is to initiate SFP makeup within 24 hours of the event by running a branch hose from the BDB High Capacity pump to the BDB SFP makeup connection located in the SFP Skimmer Cage in the Millstone Unit 2 Auxiliary Building. The strategy provides sufficient makeup water to the SFP to maintain the normal SFP level (Figure 10). The connection piping is seismically designed in accordance with the plant design basis and is protected from missiles in all directions. The BDB SFP makeup connection piping ties into an existing SFP makeup line which discharges directly into the SFP. Makeup water is provided from either the RWST or from one branch of the Millstone Unit 2 distribution manifold being supplied from the BDB High Capacity pump. The BDB High Capacity pump is trailer mounted and is towed to an available draft point by one of the BDB tow vehicles also located within the protected BDB Storage Building. Required hose lengths and fittings are located in the BDB Storage Building.

The alternate FLEX strategy for making up the SFP level is in accordance with AOP 2578, "Loss of Refuel Pool and Spent Fuel Pool Level," using systems already installed at Millstone Unit 2. These include use of the site fire header and the Auxiliary Feedwater supply to the Spent Fuel Pool. Also, an available alternate FLEX strategy consists of deploying a hose directly to the spent fuel pool area. Additionally, as required by NEI 12-06, spray monitors and sufficient hose length required for the SFP Spray Option are located in the BDB Storage Building (Figure 10).

2.4.3 Phase 3 Strategy

Additional Low Pressure / High Flow pumps are available from the NSRC as a backup to the onsite BDB High Capacity pumps. The NSRC also provides two 4160 VAC generators which can be used to re-power SFP cooling systems if emergency buses are available or restored.

2.4.4 Structures, Systems, and Components

2.4.4.1 Primary Connection

The primary SFP hose connection is located inside of the SFP Skimmer Cage located at elevation 14'-6" of the Auxiliary Building. The SFP pipe connection for the SFP ties into an existing emergency SFP makeup line to the SFP. The primary SFP hose connection is sufficiently sized to restore SFP level long term with the loss of SFP cooling and a makeup rate of 250 gpm.

2.4.4.2 Alternate/Spray Option Connection

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

2.4.4.3 Spent Fuel Pool Ventilation

Ventilation to prevent excessive steam accumulation utilizes available doors (both rollup and personnel doors) in the Auxiliary Building. The Auxiliary Building rollup door is on the 14' – 6" level of the Auxiliary Building. Two additional doors at the 71' elevation would also be opened. The opening of these doors provide both a vent path for steam and allows for a flow path of cool air to enter the area from the lower level rollup door and exit through higher elevations of the Spent Fuel Pool area of the Auxiliary Building, thus creating a chimney effect to vent steam from the Spent Fuel Pool area resulting from boiling in the SFP. If needed, portable fans can also be positioned at the

Auxiliary Building rollup door to enhance the ventilation. BDB FSGs implement this method of ventilation for the Spent Fuel Pool area.

2.4.5 Key Reactor Parameters

The key parameter for the SFP makeup strategy is the SFP water level. The SFP water level is monitored by the instrumentation that was installed in response to Order EA-12-051, *Reliable Spent Fuel Pool Level Instrumentation* (Reference 5).

2.4.6 Thermal-Hydraulic Analyses

An analysis was performed that determined, with the maximum expected SFP heat load immediately following a core offload and with the SFP cooling system unavailable, that the SFP reaches a bulk boiling temperature of 212°F in approximately 6 hours and boil off to a level 10 feet above the top of fuel in 30 hours unless additional water is supplied to the SFP. A flow of approximately 75 gpm replenishes the water being lost due to boiling. Deployment of the SFP hose connection from the BDB High Capacity pump within 24 hours with a design flow of 250 gpm for the SFP provides adequate flow to operate the SFP spray monitors or to provide makeup the SFP level to restore SFP levels. At a minimum, SFP level would be restored sufficiently to maintain an acceptable level of water for shielding purposes (greater than 10 feet above the top of fuel).

2.4.7 FLEX Pump and Water Supplies

2.4.7.1 BDB High Capacity Pump (Refer to 2.3.10.1)

The BDB High Capacity pump is a 150 psid at 1200 gpm pump that is shared between several functions. The BDB High Capacity Pump is a trailer-mounted, diesel driven centrifugal pump that is stored in the BDB Storage Building. The pump is deployed by towing the trailer to a designated draft location near the selected water source. One BDB High Capacity pump is sized to provide 600 gpm (300 gpm to each unit) for AFW and 250 gpm makeup to either the Millstone Unit 2 or Millstone Unit 3 SFPs coincident with a 100 gpm makeup to the opposite unit's SFP to account for losses due to boiling.

2.4.7.2 Fire Protection/City Water Supply

If the fire water storage tanks are available after an ELAP/LUHS event, a BDB portable pump suction can be aligned to supply suction from these two tanks. Each of the two fire water storage tanks has a useable volume of 245,000 gallons. This is a non-seismic, non-safety-related water supply.

The fire water storage tanks are filled through a domestic water line fed from the city water system.

If the fire water storage tanks are not available but the offsite city water supply is intact, the suction side of a portable pump is connected to a fire hydrant that is connected to the city water supply.

2.4.7.3 Onsite Freshwater Pond

This is an untreated water source and requires the use of a suction strainer. There is access to the pond from the west (plant side) side of the security barriers adjacent to the school house. For every foot of depth there are approximately 1.06 million gallons in the pond. Even at the driest times the pond should maintain a 3 feet minimum depth. In event of a storm surge there is a high probability that this water supply may become brackish due to the close proximity and limited elevation change to Long Island Sound.

2.4.7.4 Long Island Sound

The Long Island Sound is a salt-water source and is not a recommended source of makeup water for the SFP until all available freshwater sources have been depleted.

2.4.8 Electrical Analysis

The Spent Fuel Pool is monitored by instrumentation installed in response to Order EA-12-051. The power for this equipment has backup battery capacity for 72 hours. Alternative power is provided within 72 hours using onsite portable generators, if necessary, to provide power to the instrumentation and display panels and to recharge the backup battery.

2.5 Containment Integrity

With an ELAP/LUHS initiated while Millstone Unit 2 is in Modes 1-4, containment cooling is also lost for an extended period of time. Therefore, containment temperature and pressure slowly increase. Structural integrity of the containment due to increasing containment pressure is not challenged. However, with no cooling in the containment, temperatures in the containment are expected to rise and could reach a point where continued reliable operation of key instrument transmitters might be challenged.

Conservative evaluations have concluded that containment temperature and pressure remains below containment design limits and that key parameter instruments subject to the containment environment remains functional for a minimum of seven days. Therefore, actions to reduce containment temperature and pressure and to ensure continued functionality of the key parameters are not required immediately and utilize offsite equipment during Phase 3 if onsite capability is not restored.

2.5.1 Phase I

The Phase 1 coping strategy for containment involves initiating and verifying containment isolation per EOP 2530, *Station Blackout.* These actions ensure containment isolation following an ELAP/LUHS. Phase 1 also includes monitoring containment temperature and pressure from the MCR using installed instrumentation. Control room indication for containment pressure and containment temperature is available for the duration of the ELAP/LUHS.

2.5.2 Phase 2

Phase 2 coping strategy is to continue monitoring containment temperature and pressure using installed instrumentation. Phase 2 activities to repower key instrumentation (Section 2.9.4) are required to continue containment monitoring and also return the instrumentation necessary to monitor containment sump level.

The containment temperature is procedurally monitored and, if necessary, the containment temperature is reduced to ensure that key containment instruments remain within analyzed limits for equipment qualification. (The choice of equipment qualification as a temperature limit is conservative with respect to the containment temperature design limit.) Containment temperature reduction requires the implementation of a containment cooling strategy utilizing equipment provided in Phase 3. The various containment cooling strategy options are discussed Section 2.5.3.

2.5.3 Phase 3

Necessary actions to reduce containment temperature and pressure and to ensure continued functionality of the key parameters utilize existing plant systems powered by offsite equipment during Phase 3. The most significant need is to provide 4160 VAC power to operate the necessary station pumps. This capability is provided by two 1 MW 4160 VAC portable generators per unit provided from the NSRC. The mobile 4160 VAC generators and a distribution panel for each unit is brought in from the NSRC in order to supply power to one of the two Class 1E 4160 VAC buses. Additionally, by restoring the Class 1E 4160 VAC bus, power can be restored to the Class 1E 480 VAC via the 4160/480 VAC transformers to power selected 480 VAC loads.

If the SW pumps are not available, then Low Pressure/High Flow diesel driven pumps (up to 5,000 gpm) from the NSRC are available to provide flow to existing site heat exchangers in order to remove heat from the containment atmosphere.

Several options were evaluated to provide operators with the ability to reduce the containment temperature. Each of these options requires the restoration of multiple support systems to effectively remove heat from the containment thus reducing containment temperature and pressure.

Ventilation Cooling Option (Preferred)

The preferred option is to establish containment ventilation cooling using a Containment Air Recirculation (CAR) Fan, powered from the 480 VAC temporary generator. RBCCW and SW, (either from temporary pumps from the NSRC or installed plant equipment, if available) are powered from 4160 VAC temporary generators from the NSRC. This option is preferred since it does not "wet" the components inside containment. Once power is restored to the 4160 VAC and 480 VAC buses, a SW pump, RBCCW pump and a CAR fan are started, if available. The fans circulate air through their heat exchangers transferring containment heat to the RBCCW System, which in turn transfers the heat to the SW System and the ultimate heat sink (Figure 11). If a SW pump is unavailable, low pressure/high flow pumps from the NSRC supplies the SW header through hose connections.

Electrical System Requirements:

The CAR fan motor is 480 VAC, 75 HP and can be powered using the 480 VAC generator deployed from the onsite BDB Storage Building. The SW and an RBCCW pumps, however, require the 4160 VAC generators from the NSRC to be available. The 4160 VAC generators from the NSRC are sized to support these loads in support of containment cooling.

Component Cooling System Requirements:

The RBCCW system is required to provide a heat sink for the CAR fan coolers. It then transfers the heat load through the SW system to the UHS. RBCCW flow is manually controlled by throttling valves to the components being cooled.

Service Water Cooling System Requirements:

It is assumed the SW pumps at the intake structure are NOT available to be restarted, (starting one of the installed SW pumps is preferred). Therefore, this strategy includes the installation of a high volume (minimum 4,000 gpm), low pressure diesel driven pump from the NSRC. To supply the SW header in case the SW pumps are unable to be restarted, there are two 12-inch inspection flanges in the seismic Category 1 Intake Structure. Either one can be removed and replaced with an adapter (stored in the BDB Storage Building) designed to connect to the discharge of the low pressure/high flow pump from the NSRC (Figure 11). The SW piping is seismic and safety related. This source of SW can also be used for providing an UHS for SFP Cooling and Decay Heat Removal from the Reactor Core.

SW valves are manually aligned to distribute SW to the RBCCW heat exchanger.

Once cooling water flow is established to a CAR fan coil unit, Operations starts either the "B" or “C” CAR fan. These fans are powered from the station's emergency buses which are repowered when the 480 VAC temporary generator is running. Hydraulic analysis has been performed to support this strategy option.

Spray Option

An additional containment cooling option is to establish Containment Spray (CS) via the CS pump. The CS pump is powered from 4160 VAC generators from the NSRC, and uses clean water from the RWST to fill the containment sump and establish CS via a recirculation flow path after the sump is filled.

The CS heat exchanger is cooled by an RBCCW pump powered from 4160 VAC generators from the NSRC, and a portable high capacity pump tied into the SW system at the Intake (Figure 12).

Electrical System Requirements:

The CS pump motor is a 4160 VAC, 298 KW motor and is powered by the portable 4160 VAC diesel generators from the NSRC. One MOV must be opened manually or powered from the portable BDB 480 VAC DG from the BDB Storage Building. The RBCCW pump motor is 4160 VAC, 262 KW and is powered from the 4160 VAC generators from the NSRC.

Service Water Cooling System Requirements:

It is assumed the SW pumps at the intake structure are not available to be restarted, therefore, this strategy includes the use of a low pressure/high flow diesel driven pump from the NSRC. The connection of the low pressure / high flow pump is the same for the spray option as for the ventilation option previously discussed.

SW valves are manually aligned to distribute SW to the RBCCW heat exchanger.

2.5.4 Structures, Systems, Components

2.5.4.1 Ventilation Cooling Strategy

No mechanical equipment connections are required for the ventilation option if the SW pumps are available. If not, a Low Pressure / High Flow pump from the NSRC is connected to a pre-fabricated flanged adapter attached to one of the two 12-inch SW system inspection flanges in the Millstone Unit 2 Intake Structure to accommodate the NSRC low pressure/high flow pump.

2.5.4.2 Spray Strategy

No mechanical equipment connections are required for the spray option if the SW pumps are available. If not, a Low Pressure / High Flow pump from the NSRC is connected to a pre-fabricated flanged adapter attached to one of the two 12-inch SW system inspection flanges in the Millstone Unit 2 Intake Structure to accommodate the NSRC low pressure/high flow pump.

2.5.5 Key Containment Parameters

Instrumentation providing the following key parameters is credited for all phases of the containment integrity strategy:

- Containment Pressure: Containment pressure indication is available in the control room (CR) and is available by local pressure gage.
- Containment Temperature: FSG-07 provides direction for taking containment temperature readings, by use of a portable meter applied to the instrumentation contacts for temperature of various detectors, in either of the Instrumentation Racksets.

Instrumentation providing containment sump level indication is available in the CR for Phases 2 and 3. Although this key parameter is available in Phase 2, it is only credited in Phase 3, specifically for the containment cooling spray option.

Also, instrumentation for use in Phase 3 containment cooling options, such as SW flow rate (either from plant equipment or portable pump), RBCCW flow rate, RBCCW temperature, and RBCCW pressure is available to the operators once the instruments are repowered from temporary generators installed prior to implementing this strategy.

2.5.6 Thermal-Hydraulic Analyses

Conservative evaluations have concluded that containment temperature and pressure remains below containment design limits and that key parameter instruments subject to the containment environment remains functional for a minimum of seven days. The containment temperature is procedurally monitored and, if necessary, the containment temperature is reduced using the options available to ensure that key containment instruments remain within their analyzed limits for equipment qualification.

2.5.7 FLEX Pump and Water Supplies

The NSRC is providing a Low Pressure / High Flow pump (nominal 5,000 gpm) which may be used to provide cooling flow to the SW system. A Low Pressure / Medium Flow (nominal 2,500 gpm) pump is also available from the NSRC, if needed. Water supplies are from Long Island Sound.

2.5.8 Electrical Analysis

The containment cooling options described above require the powering of the 4160 VAC bus. The 4160 VAC equipment being supplied from the NSRC provide adequate power to perform the Phase 3 containment cooling strategies. The necessary components to implement the various containment cooling options have been included in the load calculations to support the sizing of the 4160 VAC generators. Accordingly, two 1 MW 4160 VAC generators and a distribution panel are provided from the NSRC for Millstone Unit 2.

2.6 Characterization of External Hazards

2.6.1 Seismic

The Millstone Unit 2 seismic hazard is considered to be the earthquake magnitude associated with the design basis seismic event. Per the Millstone Unit 2 FSAR (Reference 15), Section 5.8.1.1, the safe shutdown earthquake (SSE) has been specified as 0.17g maximum horizontal ground motion and a vertical ground acceleration of 0.11g. The operating basis earthquake (OBE) has been specified as 0.09g maximum horizontal ground motion with a vertical ground acceleration of 0.06g acting simultaneously.

The site lies in an area of low seismic activity. Only 13 earthquakes of Intensity V, Modified Mercalli (MM) or greater have been recorded within a distance of 50 miles of the site in more than 300 years. The nearest significant earthquake was at East Haddam, Connecticut, in 1791. Its epicenter was approximately 25 miles north of the site. At the time, the earthquake was classified as having an intensity of VIII but later review indicates that the intensity was no higher than VI to VII MM. Per Section 2.5.1 of Reference 16, the maximum intensity of ground motion experienced at the site in approximately 300 years of recorded history has not exceeded intensity V MM, which would correspond to an acceleration of 0.02 to 0.03g.

In addition to the NEI 12-06 guidance, NTTF Recommendation 2.1, Seismic, required that facilities re-evaluate the site's seismic hazard. Millstone Unit 2 subsequently re-evaluated the seismic hazard and developed a Ground Motion Response Spectra (GMRS) for the site based upon the most recent seismic data and methodologies. A review of the re-evaluated hazard determined that seismic reviews performed for initial plant licensing, and further evaluated as part of the Individual Plant Examination for External Events (IPEEE), bounded the GMRS in the lower frequency range (1 to 10

Hz), and concluded that performance of an Expedited Seismic Evaluation Plan (ESEP) and risk evaluation was not required for Millstone Unit 2 (Reference 17).

For FLEX Strategies, non-seismic structures and equipment may fail in a manner that would prevent accomplishment of FLEX-related activities (normal access to plant equipment, functionality of non-seismic plant equipment, deployment of beyond-design-basis (BDB) equipment, restoration of normal plant services, etc.). The diverse nature of the FLEX strategies has been discussed. The availability of primary and alternate connection points where non-seismic structures are involved ensures the ability to implement the FLEX strategies. The ability to clear haul routes from debris, resulting from a seismic event, to facilitate the deployment of the BDB Phase 2 equipment is addressed in Section 2.8.

2.6.2 External Flooding

Millstone is located on the north shore of Long Island Sound. To the west of the site is Niantic Bay and to the east is Jordan Cove. Based on current licensing basis considerations, the only sources of flooding that could affect Millstone are direct rainfall and storm surge. There are no major rivers or streams in the vicinity of the station, nor are there any watercourses on the site. A number of small brooks flow into Jordan Cove, east of the site, and into the Niantic River and thence to Niantic Bay, west of the site. Any flooding of these brooks, even as a result of the probable maximum precipitation, would not significantly raise the water levels of any body of water in the vicinity of the site. Additionally, in each area, local topography precludes flooding of any portion of the site from the landward side. Since there are no major rivers or streams in the vicinity of the station, the effects of potential seismically-induced dam failures, are not applicable.

Since Millstone is located on a peninsula projecting into Long Island Sound, it is subjected to tidal flooding from severe storms. The highest such flooding has resulted from the passage of hurricanes. For a probable maximum hurricane, the maximum still water level was determined to be +19.2' Mean Sea Level (msl) with an associated wave runup elevation of +21.7' msl. The design of Millstone Unit 2 reflects the decision to provide flood protection up to Elevation +22' msl minimum for the Containment, Turbine, and Auxiliary Buildings. Per NEI 12-06, the "site" flood characteristics must be considered. Millstone Unit 3 has a slightly higher Licensing Basis flood level of 19.7 feet msl stillwater with a wave run-up to an elevation of 23.8 feet msl. Therefore, the more limiting Millstone Unit 3 flood characteristics are applied to the Millstone Unit 2 FLEX strategy development. The stillwater level of 19.7 feet msl is below the flood gate and wall protection of 22 feet msl; however, with this stillwater level, wave action can approach 24 feet msl. Wave action at this design maximum level will generate some leakage past the corrugated siding barriers and at the tops of some flood gates, which are not sealed at the top edge.

The SW pumps and motors are located at elevation +14.5 feet msl in the Millstone Unit 2 Intake Structure and are protected to the height of +22 feet in the pumphouse and provisions to protect a single SW pump motor up to 28 feet is initiated when significant flood surges are anticipated. The front wall of the intake structure is designed to withstand the forces of a standing wave.

The effect of local intense precipitation has been evaluated onsite for existing structures containing safety-related equipment. It was determined that water accumulation from this precipitation was bounded by the impact of storm surges and, therefore, would not have an adverse effect on safety-related equipment (Reference 15, Section 2.5.4.2).

The areas of the North American continent most susceptible to tsunamis are those bordering the Pacific Ocean and the Gulf of Mexico. Millstone is located on the North Atlantic coastline where there is an extremely low probability of tsunamis (Reference 16, Section 2.4.6). Therefore, in the original licensing and license renewal processes, tsunamis were not considered to be credible natural phenomena which might affect the safety of either unit at the Millstone site. Likewise, flooding due to ice jams was not considered a possibility since the site is not located on a river.

Since the original submittal of the Overall Integrated Plan, DNC has completed and submitted the Flood Hazard Reevaluation Report for Millstone requested by the 10 CFR 50.54(f) letter dated March 12, 2012. The reevaluation represents the most current flooding analysis for both Millstone Units 2 and 3. However, the impact of the flooding reevaluation on the execution and deployment of the FLEX strategies will be addressed through the Integrated Assessment process required by NTTF Recommendation 2.1: Flooding.

2.6.3 Severe Storms with High Wind

Strong winds, usually caused by intense low-pressure systems, tropical storms and hurricanes, or passages of strong winter frontal zones, occasionally affect the region. Millstone Power Station is located on the north shore of the Long Island Sound. As such, it is exposed to tropical storms and hurricanes coming off the Atlantic Ocean. Storms of tropical origin occasionally affect the region during the summer and fall months. According to a statistical study by Simplon and Lawrence (1971), the 50-mile segment of coastline on which Millstone is located, was crossed by five hurricanes during the 1886 to 1970 period. Based on observations from Montauk Point (located about 23 miles southeast of Millstone Power Station on the eastern tip of Long Island), the maximum reported wind speed in the region was associated with the passage of a hurricane during which sustained winds of 115 mph, with short-term gusts up to 140 mph (Dunn and Miller 1960) were observed. For the period from 1961 through 1990, the "fastest-mile" wind speed recorded at Bridgeport was 74 mph occurring with a south wind in September 1985 (Reference 16, Section 2.3.1.2).

According to Reference 16, Section 2.3.1.2.4, a study of tornado occurrences during the period of 1955 through 1967 (augmented by 1968-1981 storm data reports), the mean tornado frequency in the one-degree (latitude-longitude) square where the Millstone Power Station site is located is determined to be approximately 0.704 per year. The tornado model used for design purposes at Millstone Unit 2 has a 360 mph wind velocity (Reference 15, Section 5.2.2.1.6).

2.6.4 Ice, Snow and Extreme Cold

The climatology of the Millstone site may be reasonably described by the data collected by the National Weather Service at Bridgeport, CT.

Measurable snowfall has occurred in the months of November through April, although heavy snowfall occurrences are usually confined to the months of December through March. The mean annual snowfall at the present Bridgeport location is 25.3 inches, with totals (based on data from 1932 through 1990) ranging from 8.2 inches in the 1972-1973 season, to 71.3 inches in the 1933-1934 season. The maximum monthly snowfall, occurring in February 1934, was 47.0 inches. Since 1949, both the maximum measured snowfall in 24 hours (16.7 inches), and the greatest snowfall in one storm (17.7 inches) occurred during the same storm in February 1969.

Per Reference 16, Section 2.3.1, the maximum measured snowfall in 24 hours (16.7 inches) was matched again in January 1978. For the time period following the reported values in Reference 16, the National Weather Service reported a maximum measured snowfall in 24 hours of 18.5 inches in February 2013.

Freezing rain and drizzle are occasionally observed during the months of December through March, and only rarely observed in November and April. An average of 18.5 hours of freezing rain and 8.5 hours of freezing drizzle occur annually in the region. Per Reference 16, Section 2.3.1, in the 32-year period between 1949-1980, all cases of freezing precipitation were reported as light (less than 0.10 inch per hour), except for 1 hour of moderate (0.10 to 0.30 inch per hour).

Winters are moderately cold, but seldom severe. Minimum daily temperatures during the winter months are usually below freezing, but subzero (°F) readings are observed, on the average, less than one day every two years. Per Reference 16, Section 2.3.1, below zero temperatures have been observed in each winter month, with an extreme minimum of -20°F occurring in February 1934.

2.6.5 High Temperatures

Due to the proximity of Long Island Sound and the Atlantic Ocean, the heat of summer is moderated. Temperatures of 90°F or greater occur an average of seven days per year at Bridgeport, while temperatures of 100°F or greater have occurred only in July and August; with an extreme maximum of 104°F occurring in July 1957 (Reference 16, Section 2.3.1).

2.7 Protection of FLEX Equipment

BDB equipment is stored in a single 10,000 sq.ft. concrete building that meets the plant's design-basis for tornado-missile and earthquake protection. The BDB Storage Building was evaluated for the effect of local seismic ground motions consistent with the MPS Ground Motion Response Spectrum (GMRS) developed for the original site licensing basis (See Section 2.6.1) and found to have adequate structural margin to remain functional (i.e., collapse is not expected and access to the interior retained).

The BDB Storage Building is located on the north-east side of the northern most overflow parking lot along the plant access road (Figure 13). This location is significantly above the upper-bound flood stage elevation for Millstone Unit 3. The

BDB Storage Building was designed and constructed to protect the BDB equipment from the hazards identified in Section 2.6.

Analysis of components stored in the BDB Storage Building have been performed to determine appropriate measures to prevent seismic interaction. The fire protection and Heating, Ventilation, and Air Conditioning (HVAC) systems in the BDB Storage Building are seismically installed. The lighting, conduits, electrical, and fire detection components are not seismically installed, but are considered insignificant and not able to damage BDB equipment.

The debris removal equipment required to support the implementation of the FLEX strategies is also stored inside the BDB Storage Building in order to protect the equipment from the applicable external hazards. Therefore, the equipment remains functional and deployable to clear obstructions from the pathways between the BDB equipment's storage location and the various deployment locations. This debris removal equipment includes a front end loader and tow vehicles (tractors).

Deployment of the debris removal equipment and the Phase 2 BDB equipment from the BDB Storage Building is not dependent on offsite power. The building equipment doors are hydraulically operated with a battery backup and can also be opened manually.

2.8 Planned Deployment of FLEX Equipment

2.8.1 Haul Paths

The deployment of onsite BDB equipment in Phase 2 requires that pathways between the BDB Storage Building and various deployment locations be clear of debris resulting from seismic, high wind (tornado), or flooding events. The stored BDB debris removal equipment includes tow vehicles (tractors) equipped with front end buckets and rear tow connections in order to move or remove debris from the needed travel paths. A front end loader is also available to deal with more significant debris conditions.

Pre-determined haul paths have been evaluated and are identified in the FLEX Support Guideline, FSG-5. Figures 13 and 14 show the haul paths from the BDB Storage Building to the various deployment locations. These haul paths have been reviewed for potential soil liquefaction and have been determined to be stable following a seismic event. Additionally, these haul paths minimize travel through areas with trees, power lines, narrow passages, etc. to the extent practical. However, high winds can cause debris from distant sources to interfere with these haul paths. Debris removal equipment is stored inside the BDB Storage Building and is protected from the severe storm and high wind hazards such that the equipment remains functional and deployable to clear obstructions from the pathway between the BDB equipment stored in the BDB Storage Building and its deployment location(s).

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 or via ground transportation. Debris removal for the pathway between the site and the NSRC receiving "Staging Areas" 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 essential as part of the immediate activities required during Phase 1.

Doors and gates serve a variety of barrier functions on the site. One primary function, security, is discussed below. However, other barrier functions include fire, flood, radiation, ventilation, tornado, and High Energy Line Break (HELB). These doors and gates are typically administratively controlled to maintain their function as barriers during normal operations. Following a BDB external event and subsequent ELAP/LUHS event, FLEX coping strategies require the routing of hoses and cables through various barriers in order to connect portable BDB equipment to station fluid and electric systems. For this reason, certain barriers (gates and doors) are opened and remain open. This departure from normal administrative controls is necessary and is acceptable during the implementation of FLEX coping strategies.

The ability to open doors for ingress and egress, ventilation, or temporary cables/hoses routing is necessary to implement the FLEX coping strategies. Security doors and gates that rely on electric power to operate opening and/or locking mechanisms are barriers of concern. The Security force initiates an access contingency upon loss of the Security Diesel and all AC/DC power as part of the Security Plan. Access to the Owner Controlled Area, site Protected Area, and areas within the plant structures are controlled under this access contingency as implemented by Security personnel. Access authorization lists are prepared daily and copies are protected from the hazards described in Section 2.6. The plant Control Room contains duplicates of keys necessary for use by plant Operations personnel in implementing the FLEX strategies.

Primary vehicle access to the Protected Area is via the double gated sally-port at the Security Building located on the east side of the Millstone site (Figure 14). As part of the Security access contingency, the sally-port gates are manually controlled to allow delivery of BDB equipment (e.g., generators, pumps) and other vehicles such as debris removal equipment into the Protected Area. An alternate haul route access area for BDB equipment delivery has been designated and would be available after removal of a portion of the security fence on the north side of the Millstone site (See Figure 13). Vehicle barriers have been installed on a roadway around the plant which is part of the BDB equipment haul route. These barriers can be opened manually or, if necessary, by force using debris removal equipment in order to clear the haul route.

2.9 Deployment of Strategies

2.9.1 AFW Makeup Strategy

Make-up to the CST for supply to the TDAFW pump or directly to the suction of the portable diesel driven BDB AFW pump may be from a variety of sources (Table 3), including the onsite fire system, city water system, the onsite freshwater pond, Long Island Sound, and various other onsite water sources.

The CST can be replenished using the BDB High Capacity pump and a network of temporary hoses that supply either city domestic water, onsite freshwater pond water, or seawater (as a last resort) to Millstone Unit 2 for AFW supply. It can also provide SFP makeup, support boric acid batching evolution, and limited containment spray evolutions. The discharge of the BDB High Capacity pump is tied into a water distribution manifold (water thief) located east of the Millstone Unit 2 Auxiliary Building rollup door. The CST replenishment is accomplished with a hose connected to the TDAFW pump supply line from the CST to provide a continuous water supply for the

TDAFW pump. In this configuration, water in excess of the required TDAFW flow refills the CST. Alternatively, CST replenishment can be accomplished directly by connecting a supply hose to a CST refill connection which is not in the TDAFW pump supply line. In this case, the TDAFW pump continues to take its supply directly from the CST while refill is in progress. If the portable BDB AFW pump is in service, a hose from the water thief is connected directly to the suction of the BDB AFW pump, bypassing the CST.

The BDB High Capacity pump (150 psid at 1200 gpm capacity) is positioned to take suction from city water / fire water, onsite freshwater pond, or Long Island Sound (as a last resort). For the onsite freshwater pond, a floating suction strainer is required to prevent debris from entering the suction hose during drafting operation of the pump. The hose network also contains inline strainers, in required locations, for finer particle removal.

Both the primary BDB AFW Pump discharge connection and the CST Refill connection are located adjacent to the AFW valve cage which is below the flood level for Millstone Unit 2, but is protected by flood gates. The Turbine Building is a seismically designed building and the wall of the AFW valve cage where the connections are made shares a wall with the safety-related Auxiliary Building. The alternate BDB AFW Pump discharge connection is located within the seismic Category I, missile and flood protected Auxiliary Building. The connections are protected from the external hazards described in Section 2.6.

Figure 3 provides a diagram of the flowpath and equipment utilized to facilitate this FLEX strategy.

2.9.2 RCS Makeup Strategy

The RCS Injection pumps are stored in the BDB Storage Building and are protected against the external hazards described in Section 2.6.

The primary RCS Injection pump discharge connection is inside of the AFW valve cage located in the Millstone Unit 2 Turbine Building and provides a path to the RCS cold legs. The connection is protected from the external hazards described in Section 2.6. An alternate connection for the primary RCS Injection strategy is to use the Hydrostatic Test Connection in the Charging Header. The blind flange downstream of Charging Hydrostatic Test Connector isolation valve is removed and replaced with a hose adapter. The discharge hose from the BDB RCS Injection Pump is connected to the adapter.

An alternate strategy for RCS makeup utilizes the installed Charging Pumps and requires no mechanical connections. Deployment of the 480 VAC portable DGs discussed in Section 2.9.4 is required for this strategy.

The primary supply connection from the Millstone Unit 2 RWST (or the Boric Acid Storage Tanks) for the RCS Injection pump is a hose connection outside the RWST valve pit in the RWST pipe chase providing RWST water for RCS makeup. The RCS makeup supply piping in the RWST pipe chase is safety-related (through the second manual isolation valve), seismically designed and located in an area that provides high wind and associated missile protection. Therefore, the connections are protected from the external hazards described in Section 2.6. Should the RWST and Boric Acid Storage Tanks become unavailable, an alternate supply of borated water is available from the portable Boric Acid Mixing Tanks stored in the BDB Storage Building.

Figure 3 provides a diagram of the flowpath and equipment utilized to facilitate this strategy.

2.9.3 Spent Fuel Pool Makeup Strategy

The SFP makeup strategy initiates makeup using the BDB High Capacity pump deployed from the BDB Storage Building. The discharge of the BDB High Capacity pump (via the water distribution manifold) is connected to a hose connection inside the SFP skimmer cage located in the Millstone Unit 2 Auxiliary Building. The SFP makeup hose connection is seismically designed in accordance with the plant design basis, and missile protected. The SFP make-up connection is sufficiently sized to restore SFP level long term following the loss of SFP cooling with a makeup rate of 250 gpm.

The direct hose option from the water distribution manifold is also available for use of the spray monitors or a direct hose drop into the SFP to replenish losses due to boiling in the SFP.

Figure 3 provides a diagram of the flowpath and equipment utilized to facilitate this strategy.

2.9.4 Electrical Strategy

The 480 VAC generators and their connecting cables are stored in the BDB Storage Building and are, therefore, protected from the BDB external event hazards identified in Section 2.6.

One 480 VAC DG is deployed to the Courtyard area between Millstone Units 1 and 2. The 480 VAC DG has a set of color coded cables which connect from the deployed generators to the 480 VAC bus 22F. Cables are run from the deployed generator through an exterior penetration to the 25 feet level of the Millstone Unit 1 cable vault. The cables are connected to the plug-in connection/receptacle box located along the north wall of the Millstone Unit 1 Cable Vault.

The 120/240 VAC generators and their connecting cables are stored in the BDB Storage Building and are, therefore, protected from the BDB external event hazards identified in Section 2.6.

One 120/240 VAC DG is deployed to the courtyard area between Millstone Units 1 and 2 adjacent to deployed 480 VAC DG. The 120/240 VAC DG has two output circuits. Each of the two output circuits on the 120/240 VAC DG include an adjustable output breaker, weatherproof receptacle, flexible and weatherproof cable with weatherproof connectors at both ends. Cabling is run from the 120/240 VAC portable generator through the exterior entrance of the "A" DC switchgear room, through the "A" and "B" DC switchgear rooms to a receptacle panel. The cables are connected to two single-phase, 120V, 100 amp plug receptacles feeding an 80 amp breaker in VA20 and a 70 amp breaker in VA40.

2.9.5 Fueling of Equipment

FLEX equipment is stored in the fueled condition. Fuel tanks are typically sized to hold 24 hours of fuel. Once deployed during a BDB external event, a fuel transfer truck (Ford F-350) refuels this equipment in the first 24 hours or sooner as required. The general coping strategy for supplying fuel oil to diesel driven portable equipment being utilized to cope with an ELAP / LUHS is to draw fuel oil out of any available existing diesel fuel oil tanks on the Millstone site.

Fuel sources for the BDB portable pumps and generators used for the FLEX strategies during Phase 2 and Phase 3 of an ELAP/LUHS event are provided from the following onsite fuel sources:

- Two 12,000 gallon (TS Minimum) seismic Category I, missile protected storage tanks located on the 38'-6" elevation in the Millstone Unit 2 Auxiliary Building. These two "Day Tanks" are located well above the maximum postulated flood elevation so they can reasonably be expected to survive following a BDB external event.

- Two 32,760 gallon below-ground Fuel Oil (FO) storage tanks located outside the Millstone Unit 3 Emergency Diesel Generator facility. These tanks are seismic Category I, missile protected and located above the maximum postulated flood elevation. Therefore, the storage tanks can be reasonably expected to survive following a BDB external event.

Diesel fuel in the fuel oil storage tanks is routinely sampled and tested to assure fuel oil quality is maintained to ASTM standards. This sampling and testing surveillance program also assures the fuel oil quality is maintained for operation of the station Emergency Diesel Generators (EDGs).

Portable equipment powered by diesel fuel are designed to use the same low sulfur diesel fuel oil as the installed EDGs.

The above fuel oil sources are used to fill the fuel transfer truck that is stored in the BDB Storage Building. The fuel transfer truck has a capacity of 1,100 gallons and has a self-powered transfer pump. The fuel transfer truck is deployed from the BDB Storage Building to refill the diesel fuel tanks of BDB equipment and to the various diesel fuel tank storage locations where it is refueled by either gravity fill or pumped full.

Based on a fuel consumption study, a conservative combined fuel consumption rate for the Phase 2 BDB equipment was determined to be 120 gal/hr. The fuel transfer truck has sufficient capacity to support continuous operation of the major BDB equipment expected to be deployed and placed into service following a BDB external event. At this conservative fuel consumption rate, the Fuel Oil Storage Tanks which are protected from the BDB external hazards, have adequate capacity to provide the onsite BDB equipment with diesel fuel for greater than 30 days. The NSRC is also able to provide diesel fuel for diesel operated equipment, thus providing additional margin.

The diesel fuel consumption information above does not include diesel fuel requirements for the Phase 3 equipment received from the NSRC. Provisions for receipt of additional diesel fuel from offsite sources are in place to supply the diesel powered Phase 3 strategy equipment identified in Table 2.

The BDB external event response strategy includes a very limited number of small support equipment that is powered by gasoline engines (chain saws, chop saws, etc.). These components are re-fueled using portable containers of fuel. Gasoline is obtained from an aboveground gasoline fuel storage tank or, if necessary, from private vehicles on site.

2.10 Offsite Resources

2.10.1 National SAFER Response Center

The industry has established two National SAFER Response Centers (NSRCs) to support utilities during ELAP/LUHS events. DNC has established contracts with the Pooled Equipment Inventory Company (PEICo) to participate in the process for support of the NSRCs as required. Each NSRC holds five sets of equipment, four of which are able to be fully deployed when requested, the fifth set has equipment in a maintenance cycle. In addition, onsite BDB equipment hose and cable end fittings are standardized with the equipment supplied from the NSRC.

In the event of a BDB external event and subsequent ELAP/LUHS condition, equipment is moved from an NSRC to a local assembly area established by the Strategic Alliance for FLEX Emergency Response (SAFER) team. From there, equipment can be taken to the Millstone site and staged at the SAFER onsite Staging Area "B" near the BDB Storage Building (Figure 13) by helicopter if ground transportation is unavailable. Communications are established between the Millstone plant site and the SAFER team via satellite phones and required equipment moved to the site as needed. First arriving equipment is delivered to the site within 24 hours from the initial request. The order in which equipment is delivered is identified in the Millstone's *SAFER Response Plan* (Reference 18).

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 BDB external event at Millstone Unit 2 is listed in Table 2. Table 2 identifies the equipment that is specifically credited in the FLEX strategies for the Millstone site, but also lists the equipment that is available for backup/replacement should onsite equipment break down. Since all the equipment is located at the local assembly area, the time needed for the replacement of a failed component is minimal.

2.11 Equipment Operating Conditions

2.11.1 Ventilation

Following a BDB external event and subsequent ELAP/LUHS event at Millstone Unit 2, ventilation providing cooling to occupied areas and areas containing FLEX strategy equipment is lost. Per the guidance given in NEI 12-06, FLEX strategies must be capable of execution under the adverse conditions (unavailability of installed plant lighting, ventilation, etc.) expected following a BDB external event resulting in an ELAP/LUHS. The primary concern with regard to ventilation is the heat buildup which occurs with the loss of forced ventilation in areas that continue to have heat loads. A loss of ventilation analysis was performed to quantify the steady state temperatures expected in specific areas related to FLEX implementation to ensure the environmental conditions remain acceptable for personnel habitability and equipment.

The key areas identified for all phases of implementation of the FLEX Mitigating Strategy activities are the Control Room (CR), CR A/C Equipment Room, East 480 VAC Load Center Room, TDAFW Pump Room, Enclosure Building (East and West Penetration Rooms - location of the ADVs, Auxiliary Building (Motor Control Center - MCC B61 Enclosure, Charging Pump Cubicles, East and West DC Switchgear Rooms), Turbine Building (Upper 4160 VAC Switchgear Room, Truck Bay area). These areas have been evaluated to determine the temperature profiles following an ELAP/LUHS event. Results of the evaluations have concluded that for the identified areas, some actions are needed (either short term or long term actions) in order for temperatures to remain within acceptable limits following an ELAP/LUHS event. The evaluations are based on conservative input heat load assumptions for all areas and with preemptive actions being taken, only when necessary, to reduce heat load or to establish either active or passive ventilation (e.g., portable fans, open doors, etc.)

The Phase 1 actions for ventilation primarily involve opening doors in existing plant structures. The Phase 1 (short term) actions for the CR are those required by existing procedures for SBO and require certain instrument cabinets to be opened within 30 minutes. The Phase 1 actions for the DC Switchgear Rooms, East 480 VAC Load Center Room, and the B61 MCC Enclosure are to open various designated doors within 30 minutes, 2 hours, and 4 hours, respectively. A slightly longer Phase 1 action is to open existing doors in the SFP Mezzanine at the 71' elevation prior to initiation of SFP boiling (6 hours or more per Section 2.4.1).

The ventilation related actions that are taken in Phase 1 are expected to dissipate the minimal heat loads from the DC battery sources, heat from the SFP walls and residual heat loads in the de-energized equipment. However, Phase 2 introduces additional loads when the BDB 480 VAC diesel generator is placed into service. Evaluations have demonstrated that additional actions, other than the doors opened in Phase 1, are necessary to maintain acceptable temperatures in the areas required to implement the Phase 2 FLEX Strategies. These additional actions involve starting various 480 VAC fans in the ventilation system for the DC Switchgear Rooms and the East 480 VAC Load Center Room. Additionally, the door between the Control Room Air Conditioning (CRA/C) Room and the East 480 VAC Load Center is to be opened and the A/C systems for the Control Room and for the MCC B61 Enclosure are to be started.

Once the BDB 480 VAC diesel generator is available, charging of the station Class 1E batteries begins. In order to prevent a buildup of hydrogen in the battery rooms, the battery room exhaust fans are energized. These fans are powered from the 480 VAC bus connected to the BDB 480 VAC DG. Therefore, the battery room exhaust fans will exhaust battery room air through the normal exhaust flow path to prevent hydrogen accumulation.

2.11.2 Heat Tracing

Major components for FLEX strategies are provided with cold weather packages and small electrical generators to protect the equipment from damage due to extreme cold weather and help assure equipment reliability as well as to power heat tape circuits, if necessary. Heat tape and portable heating equipment (BDB support equipment) are stored in the BDB Storage Building for additional low temperature mitigation, as needed.

2.12 Habitability

Personnel habitability was evaluated as discussed in Section 2.11.1 in conjunction with equipment operabilty and determined to be acceptable.

2.13 Lighting

In order to validate the adequacy of supplemental lighting and the adequacy and practicality of using portable lighting to perform FLEX strategy actions, a lighting study was completed. Tasks evaluated included traveling to/from the various areas necessary to implement the FLEX strategies, making required mechanical and electrical connections, performing instrumentation monitoring, equipment operation, and component manipulation.

The areas reviewed contain emergency lighting fixtures (Appendix "R" lighting) consisting of a battery, battery charger and associated light fixtures. These emergency lights are designed and periodically tested to insure the battery pack provides a minimum of eight hours of lighting with no external AC power sources. Therefore, these currently installed emergency lighting fixtures provide adequate lighting to light pathways and implement the BDB strategies for Phase 1 mitigation strategy activities for 8 hours.

Prior to the depletion of the Appendix "R" lighting units, portable battery powered Remote Area Lighting System (RALS) would be deployed to support the FLEX strategy tasks. These RALSs are rechargeable LED lighting systems designed to power the LED lights for a minimum of 7 hours at 6000 Lumens or a maximum of 40 hours at 500 lumens.

There are no emergency lighting fixtures in the yard outside of the protected area to provide necessary lighting in those areas where portable BDB equipment is to be deployed. Therefore, the large portable BDB pumps and diesel generators are outfitted with light plants that are powered from either their respective diesel generators or batteries in order to support connection and operation. In addition to the lights installed on the portable BDB equipment, portable light plants are included in the FLEX strategies. These portable diesel powered light plants can be deployed from the BDB Storage Building as needed to support night time operations. Additional portable light plants are available from the National SAFER Response Center.

In addition to installed Appendix "R" lighting, the RALS, and the portable light plants, the BDB Storage Building also includes a stock of flashlights and headband lights to further assist the staff responding to a ELAP/LUHS event during low light conditions.

2.14 Communications

In the event of a BDB external event and subsequent ELAP/LUHS, communications systems functionality could be significantly limited. A standard set of assumptions for an ELAP/LUHS event is identified in NEI 12-01, Guideline for Assessing Beyond

Design Basis Accident Response Staffing and Communications Capabilities, May 2012.

Communications necessary to provide onsite command and control of the FLEX strategies and offsite notifications at Millstone can be effectively implemented with a combination of sound powered phones, satellite phones and hand-held radios.

Onsite:

Indoor and outdoor locations where temporary BDB equipment is used may be served with either hand-held radios or satellite phones. Battery powered point-to-point radios that do not require a repeater offer a limited means of onsite communication for emergency management and command and control of the site FLEX strategy implementation efforts.

There are dedicated hand-held radios available for the implementation of onsite FLEX strategies. Sufficient batteries and chargers are also available. Use of the hand-held radios is somewhat limited (on a point to point basis); however, a portable repeater mounted on a communications trailer enhances the effectiveness of the radios when the trailer is deployed by augmented staff after 6 hours.

Functional testing has verified that the available radios at Millstone Unit 2 provide adequate communications to all areas of the plant needed to implement FLEX strategies, with the exception of three "alternate connection" locations significantly below site grade. In addition to being alternate connection locations, none of the three locations would be required prior to arrival of augmented staff onsite. Therefore, personnel would be available to function as "runners," if necessary.

Offsite:

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

NEI 12-01, Section 4.1 outlines the minimum communication pathways to the federal, state, and local authorities. Several portable (handheld) satellite phones are available for initial notifications. These handheld phones are distributed between the Control Room, the Technical Support Center (TSC), and the Emergency Operations Facility. Additionally, the local Offsite Response Organizations (OROs) that normally receive licensee notifications of an emergency declaration or a Protective Action Recommendation have been provided with a satellite phone if they are within a 25 mile radius of the Millstone site.

The CR and TSC also have satellite phones available as deskset units. The antenna setup for these desksets is a deployable system with fiber optics cable from the desksets to an outdoor, battery powered, portable dish antenna. This portion of the communications strategy is intended to function on self–contained batteries from deployment to a time beyond the first 6 hours. If necessary, the portable dish antenna system can be powered by a small portable generator available from the BDB Storage Building. Once augmented staff arrives on site a self-powered, mobile communications trailer designed to handle satellite voice traffic, as well as to function as a radio repeater to enhance onsite communications, is deployed from the BDB Storage Building.

Millstone Control Rooms:

Millstone Power Station has two separate control rooms which present a unique challenge for onsite communications. Each unit's control room operates independent of the other and each enter their own unit-specific procedures in response to a loss of AC power event. Site procedures currently establish the Shift Manager in the Millstone Unit 3 Control Room as the Site Emergency Manager for matters that impact the entire site and for notifications to offsite federal, state, and local agencies.

However, in accordance with the Millstone Emergency Plan (E-Plan), each unit can declare an emergency situation to offsite agencies using the satellite phones available in each control room. In the event that Millstone Unit 2 is at minimum staffing when a BDB external event occurs, they may not have an available designated E-Plan communicator. In this case, Millstone Unit 3 would provide the required offsite notifications for both units.

To establish direct communications between the Control Rooms, Battery Operated Field Phones are deployed. This deployment was validated to be complete within 45 minutes from the initiation of the event, which corresponds to the anticipated time at which each unit would be declaring that an ELAP has occurred. If communication between the Control Rooms has not been established at that time, necessary information would be communicated using a "runner."

2.15 Water Sources

2.15.1 Water Sources – Secondary Side

Table 3 provides a list of potential water sources that may be used to provide cooling water to the SGs, their capacities, and an assessment of availability following the applicable hazards identified in Section 2.6. Descriptions of the preferred water usage sources identified in Table 3 are provided below and are in the sequence in which they would be utilized, based on their availability after an ELAP/LUHS event. As noted in Table 3, only one clean water source would survive all applicable hazards for Millstone Unit 2 and is credited for use in FLEX strategies. However, as shown in Table 3, other clean water sources are available depending on the applicable hazard initiating the ELAP/LUHS event. No one hazard eliminates all of the additional clean water supplies. The largest of these clean water sources is the onsite freshwater pond. If the freshwater pond source is lost due to a BDB flooding event, the majority of the other clean water sources identified in Table 3 would still be available. The clean water sources identified in Table 3 would be used to refill the CST to supply the TDAFW pump. The deployment of each strategy would be performed prior to the TDAFW pump losing suction per procedure.

The water sources have a wide range of associated chemical compositions. Therefore, extended periods of makeup, with the addition of these various water sources, to the SGs has been evaluated for impact on long term SG performance and SG material (e.g., tube) degradation. This water quality analysis has provided guidance for the duration that the various onsite water sources can be used for core cooling/decay heat removal, but do not define failure limits for the SGs.

In addition to the various onsite tanks, the city water supply would be available as a clean water source for the SGs following all BDB hazards except a BDB seismic event. The analyses show that the city water could be used for approximately 444 hours after CST depletion before the SG design corrosion limit would be expected to be reached, or if a conservative Total Suspended Solids (TSS) level of 500 ppm is assumed, for about 387 hours after CST depletion before the limiting SG precipitation level would be expected to be reached. This evaluation also applies to the site fire systems since their water source is from the city water supply.

The onsite freshwater pond can be credited for all site hazards except for flooding from storm surges which would fill the pond with saltwater. The onsite freshwater pond could be used for approximately 237 hours after CST depletion before the SG design corrosion limit is reached. The corrosion evaluation bounds the precipitation evaluation regarding the limiting time period. In the event of flooding, several onsite tanks containing clean water suitable for use in the SGs for extended periods of time are available.

Exceeding the expected time to reach the SG design corrosion limit would have an insignificant impact on the ability of the SGs to remove core decay heat from the RCS at its reduced temperature/pressure conditions. However, reaching the limiting SGs precipitation levels could potentially impact/reduce the SGs heat transfer capabilities.

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

The evaluation also determined that the RWST could be used as an emergency water source for approximately 116 hours after CST depletion before the SG design corrosion limit is reached. Also, once the borated RWST is introduced into the SGs, the pH of the SG fluid is lowered, causing active corrosion. Thus, the SG corrosion rates resulting from the RWST introduction would not decrease until the concentration of boric acid is reduced by a method such as feed and bleed. Boric acid precipitation is not a concern based on the more limiting corrosion evaluation and elevated SG temperatures (the analyses were performed at a SG temperature of 341°F).

The evaluation shows that the Long Island Sound (LIS) seawater is not recommended for use in the SGs and would be used only as a last resort.

2.15.2 Water Sources- Primary Side

Three sources for borated water are available onsite: the RWSTs (one per unit), the Boric Acid Storage Tanks and the portable BDB Boric Acid Mixing Tanks stored in the BDB Storage Building. These sources are discussed in Section 2.3.10.5.

Clean water sources for use in batching borated water in the BDB Boric Acid Mixing Tanks would be used in the same order of preference provided in Table 3 for the AFW sources and dependent on availability.

2.15.3 Spent Fuel Pool

For Millstone Unit 2, any water source available is acceptable for use as makeup to the SFP, however, the primary source would be from either Long Island Sound or the onsite freshwater pond via the BDB High Capacity pump or from the city water supply through the fire protection system. Water quality is not a significant concern for makeup to the SFP. Likewise, boration is not a concern since boron is not being removed from the SFP when boiling.

2.16 Shutdown and Refueling Modes Analysis

Millstone Unit 2 is abiding by the Nuclear Energy Institute position paper entitled "Shutdown/Refueling Modes," dated September 18, 2013, addressing mitigating strategies in shutdown and refueling modes (Reference 19). This position paper has been endorsed by the NRC staff (Reference 20).

The reactor core cooling and heat removal strategies previously discussed in Section 2.3 are effective as long as the RCS is intact and the SGs are available for use. In this case, either the TDAFW pump or the BDB AFW pump can be used to remove decay heat through the SGs. Natural circulation is no longer considered a viable option once the RCS is opened (typically by removing a pressurizer 6-inch vent flange) at approximately 50 hours after shutdown. An ELAP/LUHS event at this time would rely on forced feed and spill cooling. Therefore, Millstone Unit 2 shutdown procedures require the pre-deployment of a BDB AFW pump with supply and discharge hoses to serve as a low pressure RCS injection pump to provide a means to establish forced feed of borated water to the RCS cold legs from the RWST during an ELAP/LUHS event with a unit in either Modes 5 or 6. In case of an ELAP/LUHS event while in Modes 5 or 6, Millstone Unit 2 enters AOP 2583, "Loss of All AC During Shutdown Conditions." This procedure is the controlling document throughout the event and coordinates various FSG usage, as required.

For the case of feed and spill cooling, an evaluation has been performed to show that the existing EOP guidance provides a suitable basis for required cold leg injection flow rates to remove decay heat at shutdown conditions. At a shutdown time of 50 hours, a flow of about 100 gpm is required, well within the capacity of the BDB AFW pump. Once the reactor head is removed and the refueling cavity is flooded (typically ~100 hours after shutdown), time to cavity boiling is greater than 2 hours and time to boil off the cavity contents is between 1 and 2 days.

Should an ELAP/LUHS event occur in the window between elimination of natural circulation to cavity flooded (~50-100 hours for a typical refueling outage), the immediate response is to dispatch an operator to initiate gravity feed to the RCS from the RWST. This feed injection path utilizes the Safety Injection system path that can be manually throttled open to initiate RCS injection. The gravity feed to the RCS cold legs strategy is expected to provide adequate RCS cooling to suppress core boiling for approximately 1 hour. The Safety Injection system is seismically qualified and located in missile protected facilities therefore providing assurance it would be available following an BDB external event. In parallel with initiating gravity feed, actions are taken to initiate fill and spill cooling by injecting water into the RCS using a BDB AFW pump.

The RWST is not protected from all hazards (i.e. tornado missiles). In the unlikely event that a tornado missile damages the RWST, procedures direct the operators to use the CST. If the CST is not available, the procedures direct injection of available clean water sources in order as specified in Table 3. The flowrate is reduced to match the boil-off rate of the RCS to minimize dilution of the RCS when adding unborated water. The water supply from the onsite freshwater pond is available following a tornado event, thus providing a method for restoring core cooling for all hazards during Modes 5 and 6.

A containment vent path is established soon after the Pressurizer vent path is opened. The containment vent path uses an existing Integrated Leak Rate Test (ILRT) penetration. The inboard blank flange for this penetration is manually removed and an external spectacle flange is placed in the open position. An additional external isolation valve remains closed until the needed for venting.

2.17 Sequence of Events

Table 4 presents a Sequence of Events (SOE) Timeline for an ELAP/LUHS event for Millstone Unit 2. Validation of each of the FLEX time sensitive actions has been completed in accordance with the FLEX Validation Process document issued by NEI and includes consideration for staffing. Time to clear debris 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 BDB Storage Building. Debris removal equipment is stored inside the BDB Storage Building and is, therefore, protected from the external hazards described in Section 2.6.

2.18 Programmatic Elements

2.18.1 Overall Program Document

A Dominion nuclear fleet procedure provides a description of the Diverse and Flexible Coping Strategies (FLEX) Program for Surry, North Anna and Millstone Power Stations. The key elements of the program include:

- Maintenance of the FSGs including any impacts on the interfacing procedures (EOPs, AOPs, etc.)
- Maintenance and testing of BDB equipment (i.e., SFP level instrumentation, emergency communications equipment, portable BDB equipment, BDB support equipment, and BDB support vehicles)
- Portable equipment deployment routes, staging areas, and connections to existing mechanical and electrical systems
- Validation of time sensitive operator actions
- The BDB Storage Building and the National SAFER Response Center
- Hazards Considerations (Flooding, Seismic, High Winds, etc.)
- Supporting evaluations, calculations and BDB drawings
- Tracking of commitments and equipment unavailability
- Staffing, Training and Emergency Drills
- Configuration Management
- Program Maintenance

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

A Nuclear Fleet Program Description document identifies the various elements necessary to implement the of the FLEX Program and thereby ensure readiness in the event of a Beyond Design Basis External Event.

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

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

2.18.2 Procedural Guidance

The inability to predict actual plant conditions that require the use of BDB 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 BDB external event conditions, and are not used inappropriately in lieu of existing procedures. When BDB equipment is needed to supplement EOPs or AOPs strategies, the EOP or AOP directs the entry into and exit from the appropriate FSG procedure.

FLEX support guidelines 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 EOP 2530, *Station Blackout*, to the extent necessary to include appropriate reference to FSGs and provide command and control for the ELAP. Additionally, procedural interfaces have been incorporated into the following procedures to include appropriate reference to FSGs:

– AOP 2560, *Storms, High Winds and High Tides*

– AOP 2578, *Loss of Refuel Pool and Spent Fuel Pool Level*

– AOP 2583, *Loss of All AC Power During Shutdown Conditions*

FSG maintenance is performed by the Station Procedures group via the Procedure Action Request in the Dominion nuclear fleet document AD-AA-100, *Technical Procedure Process Control*. Site administrative procedures, NEI 96-07, Revision 1 (Reference 21), and NEI 97-04, Revision 1 (Reference 22) are to be used to evaluate changes to current procedures, including the FSGs, to determine the need for prior NRC approval. However, per the guidance and examples provided in NEI 96-07, Revision 1, changes to procedures (EOPs, AOPs, or FSGs) that perform actions in response events that exceed a site's design-basis should screen out. Therefore, procedure steps which recognize that an ELAP/LUHS event has occurred and which direct FLEX strategy actions to ensure core cooling, containment, or SFP cooling should not require prior NRC approval.

FSGs have been reviewed and validated by the involved groups to the extent necessary to ensure that implementation of the associated FLEX strategy is feasible. Specific FSG validation was accomplished via table-top evaluation 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 23), an assessment of the capability of the Millstone Power Station on-shift staff and augmented Emergency Response Organization (ERO) to respond to a BDB external event was performed. The results were provided to the NRC in a letter dated December 15, 2015 (Reference 24).

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

A. An extended loss of AC power (ELAP)

B. An extended loss of access to ultimate heat sink (LUHS)

C. Impact on units (all units at a site are in operation at the time of the event)

D. Impeded access to the units by offsite responders as follows:

- 0 to 6 Hours Post Event – No site access.
- 6 to 24 Hours Post Event – Limited site access. Individuals may access the site by walking, personal vehicle or via alternate transportation capabilities (e.g., private resource providers or public sector support).
- 24+ Hours Post Event – Improved site access. Site access is restored to a near-normal status and/or augmented transportation resources are available to deliver equipment, supplies and large numbers of personnel.

A team of subject matter experts from Operations, Maintenance, Radiation Protection, Chemistry, Security, Emergency Preparedness and industry consultants performed tabletop exercises in December 2013, January 2014, and March 2015 to conduct the on-shift portion of the assessment. The participants reviewed the assumptions and applied existing procedural guidance, including applicable FLEX Support Guidelines (FSGs) for coping with a BDB external event 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 meet both the task and time motion data analyses of NEI 10-05, *Assessment of On-Shift Emergency Response Organization Staffing and Capabilities* (Reference 25).

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

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

The staffing assessments noted above were performed in conjunction with the development of procedures and guidelines that address NRC Order EA-12-049. Once the FSGs were developed, a validation assessment of the FSGs was performed using communication equipment determined to be available after a BDB external event by the staffing studies. The validation process was performed and documented in accordance with NEI Guidance (Reference 26).

2.18.4 Training

DNC's Nuclear Training Program has been revised to assure personnel proficiency in utilizing FSGs and associated BDB equipment for the mitigation of BDB external events is adequate and maintained. These programs and controls were developed and have been implemented in accordance with the Systematic Approach to Training (SAT) Process.

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

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

In accordance with Section 11.6 of NEI 12-06, ANSI/ANS 3.5, *Nuclear Power Plant Simulators for use in Operator Training* (Reference 27), certification of simulator fidelity is considered to be sufficient for the initial stages of the BDB external event scenario. Full scope simulator models have not been upgraded to accommodate FLEX training or drills.

Integrated FLEX drills are organized on a team or crew basis and conducted periodically such that all time-sensitive actions are evaluated over a period of not more than eight years. (It is not required to connect/operate permanently installed equipment during these drills.)

2.18.5 Equipment List

The equipment stored and maintained at the Millstone BDB Storage Building necessary for the implementation of the FLEX strategies in response to a BDB external event is listed in Table 1. Table 1 identifies the quantity, applicable strategy, and capacity/rating for the major BDB equipment components only, as well as various clarifying notes. Specific details regarding fittings, tools, hose lengths, consumable supplies, etc. are not provided in Table 1.

2.18.6 N+1 Equipment Requirement

NEI 12-06 invokes an N+1 requirement for the major BDB 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 implement the FLEX strategies. Sufficient equipment has been purchased to address each function at the operating units, plus one additional spare, i.e., an N+1 capability. Therefore, where a single resource is sized to support the required function of both operating units a second resource has been purchased to meet the +1 capability. In addition, where multiple strategies to accomplish a function have been developed, (e.g., two separate means to repower instrumentation) the equipment associated with each strategy does not require N+1 capability.

The N+1 capability applies to the portable FLEX equipment that directly supports maintenance of the key safety functions identified in Table 3-2 of NEI 12-06. FLEX support equipment that indirectly supports maintenance of the key safety function only requires N capability. FLEX support equipment includes equipment used for debris removal, towing of FLEX equipment, lighting, fuel transfer, alternate connection adapters, and communications in support of maintenance of the key safety functions.

In the case of hoses and cables associated with FLEX equipment required for FLEX strategies, an alternate approach to meet the N+1 capability has been selected. These hoses and cables are passive components being stored in a protected facility. It is postulated the most probable cause for degradation/damage of these components would occur during deployment of the equipment. Therefore, the +1 capability is accomplished by having sufficient hoses and cables to satisfy the N capability + 10% spares or at least 1 additional length of each type of hose and cable. This 10% margin capability ensures that single failure of any one of these passive components would not prevent the successful deployment of a FLEX strategy.

The N+1 requirement does not apply to the BDB FLEX support equipment, vehicles, and tools. However, these items are covered by a fleet administrative procedure and are subject to inventory checks 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 Factory Acceptance Testing to ensure portable FLEX equipment delivered to the site performed in accordance with the FLEX strategy functional design requirements.

The portable BDB 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 NEI 12-06 (Reference 3) and INPO AP 913, *Equipment Reliability Process,* (Reference 28), to verify proper function. Additional FLEX support equipment that requires maintenance and testing have preventive maintenance to ensure it performs its required functions during a BDB external event.

EPRI has completed and has issued *Preventive Maintenance Basis for FLEX Equipment – Project Overview Report* (Reference 29). Preventative Maintenance (PM) Templates for the major FLEX equipment including the portable diesel pumps and generators have also been issued.

The PM Templates include activities such as:

- Periodic Static Inspections – Monthly walkdown
- Fluid analysis (Yearly)
- Periodic operational verifications
- Periodic performance tests

PM procedures and test procedures are based on the templates contained within the EPRI Preventive Maintenance Basis Database, or from manufacturer provided information/recommendations 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 is maintained as necessary to ensure continued reliability. Periodic testing of FLEX equipment is scheduled and performed as part of the 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 is 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.

3. References

1. "Recommendations for Enhancing Reactor Safety in the 21st Century, The Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident," dated July 12, 2011, (ML111861807).

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

3. NEI 12-06, *Diverse and Flexible Coping Strategies (FLEX) Implementation Guide*, Revision 0, dated August 2012.

4. NRC Interim Staff Guidance JLD-ISG-2012-01, *Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events*, Revision 0, dated August 29, 2012.

5. NRC Order Number EA-12-051, *Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation*, dated March 12, 2012.

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, *Compliance with Order EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation*, Revision 0, dated August 29, 2012.

8. *Dominion Nuclear Connecticut's Supplement to 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 April 30, 2013 (Serial No. 12-161C).

9. Millstone Power Station, Unit 2, Technical Specifications.

10. WCAP-17601, Rev. 0, *Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs*, August 2012.

11. WCAP-17792-P, Revision 0, *Emergency Procedure Development Strategies for the Extended Loss of AC Power Event for all Domestic Pressurized Water Reactor Designs.*

12. "Westinghouse Response to NRC Generic Request for Additional Information (RAI) on Boron Mixing in Support of the Pressurized Water Reactor Owners Group (PWROG)," dated August 16, 2013 (ML13235A135).

13. Letter to Mr. J. Stringfellow (Westinghouse) from Mr. J. R. Davis (NRC) dated January 8, 2014 endorsing the Westinghouse Position Paper on Boron Mixing (ML13276A183).

14. Letter to Mr. J. E. Pollock (NEI) from Mr. J. R. Davis (NRC) dated September 16, 2013 endorsing NEI White Paper entitled "Battery Life Issue" (ML13241A182).

15. Millstone Power Station, Unit 2, Final Safety Analysis Report (FSAR). Rev. 21

16. Millstone Power Station, Unit 3, Final Safety Analysis Report (FSAR). Rev. 17

17. Letter to Dominion Nuclear Connecticut, *Screening and Prioritization Results Regarding Seismic Hazard Reevaluations for Recommendation 2.1 of the Near-Term Task Force Review of Insights From the Fukushima Dai-chi Accident Based on Individual Plant Examination of External Event Evaluation,"* November 21, 2014, U.S. Nuclear Regulatory Commission (ML114246A428).

18. *SAFER Response Plan for Millstone Power Station, Rev 003*, dated September 25, 2015 (Document NSRC-004).

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

20. Letter to Mr. J.E. Pollock (NEI) from Mr. J. R. Davis (NRC) dated September 30, 2013 endorsing NEI Shutdown/Refueling Modes Position Paper, (ML13267A382).

21. NEI Guideline 96-07, Revision 1, *Guidelines for 10CFR50.59 Implementation*, November 2000.

22. NEI Guideline 97-04, Revision 1, *Design Basis Program Guidelines*, February 2001.

23. NEI 12-01, *Guidelines for Assessing Beyond Design Basis Accident Response Staffing and Communications*, Rev.0.

24. Letter from D. A. Heacock to the USNRC transmitting *Millstone Power Station Phase 2 Staffing Report*, dated December 15, 2015, (Serial No. 15-364A).

25. NEI 10-05, *Assessment of On-Shift Emergency Response Organization Staffing and Capabilities,* Rev. 0, June 2011.

26. NEI guidance document FLEX *(Beyond Design Basis) Validation Process.*

27. ANSI/ANS 3.5-2009, *Nuclear Power Plant Simulators for use in Operator Training.*

28. INPO AP 913, Revision 3, *Equipment Reliability Process Description*, Institute of Nuclear Power Operations, March 2011.

29. *Preventive Maintenance Basis for FLEX Equipment – Project Overview Report* (EPRI Report 3002000623), September 2013.

Table 1- PWR Portable Equipment Phase 2							
***List Portable Equipment*[1]**	***Use and (Potential / Flexibility) Diverse Uses***						**Performance Criteria**
	Core	***Containment***	***SFP***	***Instrumentation***	***Accessibility***		
BDB High Capacity diesel-driven pump (2) and assoc. hoses and fittings	X	X	X				150 psid @1200 gpm
BDB AFW pump (3) and assoc. hoses and fittings	X						450 psid at 300 gpm
BDB RCS Injection pump (2) and assoc. hoses and fittings	X						3000 psid at 45 gpm
120/240VAC generators (3) and associated cables, connectors and switchgear				X			23.3 kW
120/240VAC generators (8) and associated cables, connectors and switchgear (to power support equipment) [2]					X		5-6.5 kW

Table 1- PWR Portable Equipment Phase 2						
List Portable Equipment[1]	***Use and* (Potential / Flexibility) Diverse Uses**					**Performance Criteria**
	Core	***Containment***	***SFP***	***Instrumentation***	***Accessibility***	
480VAC generators (3) and associated cables, connectors and switchgear (to re-power battery chargers, inverters, and Vital Buses)	X	X		X		500 kW
Portable boric acid batching tank (2)	X					1000 gal
Lighting towers (2)[2]					X	
Front end loader (1)[2]					X	
Tow vehicles (2)[2]	X	X	X		X	
Hose trailer (2), cable trailer (1) and utility vehicle (1)[2]	X	X	X		X	
Fans / blowers (10)[2]					X	

Table 1- PWR Portable Equipment Phase 2

List Portable Equipment[1]	***Use and (Potential / Flexibility) Diverse Uses***					**Performance Criteria**
	Core	***Containment***	***SFP***	***Instrumentation***	***Accessibility***	
Air compressors (6)[2]	X				X	
Fuel transfer truck (1) with 1,100 gal. tank and pumps	X	X	X	X	X	
Fuel carts (2) equipped with transfer pumps[2]	X	X	X	X	X	
Communications equipment[3]	X	X	X	X	X	
Misc. debris removal equipment[2]					X	
Misc. Support Equipment[2]					X	

Notes:
1. This table is based on one BDB Storage Building containing equipment for both Millstone Units 2 and 3.
2. Support equipment. Not required to meet N+1.
3. Quantities were identified in response to the results of the communications study performed for Recommendation 9.3 of the 10 CFR 50.54(f) letter dated March 12, 2012.

Table 2 – PWR Portable Equipment From NSRC(1)

List Portable Equipment	Quantity Req'd	Quantity Provided	Power	Use and (Potential / Flexibility) Diverse Uses					Performance Criteria		Notes
				Core Cooling	Cont. Cooling/ Integrity	Access	Instrumentation	RCS Inventory			
Medium Voltage Generators	2	2	Jet Turbine	X	X		X		4.16 kV	1 MW	(2)
4160 VAC Distribution System	1	1	N/A	X	X		X		N/A	N/A	(2)
Low Voltage Generators	0	1	Jet Turbine		X		X	X	480VAC	1000 KW	(3)
High Pressure Injection Pump	0	1	Diesel					X	2000 psig	60 GPM	(3)
SG RPV Makeup Pump	0	1	Diesel	X				X	500 psid	500 GPM	(3)
Low Pressure / Medium Flow Pump	0	1	Diesel		X	X			300 psid	2500 GPM	(3)

Table 2 – PWR Portable Equipment From NSRC[1]

List Portable Equipment	Quantity Req'd	Quantity Provided	Power	Use and (Potential / Flexibility) Diverse Uses					Performance Criteria		Notes
				Core Cooling	Cont. Cooling/ Integrity	Access	Instrumentation	RCS Inventory			
Low Pressure / High Flow Pump	1	1	Diesel	X	X				150 psid	5000 GPM	(4)
Lighting Towers	0	3	Diesel			X				440,000 Lu	
Diesel Fuel Transfer	0	As Requested	N/A	X	X	X	X	X		265 Gal	(3)
Water Treatment (Filter and RO Unit)	0	1	Diesel	X				X		250 GPM	(3)
Mobile Boration Skid	0	1	N/A					X		1000 Gal	(3)
Air Compressor	0	1	Diesel	X					150 psi	300 CFM	(3)

Notes:

1. Equipment quantities are specific to Millstone Unit 2 only.
2. NSRC 4160 VAC generator supplied in support of Phase 3 for Core Cooling, Containment Cooling, and Instrumentation FLEX Strategies.
3. NSRC Equipment – Not required for FLEX Strategy – Provided as Defense-in-Depth.
4. NSRC Low Pressure / High Flow pump supplied in support of Phase 3 for Core Cooling and Containment Cooling FLEX Strategies. Includes a suction booster lift pump to draft from Long Island Sound, if necessary.

Table 3 – Water Sources

Water Sources	Usable Volume (Gallons)	Applicable Hazard					Time Based on Decay Heat[1]
		Seismic	Flooding	Tornado/ Hurricane	Low Temp	High Temp	
Water Sources and Associated Piping that Fully Meet All BDB Hazards and Are Credited in FLEX Strategies							
Condensate Storage Tank (CST)	142,700	Y	Y	Y	Y	Y	8.4 hours
Long Island Sound (LIS) – Ultimate Heat Sink	Unlimited	Y	Y	Y	Y	Y	Unlimited [3]
Water Sources that Partially Meet BDB Hazards and Are Not Credited in FLEX Strategies.							
Primary Water Storage Tank (PWST)	100,000	N	Y	N	Y	Y	13.9 hours
Condenser Hotwell	71,000	N	N	Y	Y	Y	9.5 hours
Site Fire Water System	490,000	N	Y	N	Y	Y	75.3 hours
City Domestic Water Supply	Unlimited	N	Y	Y	Y	Y	Unlimited

Table 3 – Water Sources

Water Sources	Usable Volume (Gallons)	Applicable Hazard					Time Based on Decay Heat[1]
		Seismic	Flooding	Tornado/ Hurricane	Low Temp	High Temp	
Onsite Freshwater Pond[2]	3,000,000	Y	N	Y	Y	Y	475.2 hours
Refueling Water Storage Tank (RWST)	370,000	Y	Y	N	Y	Y	66.1 hours

Notes:

1. The CST is the initial source. The times shown for the additional sources are if they are deployed as the second source. If the source is used later, the available time would be longer. Includes cooldown to a SG pressure of 120 psia beginning at 2 hours.
2. Assumes Millstone Unit 2 uses ½ of the usable volume, i.e., 1,500,000 gallons.
3. Not a recommended source for AFW or RCS Makeup. Used only as a "last resort."

Table 4 - Sequence of Events Timeline

Action Item	Activity	Start	Duration	Time Constraint/ Sensitive Action Y/N	Personnel	Requirement
1	Event Starts	0 hour	-	N	-	Plant @ 100% power
2	Loss of All Power Procedure is entered	15 seconds	-	N	-	SBO event required response
3	Start TDAFW pump. Verify AFW flow established	5 minutes	5 min[5]	Y	1 PEO	Original design basis for SBO event. 1 hour to SG dryout
4	Throttle AFW flow to SGs	10 minutes	10 minutes to setup[5], Requires on-going control	Y	1 PEO	1.8 hours (to SG overfill)

Table 4 - Sequence of Events Timeline

Action Item	Activity	Start	Duration	Time Constraint/ Sensitive Action Y/N	Personnel	Requirement
5	Deploy TA-312 Battery Operated Field Phones	14 minutes	30 minutes	N	1 Chem. Tech	No requirement - used for Communications between Unit 2 and Unit 3 Control Rooms. A "runner" is utilized until this equipment is setup.
6	Deploy Rapidcase for Off-Site Communications	26 minutes	90 minutes	N	2 Security Personnel	No requirement. This is a backup to the Iridium Phones for Off-site Communications. Equipment is stored in the TSC.
7	Verify RCS isolation	20 minutes	10 minutes	N	Control Room Personnel	No requirement, establishes long term inventory in the RCS
8	ELAP condition Recognized and declared	45 minutes	-	Y	-	
9	Initiate Load Stripping from 120 VDC Buses	45 minutes	30 minutes	Y	1 PEO	75 minutes (provides a battery life of 29 hours)

Table 4 - Sequence of Events Timeline

Action Item	Activity	Start	Duration	Time Constraint/ Sensitive Action Y/N	Personnel	Requirement
10	Control SG atmospheric dump valves	25 minutes	30 min to setup, requires on-going control	Y	1 PEO 2 Fire Brigade	For cooldown and decay heat removal. Initiation within 2 hours meets the requirements of ELAP analyses.
11	Deploy BDB High Capacity Pump to Draft Point and initiate CST replenishment	2 hours[3,4]	3 hours + 2 hours to remove debris[1]	Y	2 Security and 2 Fire Brigade prior to 6 hours and 4 People after 6 hours[2,3]	8.4 hours (CST volume depleted) Draft Point is Onsite Freshwater Pond, Fire Main, or Long Island Sound (Last Resort). Time validation of task is to Long Island Sound
12	Augmented Staff arrive onsite	6 hours	-	N	-	6 hours (Ref. NEI 12-01)

Table 4 - Sequence of Events Timeline						
Action Item	**Activity**	**Start**	**Duration**	**Time Constraint/ Sensitive Action Y/N**	**Personnel**	**Requirement**
13	Deploy 480 VAC Generator and energize Bus 22F for repower of 120 VAC vital busses	8.5 hours[4]	4 hours	Y	4 People[2]	29 hours (batteries depleted), 120/240 VAC Generator is utilized as the alternate strategy
14	Deploy Rapidcom for Off-Site Communications	10 hours[4]	2 hours	N	2 People[2]	No requirement. This is a backup to the Iridium Phones and Rapidcase for Off-site Communications. Equipment is stored in BDB Storage Dome.

Table 4 - Sequence of Events Timeline

Action Item	Activity	Start	Duration	Time Constraint/ Sensitive Action Y/N	Personnel	Requirement
15	Deploy BDB AFW Pump	11 hours[4]	3 hours	N	4 People[2]	Note: BDB AFW Pump is early deployed as part of storm preparations as a backup to the TDAFW pump
16	Deploy portable borated water tank (if RWST, BASTs, and charging pumps not available)	14 hours[4]	2 hours	Y	4 People[2]	24 hours

Table 4 - Sequence of Events Timeline

Action Item	Activity	Start	Duration	Time Constraint/ Sensitive Action Y/N	Personnel	Requirement
17	Repower "B" or "C" Charging Pumps from the 480 VAC power supply or Deploy BDB RCS Injection pump and initiate RCS Injection	13.5 hours[4]	2 hours	Y	4 People[2]	~25 hrs (RCS inventory makeup, to prevent loss of natural circulation / Reactivity control, not required for SG pressure > 120 psig). This is setup by 16 hours.
18	Restore Control Room Air Conditioning	16 hours	1 hour	N	1 Person[2]	Restore soon after 480 VAC generator is connected to ensure continued habitability, Requires 480 VAC Diesel Generator setup

Table 4 - Sequence of Events Timeline

Action Item	Activity	Start	Duration	Time Constraint/ Sensitive Action Y/N	Personnel	Requirement
19	Route hose and add inventory to SFP	22 hours[4]	1 hr to setup, Requires on-going makeup	Y	4 People[2]	24 hours (6 hours to boiling / 30 hours to water level at 10' above fuel).
20	Reduce temperature & pressure in Containment	36 hours (Modes 5 & 6) / 4-5 days (Normal Operation)	-	N	4 People[2]	Prior to affecting the function of key parameters monitoring instrumentation (within 3 days for Modes 5 & 6 and 7 days for normal operation).
21	Shutdown RCS Makeup	-	-	N	4 People[2]	No requirement. The necessary equipment shall be pre-deployed from the BDB Storage Building.

Table 4 - Sequence of Events Timeline

Action Item	Activity	Start	Duration	Time Constraint/ Sensitive Action Y/N	Personnel	Requirement

Note 1: Debris removal time is assumed to last for 2 hours, and only needs to be included once.

Note 2: Does not require licensed personnel and may include available Chemistry, Health Physics, and Security. If the activity starts after 6 hours, Augmented Staff are available as well.

Note 3: Two Security Personnel are available after 2 hours to begin debris removal. Two Fire Brigade Members are available after 4 hours to begin equipment deployment with the two Security Personnel.

Note 4: Start times are taken from Reference 9-13, Attachment 3, which evaluates Phase 2 equipment deployment from the BDB Storage Building to both Units 2 and 3 using only 1 tow vehicle. The SFP activity is not included on Attachment 3, since all equipment required is onsite already (i.e., hose trailers).

Note 5: These times are based on remote operation from the Control Room. A total time of 35 minutes is required to setup both Action Items 3 & 4 if required locally at the pump and valves.

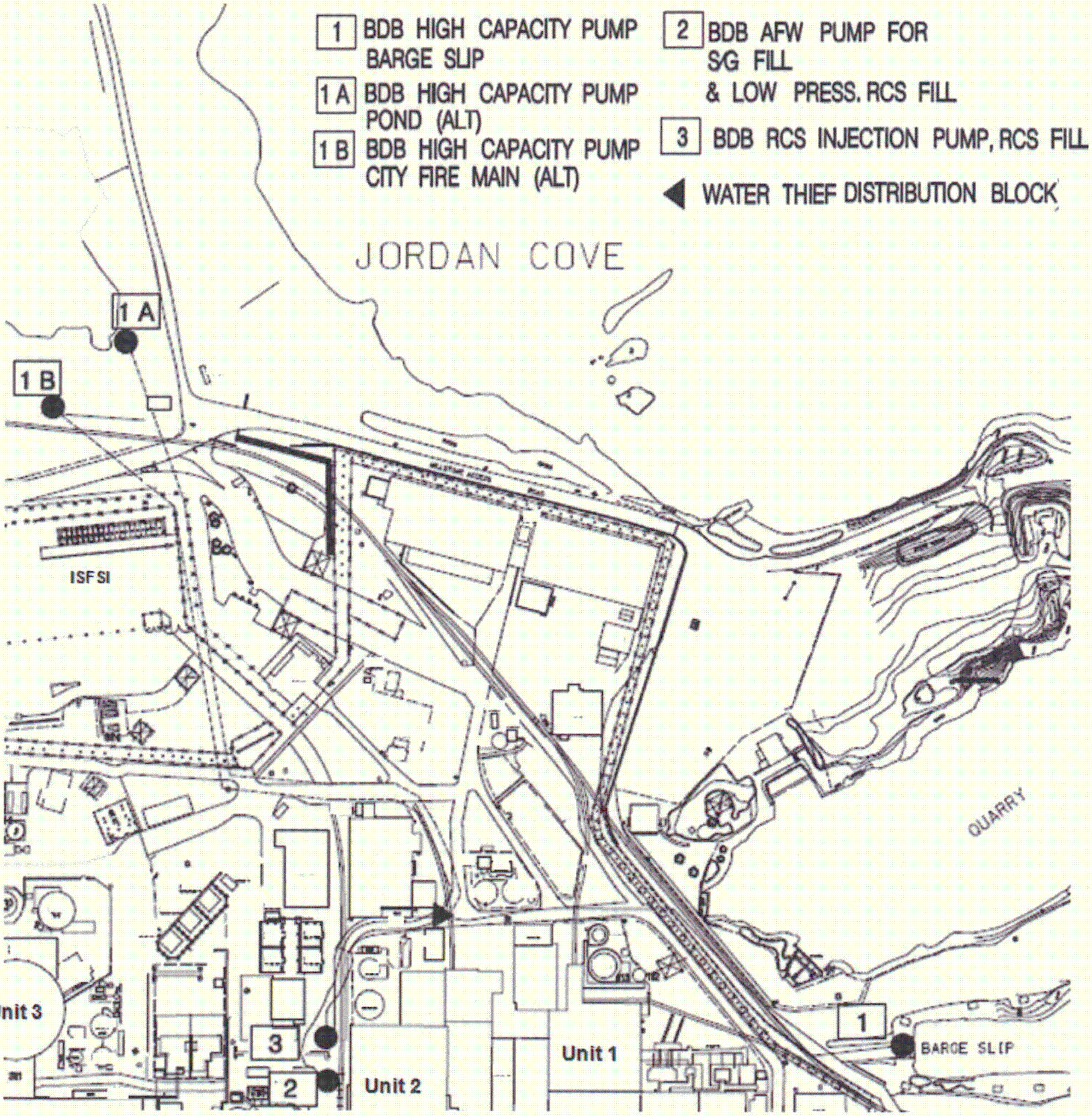


Figure 1: BDB FLEX Strategy Equipment and General Hose Layout

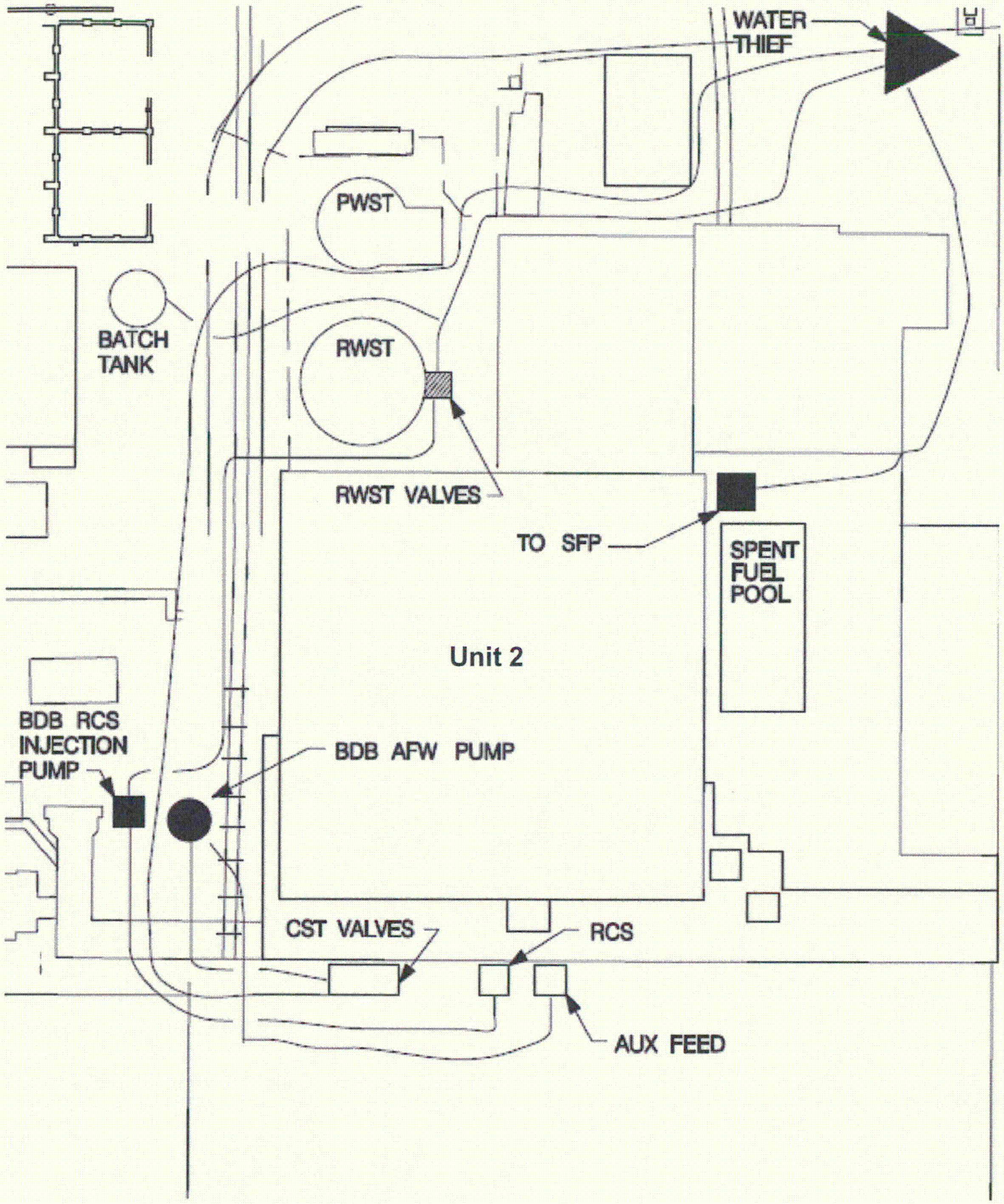


Figure 2: BDB FLEX Strategy Equipment and Detailed Hose Layout

UNIT 2 PRIMARY CONNECTIONS

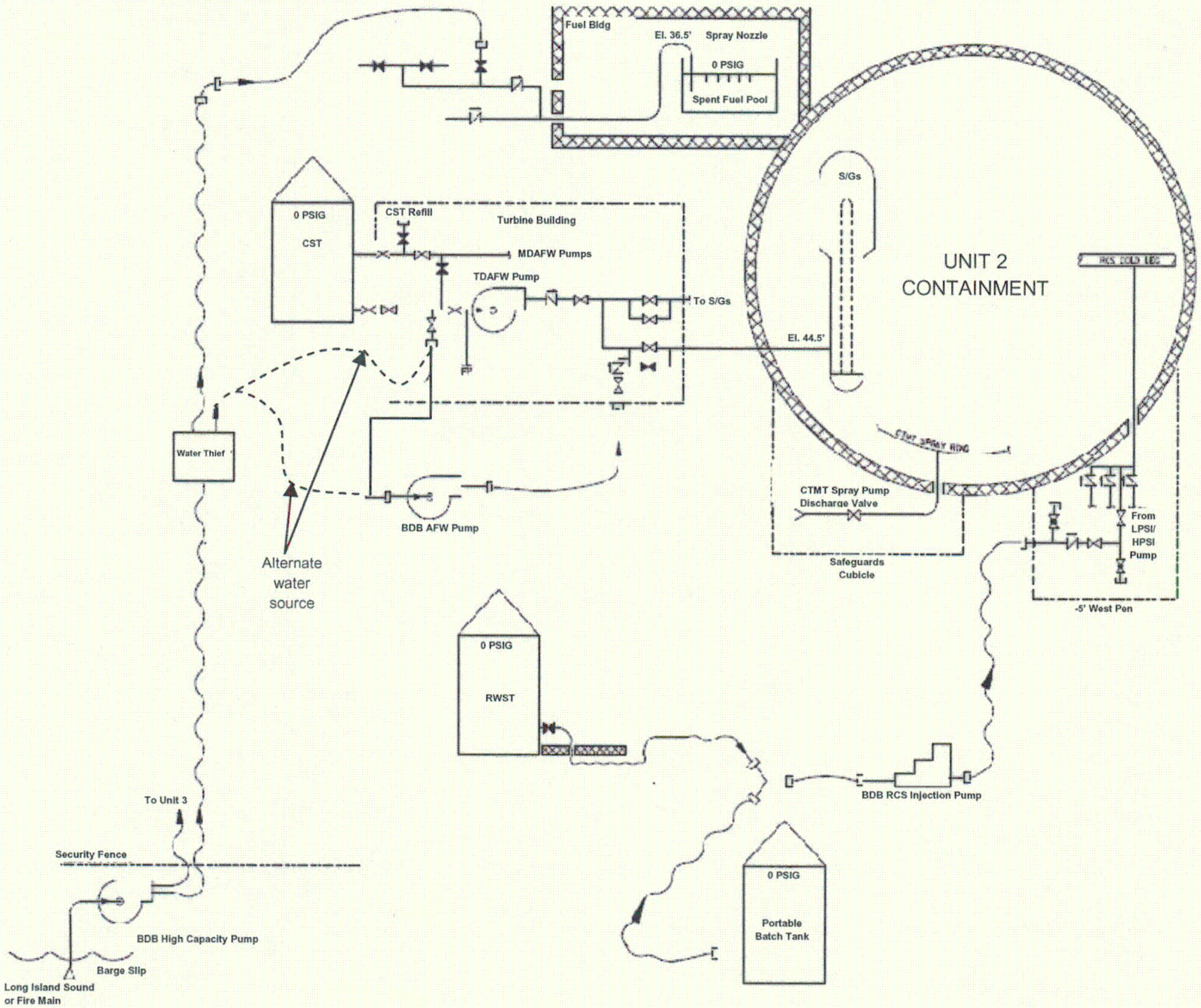


Figure 3: BDB FLX Strategy Mechanical Connections Flow Diagram

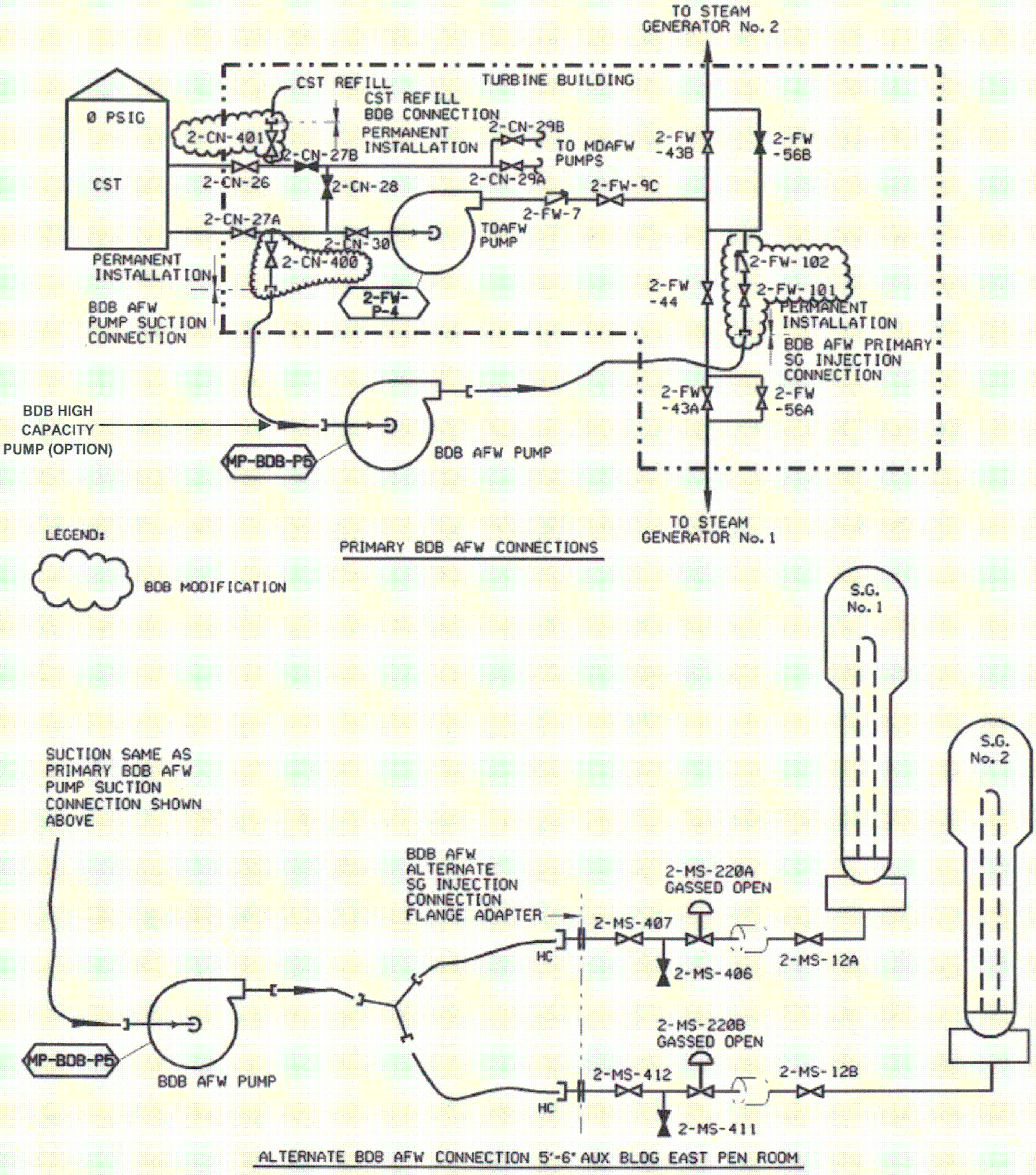


Figure 4: BDB FLEX AFW Primary and Alternate Mechanical Connections

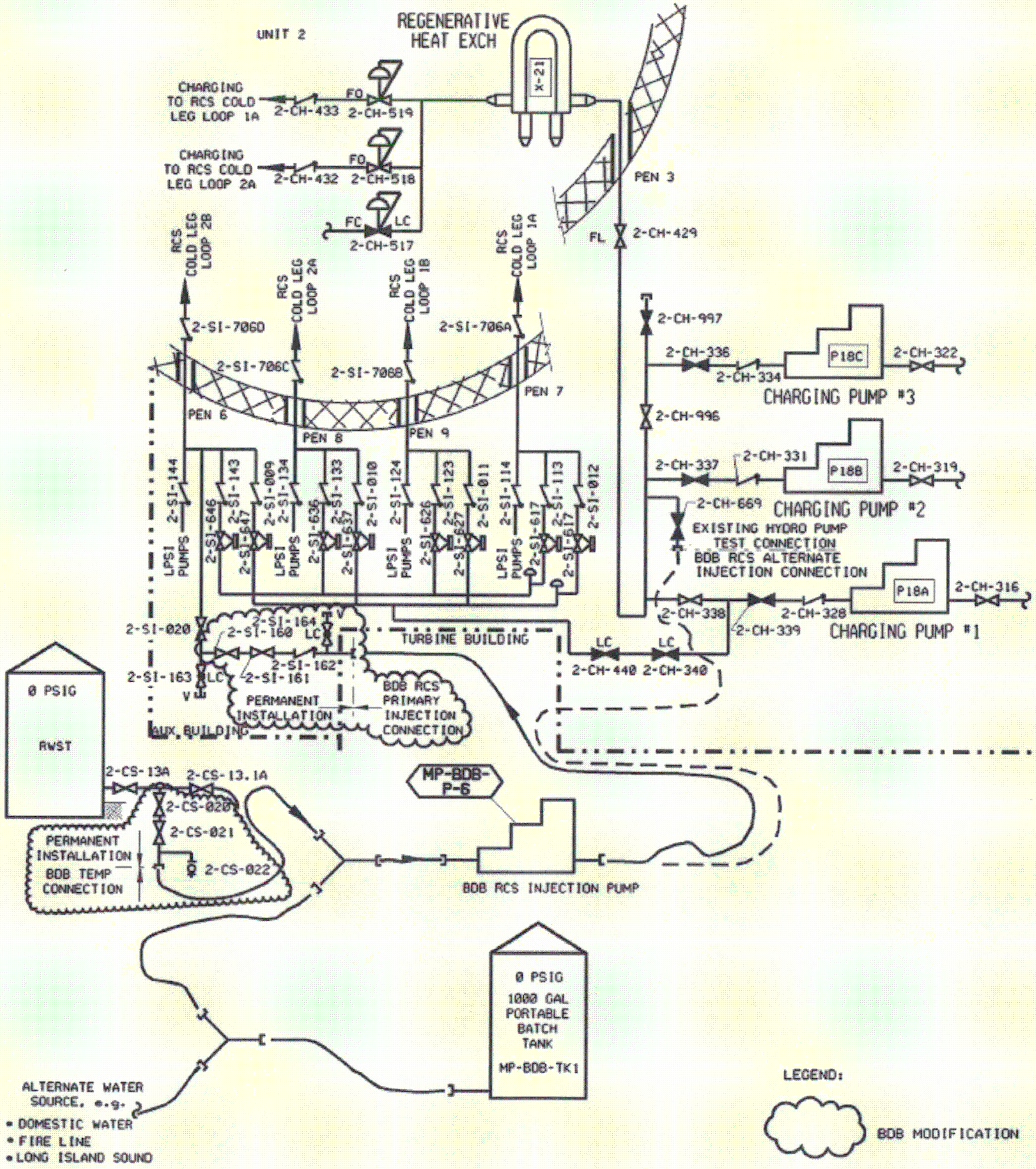


Figure 5: BDB FLEX RCS Makeup Primary and Alternate Mechanical Connections

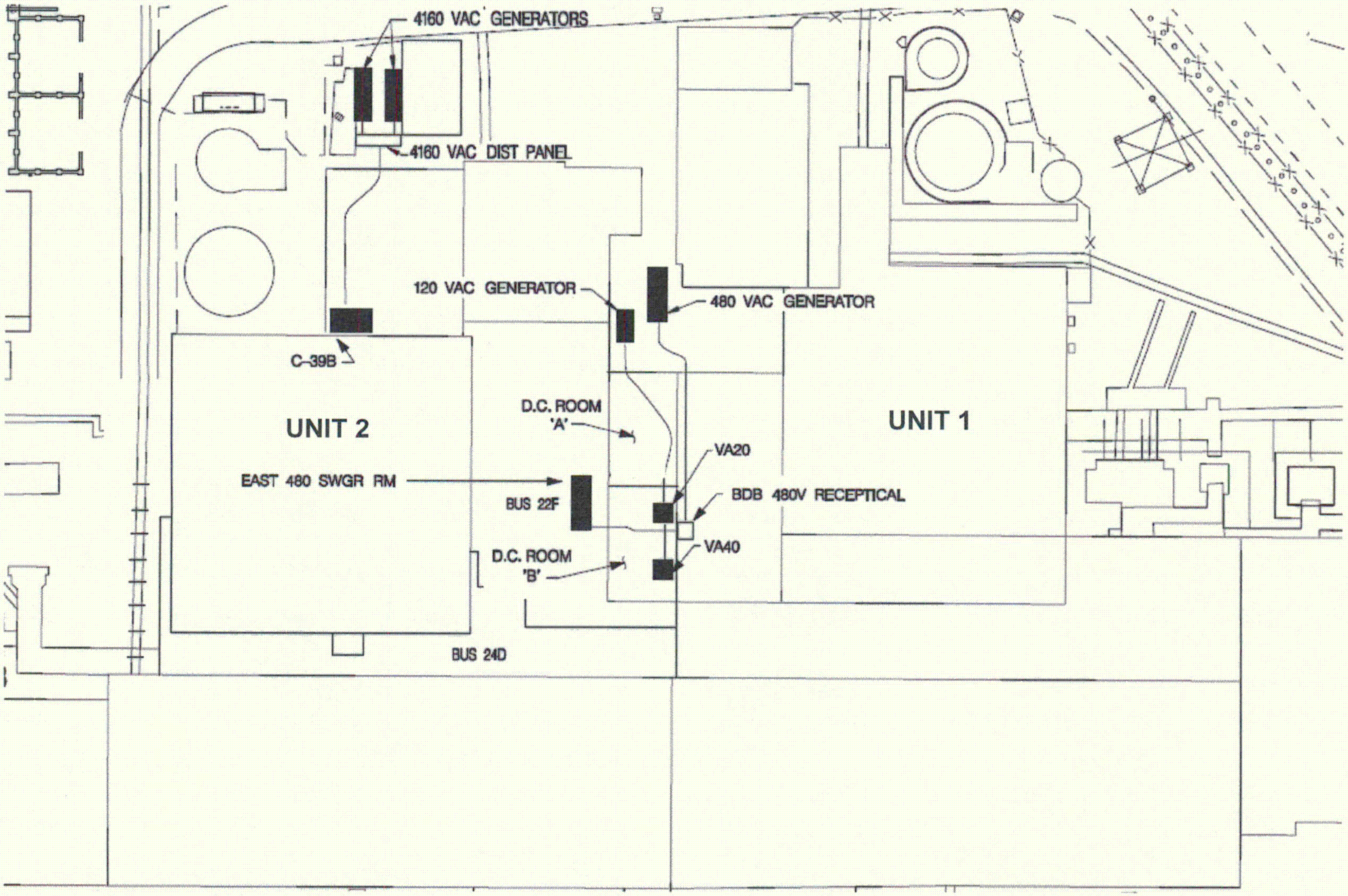


Figure 6: BDB Electrical Connections 120/240 VAC, 480 VAC, & 4160 VAC General Layout

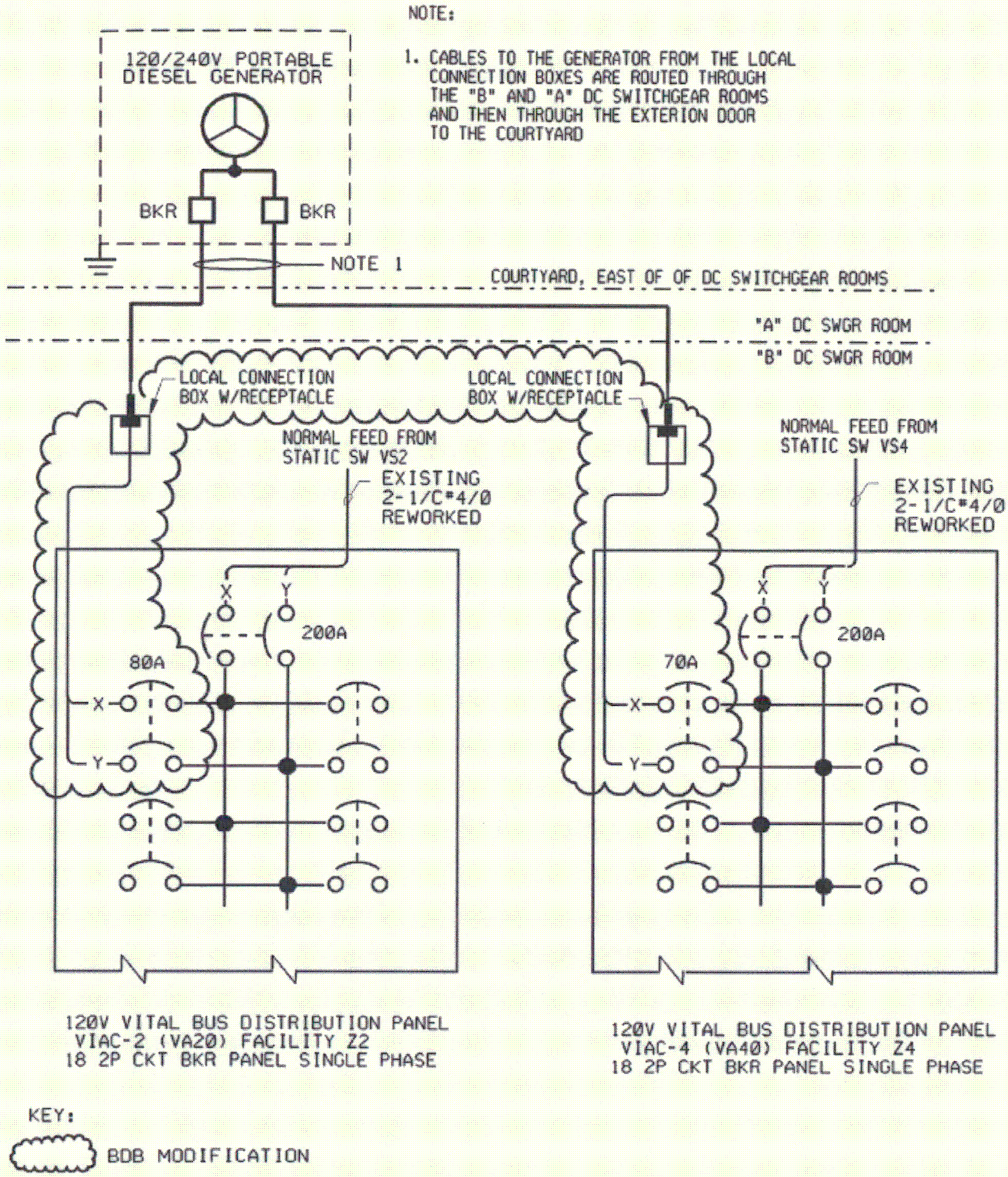


Figure 7: 120/240 VAC FLEX Electrical Connections

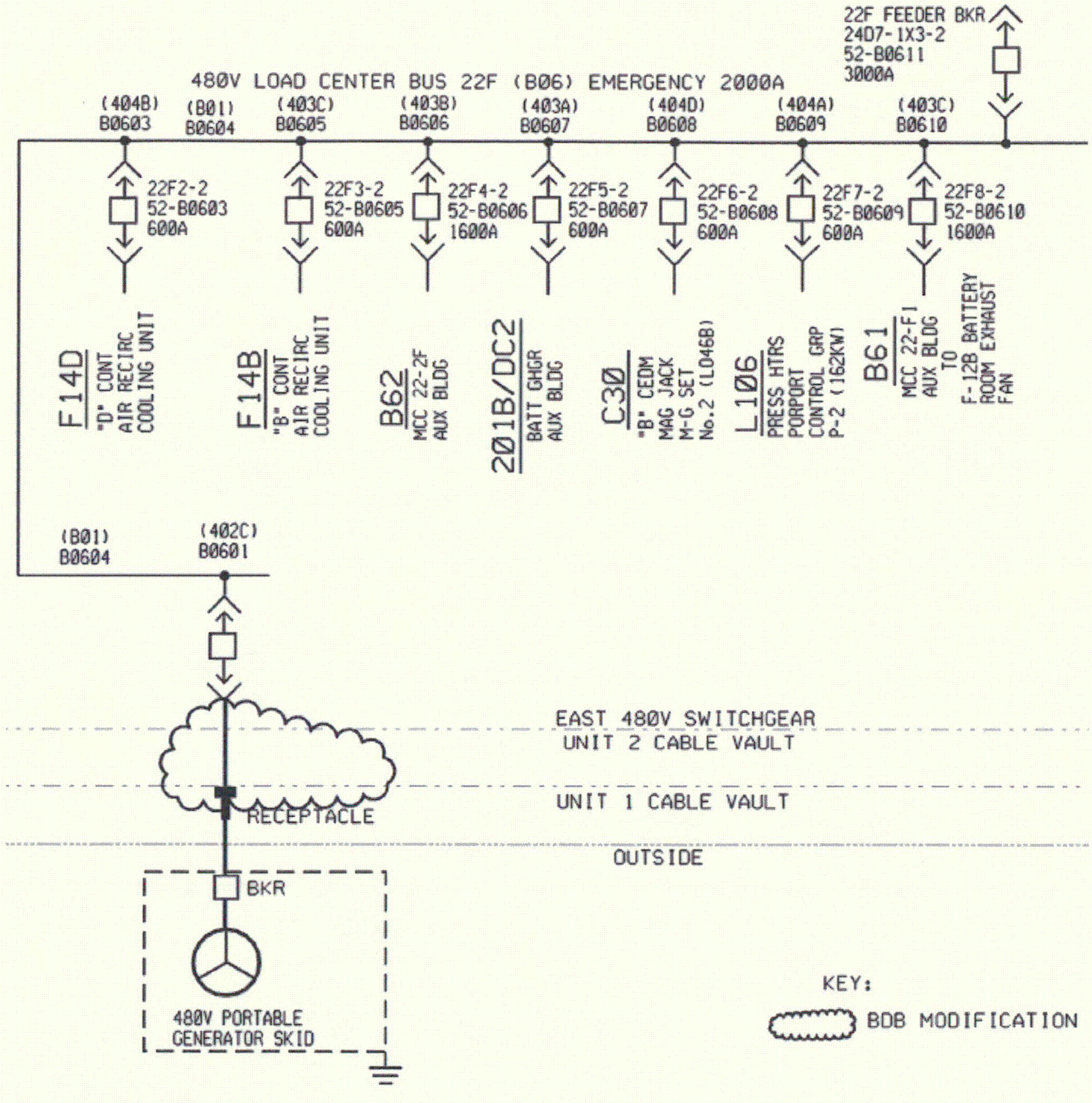
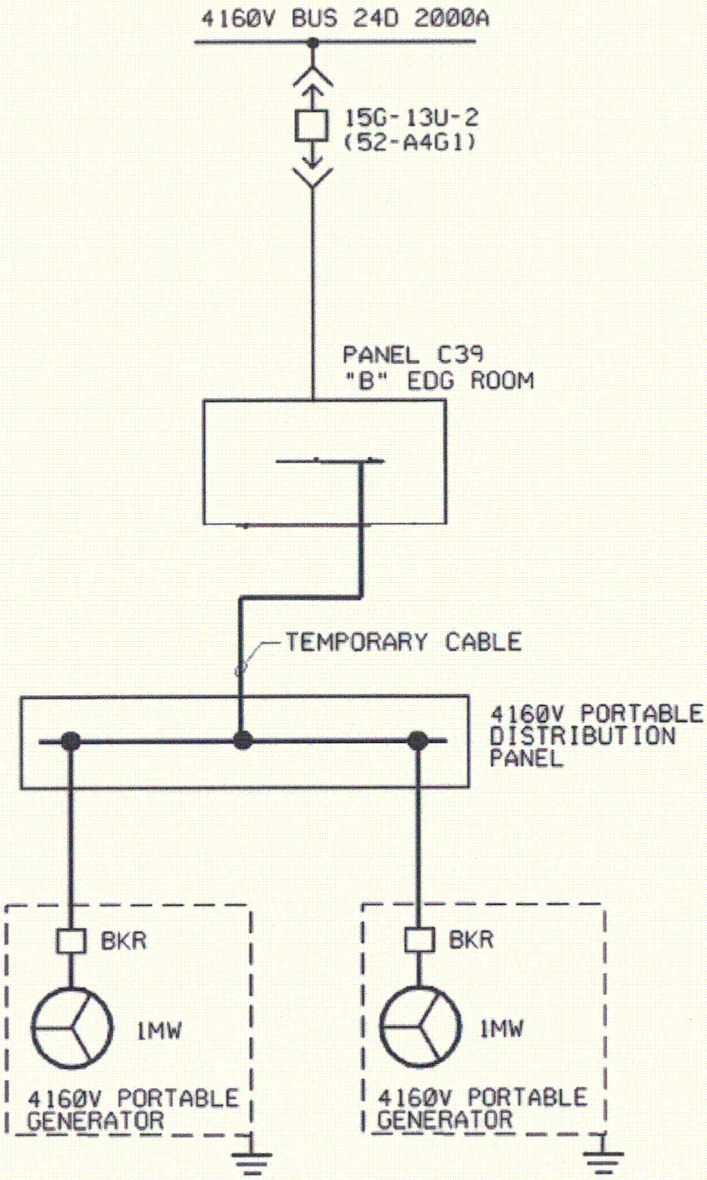


Figure 8: 480 VAC FLEX Electrical Connections



NOTE: The Two 1MW 4160V Generators and the 4160V Portable Distribution Panel are Provided by the National SAFER Regional Center and Connected to Panel C39

Figure 9: 4160 VAC FLEX Electrical Connections

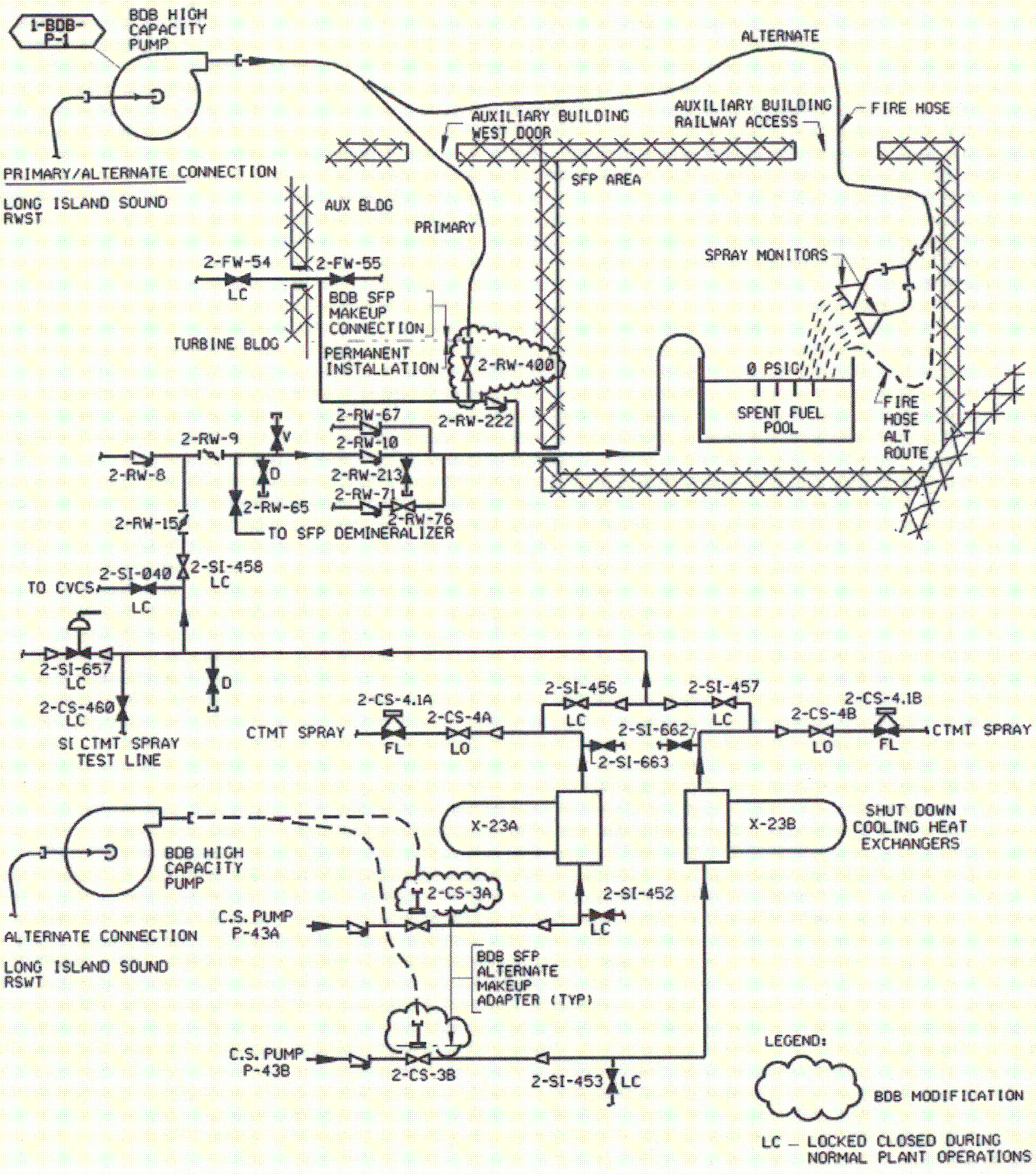


Figure 10: BDB FLEX SFP Primary and Alternate Mechanical Connections

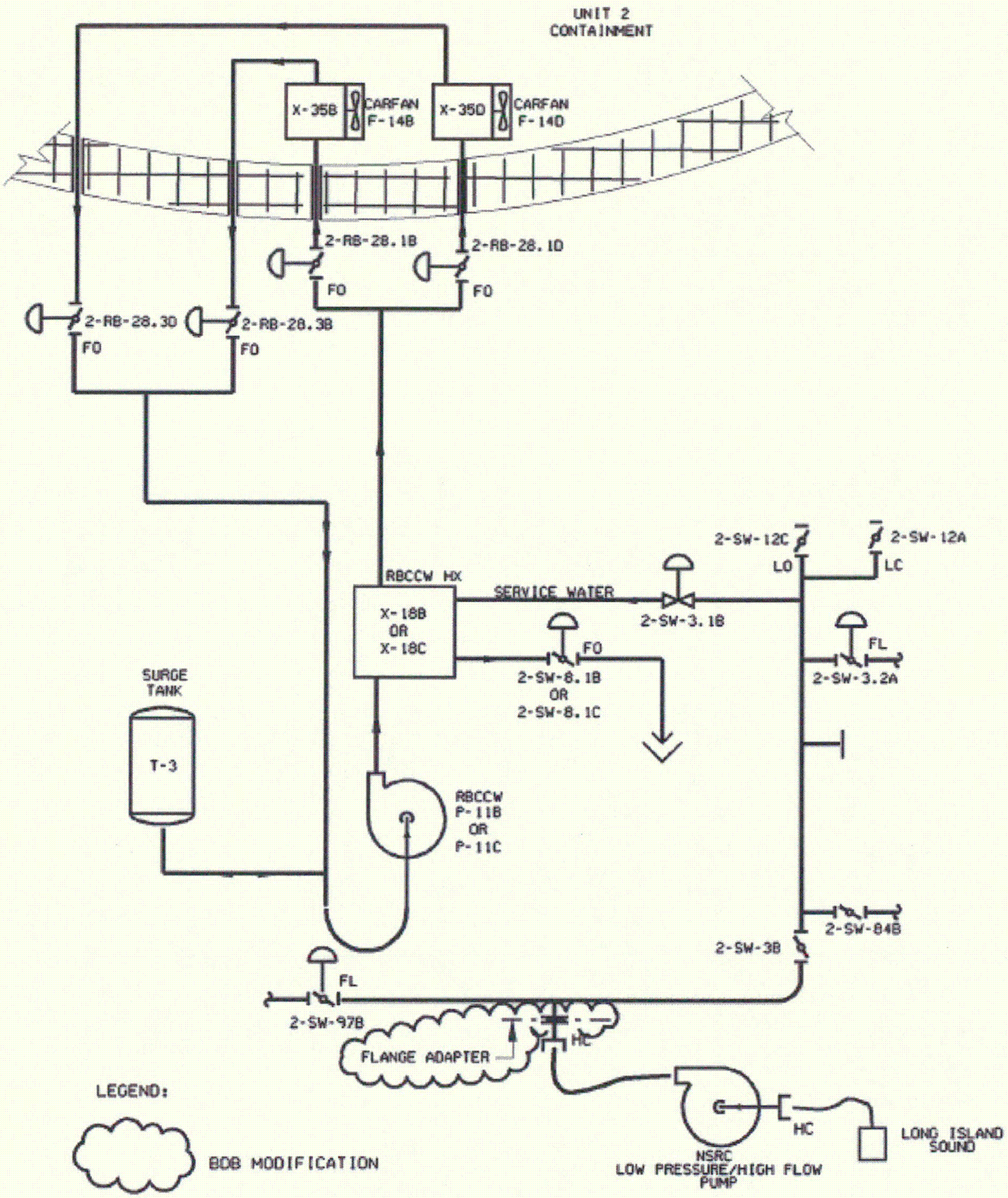


Figure 11: BDB FLEX Containment Cooling Ventilation Option Mechanical Connections

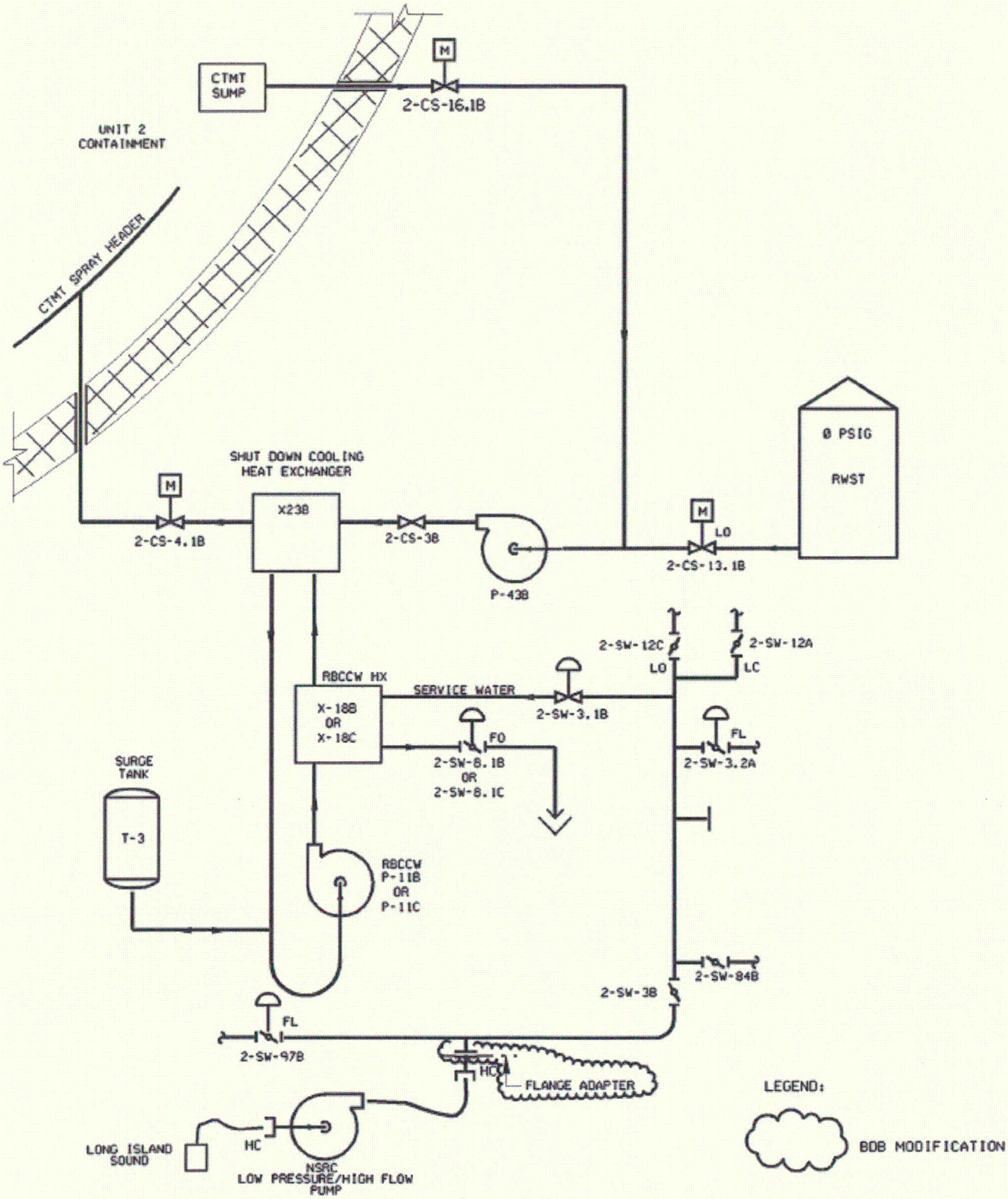


Figure 12: BDB FLEX Containment Cooling Spray Option Mechanical Connections

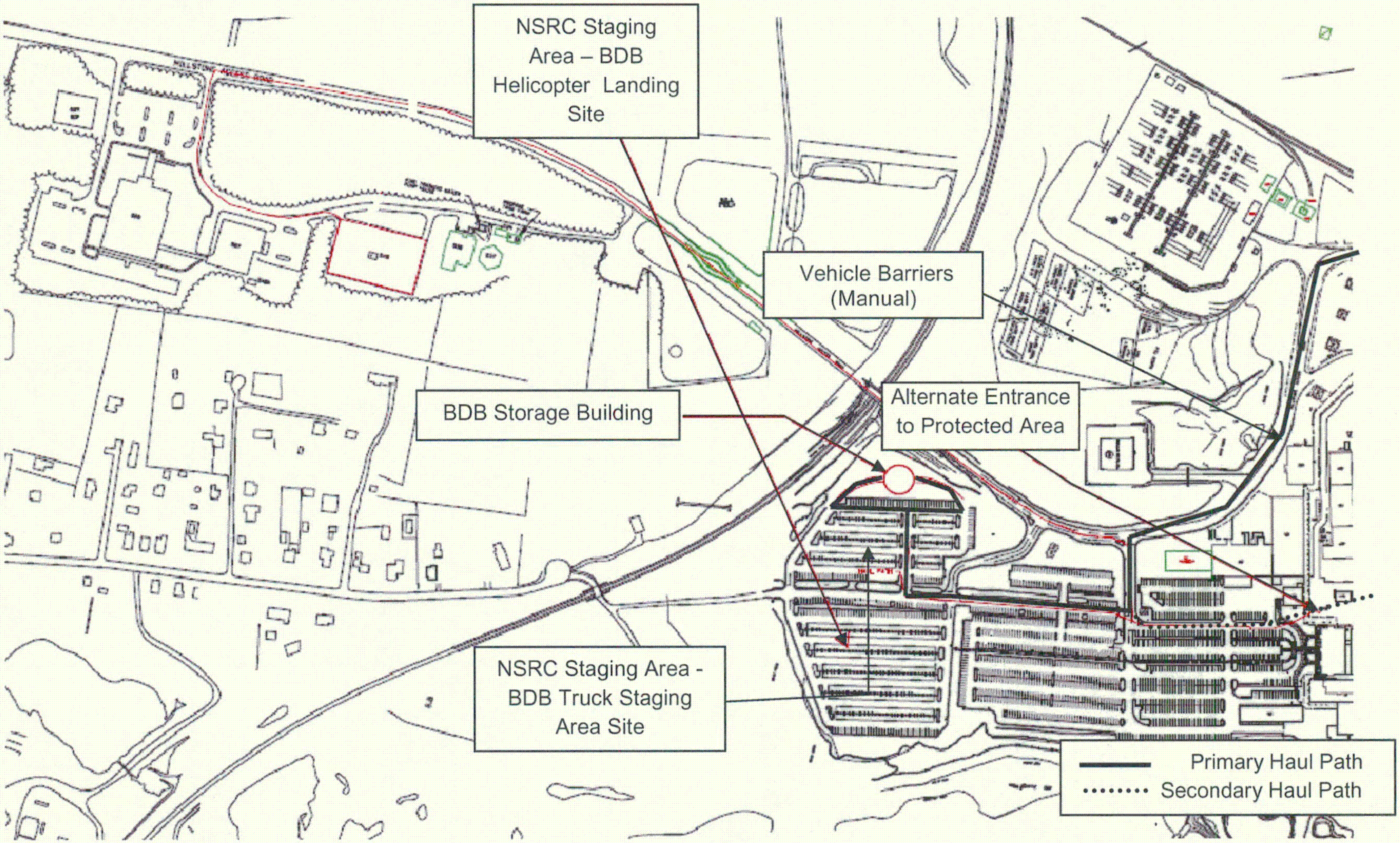


Figure 13: BDB Storage Building, NSRC Staging Area, and Haul Paths

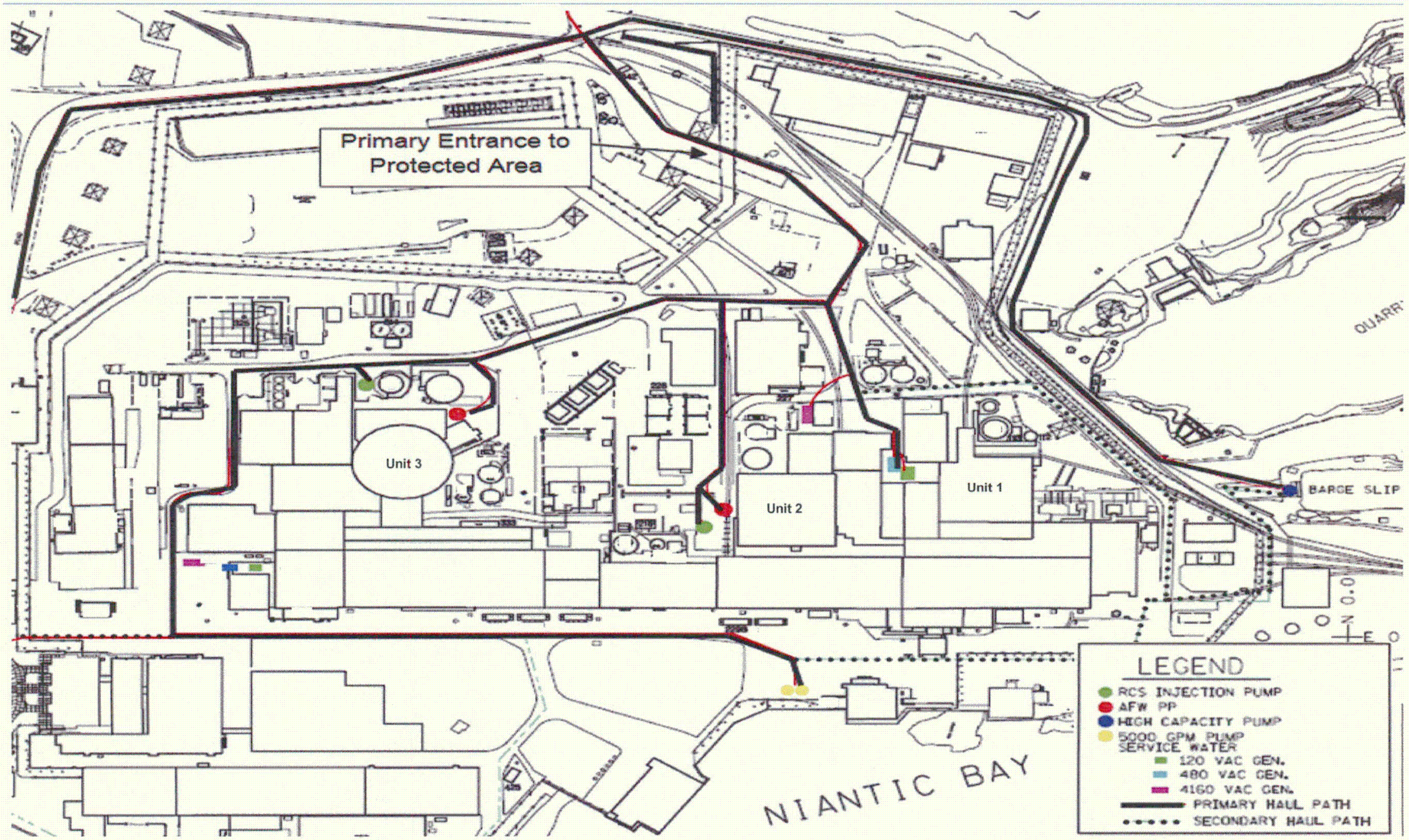


Figure 14: BDB FLEX Equipment Deployment Haul Paths (Protected Area)