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Indiana Michigan Power
Cook Nuclear Plant
One Cook Place
Bridgman, MI 49106
IndianaMichiganPower.com

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U. S. Nuclear Regulatory Commission
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Donald C. Cook Nuclear Plant Units 1 and 2
Revision 1 of Final Integrated Plan Regarding March 12, 2012, U. S. Nuclear Regulatory Commission Order Regarding Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)

Reference:

1. Letter from E. J. Leeds and M. R. Johnson, U. S. Nuclear Regulatory Commission (NRC), to All Power Reactor Licensees and Holders of Construction Permits in Active or Deferred Status, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012, Agencywide Documents Access and Management System (ADAMS) Accession No. ML12054A736.
2. Letter from J. P. Gebbie, Indiana Michigan Power Company (I&M), to NRC, "Donald C. Cook Nuclear Plant, Unit 1 and Unit 2, 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)," AEP-NRC-2013-13, dated February 27, 2013, ADAMS Accession No. ML13101A381.
3. Letter from J. P Gebbie, I&M, to the NRC, "Donald C. Cook Nuclear Plant Units 1 and 2, Final Integrated Plan Regarding March 12, 2012, U. S. Nuclear Regulatory Commission Order Regarding Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," AEP-NRC-2015-23, dated June 16, 2015, ADAMS Accession No. ML15169A106.

In response to events at the Fukushima Dai-ichi Nuclear Power Plant, the U. S. Nuclear Regulatory Commission (NRC) issued Order EA-12-049 (Reference 1) to all power reactor licensees, including Indiana Michigan Power Company, the licensee for the Donald C. Cook Nuclear Plant (CNP) Unit 1

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and Unit 2. The Order directed licensees to submit an overall integrated plan (OIP) including a description of how compliance with the requirements in the Order would be achieved. The OIP for CNP was submitted by Reference 2. The NRC staff subsequently requested that, within 60 days of the date for the final unit to achieve compliance at their plant, licensees submit a Final Integrated Plan (FIP), reflecting the strategies for their plants on that compliance date. Reference 3 transmitted Revision 0 of the FIP for CNP Units 1 and 2, which superseded the OIP. The FIP has since been revised to provide additional information and/or clarification of information regarding core cooling strategies, Reactor Coolant System boration/inventory control strategies, electric power strategies, containment conditions, cold weather considerations for portable equipment, frazil ice considerations, and N+1 requirements for hoses and cables. This letter provides Revision 1 of the FIP.

Enclosure 1 to this letter provides an affirmation regarding the information contained herein. Enclosure 2 provides Revision 1 of the FIP for CNP Units 1 and 2. Changed portions of the text are indicated by revision bars in the right margin.

This letter contains no new or revised regulatory commitments. Should you have any questions, please contact Mr. Michael K. Scarpello, Regulatory Affairs Manager, at (269) 466 2649.

Sincerely,

Joel P. Gebbie
Site Vice President

JRW/ams

Enclosures:

1. Affirmation
2. Final Integrated Plan, U. S. Nuclear Regulatory Commission Order EA-12-049 Strategies for Beyond-Design-Basis External Events Donald C. Cook Nuclear Plant, Units 1 and 2, Revision 1

c: J. P. Boska, NRC Washington, DC
A. W. Dietrich, NRC Washington, DC
J. T. King, MPSC
MDEQ – RMD/RPS
NRC Resident Inspector
C. D. Pederson, NRC Region III
A. J. Williamson, AEP Ft. Wayne, w/o enclosures

Enclosure 1 to AEP-NRC-2015-83

AFFIRMATION

I, Joel P. Gebbie, being duly sworn, state that I am Site Vice President of Indiana Michigan Power Company (I&M), that I am authorized to sign and file this document with the U. S. Nuclear Regulatory Commission on behalf of I&M, and that the statements made and the matters set forth herein pertaining to I&M are true and correct to the best of my knowledge, information, and belief.

Indiana Michigan Power Company

Joel P. Gebbie
Site Vice President

SWORN TO AND SUBSCRIBED BEFORE ME

THIS 1 DAY OF October, 2015

Danielle Burgoyne
Notary Public

My Commission Expires 04-04-2018

DANIELLE BURGOYNE
Notary Public, State of Michigan
County of Berrien
My Commission Expires 04-04-2018
Acting In the County of Berrien

FINAL INTEGRATED PLAN
U. S. NUCLEAR REGULATORY COMMISSION
ORDER EA-12-049
STRATEGIES FOR BEYOND-DESIGN-BASIS EXTERNAL EVENTS

DONALD C. COOK
NUCLEAR PLANT
UNITS 1 AND 2

REVISION 1

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1. BACKGROUND

Note: Abbreviations and acronyms are defined in Table 4.

In 2011, an earthquake-induced tsunami caused 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 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 DC power was lost early in the event on Units 1 and 2, and after some period of time at the other units. Core damage occurred in three of the units along with a loss of containment integrity resulting in a release of radioactive material to the surrounding environment.

The NRC assembled a Near-Term Task Force to advise the Commission on actions the U.S. 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 Near-Term Task Force report contained many recommendations to fulfill this charter, including assessing extreme external event hazards and strengthening station capabilities for responding to a BDBEE.

Based on Near-Term Task Force Recommendation 4.2, the NRC issued Order EA-12-049 on March 12, 2012, requiring licensees to implement mitigation strategies for BDBEEs. The order provided the following requirements for strategies to mitigate BDBEEs:

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

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

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

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

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

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

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

NRC Order EA-12-049 required licensees of operating reactors to submit an OIP, 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 OIP or December 31, 2016, whichever came first.

The NEI developed NEI 12-06, 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, dated August 29, 2012, which endorsed NEI 12-06 with clarifications.

2. NRC ORDER 12-049 – MITIGATION STRATEGIES (FLEX)

Note: A "1/2" designation at the beginning of a procedure number indicates that there is a Unit 1 procedure and a Unit 2 procedure with the same succeeding alpha-numeric designation. A "12" designation indicates that the procedure applies to both Unit 1 and Unit 2.

2.1 Assumptions and Initial Conditions

The assumptions used for the evaluations of an ELAP/LUHS event at CNP and the development of FLEX strategies are stated below. The following initial plant conditions consistent with NEI 12-06 Section 3.2.1, "General Criteria and Baseline Assumptions" are used to establish the baseline coping capability.

The initial plant conditions are assumed to be the following:

(1) Prior to the event the reactor has been operating at 100 percent rated thermal power for at least 100 days or has just been shut down from such a power history as required by plant procedures in advance of the impending event.

(2) At the time of the postulated event, the reactor and supporting systems are within normal operating ranges for pressure, temperature, and water level for the appropriate plant condition. All plant equipment is either normally operating or available from the standby state as described in the plant design and licensing basis.

The following initial conditions are applied:

(1) No specific initiating event is used. The initial condition is assumed to be a LOOP at a plant site resulting from an external event that affects the off-site power system either throughout the grid or at the plant with no prospect for recovery of off-site power for an extended period. The LOOP is assumed to affect all units at a plant site.

(2) All installed sources of emergency on-site ac power and SBO alternate ac power sources are assumed to be not available and not imminently recoverable.

(3) 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.

(4) Normal access to the UHS is lost, but the water inventory in the 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.

(5) Fuel for FLEX equipment stored in structures with designs which are robust with respect to seismic events, floods, high winds, and associated missiles, remains available.

(6) 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.

(7) Other equipment, such as portable ac power sources, portable back up DC power supplies, spare batteries, and equipment for 10 CFR 50.54(hh)(2), may be used provided it is reasonably protected from the applicable external hazards per Sections 5 through 9 and Section 11.3 of NEI 12-06 and has predetermined hookup strategies with appropriate procedures/guidance and the equipment is stored in a relative close vicinity of the site.

(8) Installed electrical distribution system, including inverters and battery chargers, remain available provided they are protected consistent with current station design.

(9) No additional events or failures are assumed to occur immediately prior to or during the event, including security events.

(10) Reliance on the fire protection system ring header as a water source is acceptable only if the header meets the criteria to be considered robust with respect to seismic events, floods, and high winds, and associated missiles.

The following additional boundary conditions are applied for the reactor transient:

(1) Following the loss of all AC power, the reactor automatically trips and all rods are inserted.

(2) The main steam system valves (such as main steam isolation valves, turbine stops, atmospheric dumps, etc.), necessary to maintain decay heat removal functions operate as designed. (For CNP, this includes the TDAFW pumps.)

(3) SRVs or PORVs initially operate in a normal manner if conditions in the RCS so require. Normal valve reseating is also assumed.

(4) No independent failures, other than those causing the ELAP/LUHS event, are assumed to occur in the course of the transient.

Sources of expected reactor coolant inventory loss include:

(1) Normal system leakage.

(2) Losses from letdown unless automatically isolated or until isolation is procedurally directed.

(3) Losses due to RCP seal leakage. The rate is dependent on the RCP seal design.

The plant TS 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 BDBEE may place the plant in a condition where it cannot comply with certain TS and/or with its Security Plan, and, as such, may warrant invocation of 10 CFR 50.54(x) and/or 10 CFR 73.55(p).

2.2 Overall 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, *on-site portable equipment, and pre-staged off-site resources.* This indefinite coping capability will address an ELAP (only those AC buses fed from inverters powered by station batteries remain available) with a simultaneous LUHS.

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

The strategies for coping with the plant conditions that result from an ELAP/LUHS event involve the three-phased approach stated in NEI 12-06 as described above. 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 following the BDBEE.

The strategies described in Sections 2.3 through 2.7 are capable of mitigating an ELAP/LHUS resulting from a BDBEE by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities at both CNP units. Although specific strategies have been developed, due to the impracticality of anticipating all possible scenarios, the strategies are also diverse and flexible so that they may encompass a wide range of possible conditions.

The CNP Engineering Change Process was used to govern overall implementation of the FLEX strategies on each unit. Unit 1 and Unit 2 Engineering Changes EC-0000053212, "Unit 1 FLEX Mitigation Strategies Overall EC," and EC-0000053213, "Unit 2 FLEX Mitigation Strategies Overall EC," identified for the respective units:

- Background
- Overall Requirements
- Key plant functions to be maintained
- Specific plant modifications and associated Engineering Changes
- *Safety Classification*
- Installed plant SSCs affected by the strategies
- Key analyses
- Specific strategies for Phases 1, 2, and 3, and various plant operating Modes
- Specific documents revised or created to implement the strategies

The pre-planned strategies developed to protect the public health and safety are contained in the FSGs integrated with the CNP EOPs in accordance with the established change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59. The strategies credited for CNP compliance with NRC Order EA-12-049 are described below. In some cases there are additional strategies that provide defense in depth for maintaining the desired functions, and there are procedures and equipment for implementation of such additional strategies. However, these additional strategies are not described because they are not credited, may not be necessary, and/or may not be available under all conditions.

2.3 Reactor Core Cooling

2.3.1 Reactor Core Cooling, Modes 1-4, Phase 1

Strategy

In an ELAP event, the reactor would trip if the unit was in Mode 1 or 2, and operators would initiate RCS cooldown by depressurizing the SGs at the maximum allowable rate to minimize RCS inventory loss through the RCP seals. Core cooling would be accomplished by natural circulation using the SGs as the heat sink. SG inventory make up of greater than 240×10^3 pph (≈ 480 gpm) would be promptly initiated using the TDAFW pump taking suction from the CST, and venting steam from the SGs via the SG PORVs. A CST volume of 215,226 gallons is sufficient to support post trip RCS cooldown and decay heat removal for at least 12 hours. Local manual SG PORV operation is credited because there are components in the control systems which are not located in robust structures. If remote operation of the PORVs was not available, SG pressure would be limited by SG Safety Valve operation until local operation of the SG PORVs is established. With credit for the recently installed SHIELD® low leakage RCP seals, initiation of RCS cooldown is required within eight hours of the ELAP. Completion of the cooldown is required within the following two hours.

Four SGs will be used to maintain symmetric RCS cooldown for the first 24 hours. This bounds the initiation of RCS Boration at 16 hours and provides acceptable Boron mixing via RCS natural circulation cooling flow out to 24 hours when the RCS will be fully Borated. This also accounts for an additional hour of symmetric RCS cooling to complete Boron mixing in the RCS with natural circulation cooling flow. Thereafter, RCS cooling may be reduced to two of four SGs to reduce the operator workload required to manually operate the SG PORVs.

Key Components and Systems

CSTs - Each unit has one CST. The CST provides a qualified source of water to the SGs for heat removal from the RCS. The CST provides a passive flow of water, by gravity, to the TDAFW pump. Although TS 3.7.6, "Plant Systems - Condensate Storage Tank (CST)," only requires 182,000 gallons of inventory to be maintained in the CST during normal operation, the normal volume maintained is 85% of the full 476,565 gallon capacity, which equates to 405,080 gallons.

The CSTs are Seismic Class II components qualified to withstand Seismic Class I loads, and are located above the probable maximum flood elevation. In addition, the portion of Seismic Class II condensate piping from the CST to the TDAFW pump shutoff valve is qualified to meet Seismic Class I requirements. The CSTs and interconnecting piping outside the Auxiliary Building are insulated and adequately protected from extremes of hot and cold weather.

TDAFW Pumps - Each unit has one TDAFW pump. Each TDAFW pump receives steam from the SG2 and SG3 main steam lines upstream of the SG Stop Valves. Each of these main steam lines will supply 100% of the requirements of the TDAFW pump. The TDAFW pump takes suction from the CST. The TDAFW pump is capable of providing 900 gpm at a pressure of 1065 psig. The TDAFW pump discharges to a common header that feeds all four SGs with DC powered control valves actuated to the appropriate SG. The TDAFW pump at full flow is sufficient to remove decay heat and cool the unit to RHR entry conditions.

The TDAFW pump does not require AC power or external cooling for startup or operation during an ELAP. The turbine shaft bearings are lubricated by a self-contained lube oil system utilizing a shaft-driven oil pump. Cooling water through the turbine bearing lube-oil cooler and the governor oil cooler is supplied from the TDAFW pump discharge which ensures cooling water supply whenever the turbine is driving the pump. TDAFW pump SG injection MOVs are powered from the N Train battery. Operating procedures currently provide guidance for controlling these valves manually. The N Train battery power would be available for greater than 12 hours by implementing the DC deep load shed strategy specified by 1/2-OHP-4027-FSG-4, "ELAP Power Management."

The TDAFW pump would automatically start and deliver AFW flow to all four SGs following an ELAP/LUHS event. Two normally open motor operated valves provide the steam supply from SGs 2 and 3. On a loss of AC power the TDAFP trip and throttle valve would open due to the AFW start signal and the TDAFW pump turbine steam flow would be controlled automatically by the governor valve. Flow would be provided to all four SGs through motor operated valves. In the event the TDAFW pump fails to start, procedures direct the operators to manually reset and start the pump.

The TDAFW pump trip and throttle valve, electronic governor, and all associated MOVs are powered by 250 VDC from the N train battery. In the unlikely event that that DC power is lost, the trip and throttle valve can be manually opened and turbine over speed would be prevented by a mechanical governor. SG feedwater valves can be manually operated. Approximately 65 minutes are available to manually start the pump and initiate flow prior to SG dryout. Therefore, the TDAFW pump would be available until Phase 3 equipment can be deployed and the RCS is placed on RHR cooling.

SG PORVs - In each unit, each of the four SGs is provided with an SG PORV line. Each SG PORV line consists of one SG PORV and an associated upstream isolation valve. The isolation valves are provided in the event an SG PORV spuriously opens or fails to close. The SG PORVs are equipped with pneumatic controllers to permit remote control of the RCS cooldown rate. The Control Air System provides the normal air supply for pneumatic control. However, the SG PORVs can be manually operated via local hand wheels with no pneumatic supply. The SG PORVs are located in the seismic Category I Auxiliary Building and protected from external events.

Implementing Procedures

1/2-OHP-4023-ECA-0.0, “Loss of All AC Power,” provides directions to stabilize the plant following an ELAP and initiate RCS cooldown by venting steam from the SGs via the SG PORVs, and checking TDAFW pump flow .

1/2-OHP-4025-LS-3, “Steam Generator 2/3 Level Control,” and 1/2-OHP-4025-LS-4, “Steam Generator 1/4 Level Control,” provides instructions for local manual SG PORV operation.

Analyses and Calculations

AREVA calculation 32-9222176-002, "FLEX Coping Capability of Condensate Storage Tanks," determined the capability of the CSTs to supply cooling water required during a BDBEE. This calculation determined that a CST volume of 215,226 gallons would be sufficient to support post trip RCS cooldown and decay heat removal for at least 12 hours.

CNP calculation 51-9225061, “Donald C. Cook CST and RWST Survivability Report,” addressed the survivability of the CST. The survivability report integrated and summarized the results of other assessments and analyses, including a meteorological and intervening structures assessment, a hydraulic analysis of CST FLEX coping capability, missile impact analyses, a tornado wind load and differential pressure assessment, and a detailed finite element model missile impact analysis performed to determine the possibility and extent of penetration of the CSTs for missiles that could not be eliminated from consideration via a manual calculation.

As documented in the survivability report, there is reasonable assurance that both Unit 1 and Unit 2 tanks would remain available as an adequate TDAFW pump suction source during and after a tornado-generated high wind and missile hazard event. Specific aspects of this conclusion were as follows:

- The CSTs can withstand the wind and pressure drop from the postulated tornado.
- Tornado missiles would not render the CSTs unavailable, considering attributes that include, but are not limited to, separation of the Unit 1 and Unit 2 tanks.
- Both CSTs may be impacted by tornado missiles from a single event. However, the CSTs would not be penetrated by tornado missiles in the lower or middle sections of the tank. Penetrations above these sections would not compromise the ability of the tank to provide adequate water inventory for the TDAFW pump for the duration of Phase 1 of the FLEX response.
- The large bore (nominal pipe size >2 in.) penetrations on each CST, including the TDAFW pump suction piping penetrations, are protected by *intervening structures and are not credible tornado-borne missile targets.*
- There are two nominal 1 in. penetrations located within one ft. of the bottom of each tank that are in the same quadrant as the large bore penetrations and are also protected by intervening structures.
- There are two nominal 3/4 in. penetrations located within two ft. of the bottom of each tank that are not protected by intervening structures. However, even if compromised by a tornado missile, these two penetrations will not threaten the inventory needed for the FLEX Phase 1 coping period.

Westinghouse document DAR-SEE-II-14-15, "Evaluation of Alternate Coolant Sources for Responding to a Postulated Extended Loss of All AC Power at the D.C. Cook Nuclear Power Plant," documents that 327 gpm feedwater to SGs in each unit is adequate to remove decay heat and avoid loss of secondary heat sink approximately 1 hour following a plant trip from full power.

Westinghouse document CN-SEE-II-13-16, "DC Cook Units 1 and 2 FLEX Alternate Cooling Impact Evaluation," documents the determination that SG make up must be established within 65 minutes.

Westinghouse document CN-FSE-13-13-R, "D.C. Cook Unit 1 and Unit 2 (AEP/AMP) Reactor Coolant System (RCS) Inventory Control and Long-Term Subcriticality Analysis to Support the Diverse and Flexible Coping Strategy (FLEX)," documents the determination that, with SHIELD® low leakage RCP seals installed, the allowable time to initiate RCS cooldown is eight hours, with completion within the next two hours.

CNP Environmental Qualification Evaluation Report EQER-2000-166, "72 Hour Thermal Rating Limitorque Actuator Motor AFW Pump Room," determined that the equipment survivability temperature limit for the TDAFW pump room is 200°F for 15 days.

CNP calculation TH-00-05, "AFW Pump Room Heat-up Temperatures," evaluated the heat up rate for the TDAFW pump room during an Appendix R event and determined that the pump room would not reach 200°F. Therefore, the TDAFW pump would be available for the postulated 24 hour coping period until Phase 3 equipment can be deployed and the RCS can be placed on RHR cooling.

2.3.2 Reactor Core Cooling, Modes 1-4, Phase 2

Strategy

Upon depletion of the CST inventory, Lake Michigan, the UHS, would be used as the credited SG cooling water source.

A portable diesel driven FLEX Lift Pump would be deployed to take suction from Lake Michigan using a suction hose and strainer. The FLEX Lift Pump would discharge to the ESW supply piping to the TDAFW suction via a hose connection installed by a plant modification. The TDAFW discharge MOVs are powered from the N Train battery. During Phase 2, power to the N Train battery charger would be provided as described in Section 2.7, "Electric Power." One FLEX Lift Pump is capable of providing adequate flow to both the Unit 1 and Unit 2 TDAFW pumps concurrently. Since there are two FLEX Lift Pumps available, the requirement to provide N+1 portable components has been met.

An alternate strategy for supplying water to the SGs would be available by routing the discharge of the FLEX Lift Pump to a FLEX Booster pump to achieve sufficient pressure to feed the SGs. This strategy would use a high pressure manifold to route the FLEX Booster Pump discharge to two SGs in each unit. The manifold would route the FLEX Booster Pump discharge to SG1 and SG4 via one of two new valves, 1-FW-214 or 2-FW-214 and associated connection points. The FLEX Booster Pump discharge can also be routed to SG2 and SG3 in the opposite unit via installed unit cross-connect piping. Since the cross-connect piping allows two SGs in each unit to be fed from either 1-FW-214 or 2-FW-214, either of the associated connection points may be credited for meeting the NEI 12-06 requirement to provide an alternate connection point. CNP calculations demonstrate that one FLEX Lift Pump plus one FLEX Booster pump are capable of providing adequate flow to two SGs in each unit concurrently. Since there are two FLEX Lift Pumps and two FLEX Booster Pumps available, the requirement to provide N+1 portable components has been met. Additionally, non-credited defense-in-depth is provided by the capability of one FLEX Lift Pump plus one FLEX Booster pump to provide adequate flow to all four SGs in each unit concurrently.

Key Components and Systems

UHS - The UHS for CNP is Lake Michigan. The UHS is the sink for heat removed from the reactor core following all accidents and anticipated operational occurrences in which the unit is cooled down and placed on RHR. During normal operation water is drawn from three submerged intake structures in the lake, located approximately 2,250 ft. from the shoreline, and is piped through parallel lines to the CW forebay. The CW intake tunnels maintain communication with Lake Michigan below the anticipated level of winter ice cover. Forebay access is maintained through removable cover plates and manholes allowing FLEX equipment access to the UHS. The CW System and related structures are designed to assure that water is available to the ESW System under all foreseeable conditions.

FLEX Lift Pumps - The FLEX Lift Pump would be deployed to draw suction from the UHS via the CW forebay and discharge to the suction of the TDAFW pump. The FLEX Lift Pump is a trailer mounted diesel driven centrifugal pump. One FLEX Lift Pump is adequate to supply the TDAFW pumps in both units. There are two FLEX Lift Pumps to provide N+1 capability (N = the number of units at a site). Both pumps are stored in the FLEX Storage Building. The design pressure of the ESW system is 105 psi. The FLEX Lift Pump injection pressure into the ESW system would be controlled to ensure the ESW system design pressure is not exceeded.

FLEX Booster Pump – The FLEX Booster pumps are diesel driven centrifugal pumps that are trailer-mounted and stored in the FLEX Storage Building along with an associated hose trailer. The deployed location for the pump is near access ports in the Auxiliary Building wall. The FLEX Booster pump can raise the water delivery pressure to the SGs to at least 327 gpm at 300 psia at the SG feed ring.

FLEX Lift Pump Connection Point - The connection point for the FLEX Lift Pump to inject UHS water to the suction of the TDAFW pump for SG makeup was installed by Unit 1 and Unit 2 Engineering Changes EC-0000053177, "Unit 1 Hose Connections to Essential Service Water for FLEX," and EC-0000053182, "Unit 2 Hose Connections to Essential Service Water for FLEX," respectively. The Engineering Changes replaced a blind flange on the existing 6 in. ESW piping which provides an emergency source of water to the TDAFW pump. The existing flange was replaced with a 6 in. x 4 in. reducing flange, elbow, and piping to allow connection of hoses from the FLEX Lift Pump. The affected ESW piping is located in the Turbine Building which is shared by both units. The portions of the Turbine Building containing the ESW system are Seismic Class I structures capable of protecting the system from natural phenomena such as earthquakes, tornadoes and flooding. An analysis was performed showing the structural adequacy of the new piping segment and confirming its classification as Seismic Class I.

FLEX Booster Pump Connection Point for SG1 and SG4, and Opposite Unit SG2 and SG3 - The connection point for the FLEX Booster Pump discharge to SG1 and SG4 was installed by Unit 1 and Unit 2 Engineering Changes

EC 0000053176, "Unit 1 Hose Connections to Auxiliary Feedwater For FLEX," and EC-0000053183, "Unit 2 Hose Connection for Auxiliary Feedwater for FLEX," respectively. These Engineering Changes installed a 4 in. diameter pipe segment, isolation valve 1/2-FW-214, and pipe cap on the AFW System discharge piping from the West MDAFW pump in the Auxiliary Building. This connection point can also be used to provide flow to SG2 and SG3 in the opposite unit using existing piping and valves.

Equipment Layout Diagrams

The equipment layout for using the FLEX Lift Pump to supply lake water to the Unit 1 TDAFW pumps is shown in Figure 1. The Unit 2 layout is similar. The equipment layout for using the FLEX Lift Pump and FLEX Booster Pump to supply lake water to Unit 1 SG1 and SG4 and Unit 2 SG2 and SG3 via 1-FW-214 is shown in Figure 18A. The layout for using the FLEX Lift Pump and FLEX Booster Pump to supply lake water to Unit 2 SG1 and SG4 and Unit 1 SG2 and SG3 via 2-FW-214 is similar. The layout for using the non-credited defense-in-depth capability of the FLEX Lift Pump and FLEX Booster Pump to supply lake water to all four SGs in both units via 1-FW-214 and 2-FW-214 is shown in Figure 18B.

Implementing Procedures

1/2-OHP-4023-ECA-0.0 provides directions to stabilize the plant following an ELAP and initiate RCS cooldown by venting steam from the SGs via the SG PORVs, initiating makeup to the SGs with the TDAFW pump taking suction from an alternate suction source if CST level cannot be maintained greater than 27%.

1/2-OHP-4025-LS-3, "Steam Generator 2/3 Level Control," and 1/2-OHP-4025-LS-4, "Steam Generator 1/4 Level Control," provide instructions for local manual SG PORV operation.

1/2-OHP-4027-FSG-201, "Alternate AFW Suction Source Equipment Deployment," provides directions for deploying the FLEX Lift Pump, and associated hoses and fittings.

1/2-OHP-4027-FSG-301, "Alternate Low Pressure Feedwater Equipment Deployment," provides directions for deploying the FLEX Booster pump, high pressure manifolds, associated hoses, and fittings.

12-OHP-4027-FSG-311, "FLEX Lift Pump Operation," provides directions for operation of the FLEX Lift Pump.

12-OHP-4027-FSG-312, "FLEX Booster Pump Operation," provides directions for operation of the FLEX Booster Pump.

1/2-OHP-4027-FSG-2, "Alternate AFW Suction Source," provides directions for adding makeup water to the SGs when the TDAFW pump is aligned to an alternate suction source.

1/2-OHP-4027-FSG-3, "Alternate Low Pressure Feedwater," provides directions for adding makeup water to the SGs using the FLEX Lift Pump and FLEX Booster Pump.

Plant Modifications

Unit 1 and Unit 2 Engineering Changes EC-0000053177, and EC-0000053182, respectively, provided instructions for installation of the connection point in the ESW system that allows an alternate cooling source of water to be injected to the suction of the TDAFW pump for SG makeup. Unit 1 and Unit 2 Engineering Changes EC 0000053176, "Unit 1 Hose Connections to Auxiliary Feedwater for FLEX," and EC-0000053183, "Unit 2 Hose Connection for Auxiliary Feedwater for FLEX," installed the 1/2-FW-214 connection points that allow a FLEX Booster Pump to supply SGs in both units.

Analyses and Calculations

Westinghouse document DAR-SEE-II-14-15, "Evaluation of Alternate Coolant Sources for Responding to a Postulated Extended Loss of All AC Power at the D.C. Cook Nuclear Power Plant," documented the acceptability of using Lake Michigan as a makeup source for the SGs. The evaluations addressed the consequences of using non-standard coolant in the secondary system, including the effects on the integrity of the SG tubes, the steam flow path from the two-phase mixture level in the SG through the TDAFW pump, and the feedwater side flow path up to the SG. This included consideration of the impact of corrosion of the secondary side carbon steel with specific attention to the impact on the integrity of the main steam lines as well as the impact due to phase transitions that result in precipitation or volatilization of chemical species in the SG and secondary system. The evaluations also determined the potential impact on the SG heat exchanger surface and the potential impact on the components of the TDAFW turbine and pump. The evaluation concluded that use of Lake Michigan water would not compromise system integrity or equipment performance that would preclude maintaining the plant in a safe condition for at least 98 hours when feeding two SGs or 199 hours when feeding four SGs. These are well within the expected time for transitioning to RHR cooling as described below in Section 2.3.6, "Reactor Core Cooling, All Modes, Phase 3."

Westinghouse document CN-CDME-13-7, "Supporting Chemistry Calculations for Alternate Cooling Source Usage during Extended Loss of All A.C. Power at D.C. Cook Units 1 and 2," evaluated alternate cooling sources to the SGs and determined that the limiting makeup time durations resulting from potential SG corrosion and precipitation due to the credited water source (Lake Michigan), significantly exceeds projected NSRC FLEX equipment deployment time.

Westinghouse document CN-SEE-II-13-16, "DC Cook Units 1 and 2 FLEX Alternate Cooling Impact Evaluation," evaluated secondary system components with respect to maximum blockage of flow and reduction in SG heat transfer. The results of this evaluation were used in Westinghouse documents DAR-SEE-II-14-15 and CN-CDME-13-7.

Westinghouse document CN-SEE-II-13-14, "DC Cook FLEX Alternate Cooling Evaluation Input Auxiliary Feedwater Usage," documented AFW usage for a postulated BDBEE concurrent with an ELAP. The results of this determination were used in Westinghouse documents DAR-SEE-II-14-15 and CN-CDME-13-7.

CNP calculation MD-12-FLEX-002-S, "DC Cook FLEX Core Cooling and SFP Makeup Hydraulic Analysis," determined that the FLEX Lift Pump, hoses, associated manifolds, and fittings would supply the required flow to the suction of the TDAFW pump. This calculation shows that one FLEX Lift Pump can supply the required flows (327 gpm to the Unit 1 TDAFW pump and 327 gpm to the Unit 2 TDAFW pump) to both units concurrently. This calculation also shows that one FLEX Lift Pump plus one FLEX Booster Pump can supply the same required flows to SG1 and SG4 in one unit and SG2 and SG3 in the opposite unit, concurrently, or all four SGs in both units concurrently.

2.3.3 Reactor Core Cooling, Mode 5, with SGs Available and RCS Intact, Phase 1 and Phase 2

Strategy

If the SGs are available in Mode 5 and the RCS is intact, the same strategies would be used as described for Modes 1 through 4 above. The RCS would be allowed to heat up and, when adequate SG pressure is available, SG make-up using the TDAFW pump would be initiated. Steam would be vented using the SG PORVs to remove decay heat.

2.3.4 Reactor Core Cooling, Mode 5, with SGs Not Available or Mode 6 with the Refueling Cavity Not Flooded, Phase 1 and Phase 2

Strategy

Reactor core cooling in Mode 5 with SGs unavailable or Mode 6 is accomplished using an RCS feed and bleed strategy as described below in Section 2.4, "RCS Boration/Inventory Control."

2.3.5 Reactor Core Cooling, Mode 6 with the Reactor Cavity flooded, Phase 1 and Phase 2

Strategy

In Mode 6 with the refueling cavity flooded with reactor upper internals removed, there would be adequate inventory for core cooling until Phase 3. The volume of the refueling cavity above the flange is approximately 261,600 gallons to the top of the liner. Required flow to make up for boil off is approximately 85 gpm 167 hours after shutdown. This equates to a conservative estimate of 49 hours to boil off the inventory in the cavity if no makeup is available. This would provide sufficient coping time for Phase 3 of the FLEX strategies to be implemented.

If the reactor internals are installed, feed and bleed cooling at 120 gpm is required even with the Reactor Cavity flooded to the normal refueling cavity water level above the RV flange. This is because even with the substantial amount of water above the RV flange, there is insufficient flow area to allow counter-current water flow down into the fuel with steam flow up through the RV internals. Consequently, RCS feed and bleed cooling as described below in Section 2.4 would be required in Mode 6 with the RV internals installed.

Analyses and Calculations

AREVA calculation 32-9213802-001, "DC Cook FLEX - Time to Establish Flow Under an Assumed ELAP During Plant Mid-Loop Operation and in MODE 6," documents the determination that it would take at least 49 hours for the water in the refueling cavity to boil off.

2.3.6 Reactor Core Cooling, All Modes, Phase 3

Strategy

Two 1 MW generators from the NSRC would provide 4 kV power to Train B components as described below in Section 2.7, "Electric Power." The availability of Train B 4kV power would allow operation of equipment necessary to establish RHR cooling using the West CCW Pump and West RHR Pump.

The NSRC would also provide:

- A diesel driven, low pressure, high flow, raw water pump capable of providing up to 5000 gpm, to provide flow to the ESW system, and
- Two hydraulically driven, floating lift pumps with a diesel driven hydraulic driver unit to provide flow to the raw water pump.

The NSRC raw water pump would provide flow to the ESW system via a connection to the West ESW pump discharge strainer. The West ESW pump discharge strainer cover would be removed and replaced with a FLEX Strainer Lid equipped with hose connections to accept discharge from the NSRC raw water pump. The NSRC raw water pump would take suction from the CW forebay using two hydraulically driven floating lift pumps and discharge through the West ESW pump discharge strainer to the West ESW pump discharge header. This would restore ESW system cooling flow to the CCW Heat Exchanger and the Control Room Ventilation systems. Phase 3 deployment of RHR would be completed between 24 and 48 hours following NSRC notification.

Key Components and Systems

ESW Strainers - The ESW System normally provides a heat sink for the removal of process and operating heat from safety related components during a Design Basis Accident or transient. The ESW System is safety related and seismic Category I. The ESW System, in conjunction with the CCW System, removes heat from the RHR System, from RHR entry conditions in Mode 4 to steady state cooling in Mode 5 and Mode 6. The ESW System in each unit includes two ESW pumps and two duplex strainers located in the Seismic Category I ESW Screenhouse. ESW System piping is arranged in two independent headers (trains), each serving certain safety related components. The ESW pumps normally obtain and discharge water to the UHS. However, during Phase 3, the cover of the West ESW pump discharge duplex strainers would be removed and replaced with a FLEX strainer lid adapter equipped with hose connections to accept discharge from the NSRC raw water pump. The NSRC raw water pump would receive the discharge of hydraulically driven, floating lift pumps as described above under "Strategy." The installed ESW pumps are not credited for this strategy.

Equipment Layout Diagrams

The equipment layout for Unit 1 is shown in Figure 2. The Unit 2 layout is similar.

Implementing Procedures

1/2-OHP-4027-FSG-1301, "Alternate RHR Cooling Equipment Deployment," provides directions for deploying the NSRC raw water pump, the NSRC floating lift pumps and their hydraulic driver unit, and the associated ESW strainer lid adapter, hoses, manifolds, and fittings.

1/2-OHP-4027-FSG-13, "Alternate RHR Cooling," provides direction for placing the necessary portions of the ESW system, CCW system, and RHR system in service for decay heat removal.

Directions for operation of the NSRC raw water pump, and the NSRC floating lift pumps and their hydraulic driver unit would be provided by the NSRC.

Plant Modifications

No plant modifications are needed. However an ESW strainer lid adapter and hose manifold have been fabricated for use in each unit as described above. The ESW strainer lid adapters are stored in the FLEX Storage Building.

Analyses and Calculations

CNP calculation MD-12-FLEX-004-S, "DC Cook FLEX ESW Heat Balance and Hydraulic Analysis," determined the required ESW flow rate to remove decay heat while keeping RHR temperature at 200°F at both 24 hours and 36 hours after shutdown. The calculation also determined the size and number of FLEX hoses necessary to ensure delivery of the required ESW flowrate, and demonstrated that the NSRC raw water pump would provide adequate flow and discharge pressure.

2.4 RCS Boration/Inventory Control

2.4.1 RCS Boration/Inventory Control, Modes 1-4, Phase 1

Strategy

No actions would be needed in Phase 1. The Unit 1 and Unit 2 RCP seals were upgraded to the Generation 3 SHIELD® equipped low leakage design during the fall 2014 refueling outage and the spring 2015 refueling outages, respectively. The low leakage seals limit the total RCS leak rate to no more than 5 gpm (1 gpm per RCP seal and 1 gpm of unidentified RCS leakage). With credit for the SHIELD® seals, Westinghouse analyses demonstrate that no pumped RCS boration or RCS make up would be required for a unit in Modes 1 through 4 prior to 16 hours. If RCS makeup and boration are commenced within 16 hours, reflux cooling will not occur.

Plant Modifications

Unit 1 and Unit 2 Engineering Changes EC-0000053737, "Installation of U1 Reactor Coolant Pump Generation III Passive Thermal Shutdown Seals," and EC-0000053868, "Installation of U2 Reactor Coolant Pump Generation III Passive Thermal Shutdown Seals," respectively, provided directions for installation of the Generation III SHIELD® low leakage seals on the Unit 1 and Unit 2 RCPs.

Analyses and Calculations

Westinghouse document CN-FSE-13-13-R presents analyses showing that, with credit for the SHIELD® low leakage seals, no pumped RCS boration or RCS make up would be required for a unit in Modes 1 through 4 prior to 16 hours. CN-FSE-13-13-R demonstrates that crediting SHIELD® low leakage RCP seals extends the allowable time to initiate RCS cooldown to eight hours while still requiring completion within the next two hours.

The SHIELD® low leakage seals are credited in the FLEX strategies in accordance with the four conditions identified in the NRC's endorsement letter from J. Davis, NRC, to J. A. Gresham, Westinghouse Electric Company, LLC, dated May 28, 2014. That NRC letter endorsed Westinghouse Technical Report TR-FSE-14-1-P and supplemental information provided by Westinghouse letters dated March 19, 2014, and April 22, 2014 (ADAMS Accession Nos. ML14084A497 and ML14129A353, respectively). The May 28, 2014 NRC letter documented the staff's conclusion that the Westinghouse Technical Report and supplemental information is acceptable for use in ELAP evaluations for NRC Order EA-12-049 subject to four limitations and conditions. Each of these four limitations and conditions is restated in italic font below followed by a description of CNP Unit 1 and Unit 2 compliance.

(1) *Credit for the SHIELD® seals is only endorsed for Westinghouse RCP Models 93, 93A, and 93A-1. Additional information would be needed to justify use of SHIELD® seals in other RCP models.*

CNP Unit 1 and Unit 2 compliance: The CNP Unit 1 and Unit 2 RCPs are Model 93AS. The "S" designation refers to the presence of a spool piece between the pump and the motor that facilitates seal inspection and replacement. The seal package for Model 93A RCPs is identical to that for Model 93AS. Therefore CNP Unit 1 and Unit 2 comply with this limitation/condition.

(2) *The maximum steady-state reactor coolant system (RCS) cold-leg temperature is limited to 571 °F during the ELAP (i.e., the applicable main steam safety valve setpoints result in an RCS cold-leg temperature of 571 °F or less after a brief post-trip transient). Nuclear power plants that predict higher cold-leg temperatures shall demonstrate the following:*

a. *The polymer ring and sleeve 0-ring remain at or below the temperature to which they have been tested, as provided in TR-FSE-14-1-P, Revision 1; or,*

b. *The polymer ring and sleeve 0-ring shall be re-tested at the higher temperature.*

CNP Unit 1 and Unit 2 compliance: The maximum steady-state RCP seal temperature during an ELAP response is expected to be the T_{cold} corresponding to the lowest SG safety relief valve setting of 1065 pounds psig. This corresponds to a T_{cold} value of 556°F to 557°F. Therefore CNP Unit 1 and Unit 2 comply with this limitation/condition.

(3) *The maximum RCS pressure during the ELAP (notwithstanding the brief pressure transient directly following the reactor trip comparable to that predicted in the applicable analysis case from WCAP-17601-P) is as follows: For Westinghouse Models 93 and 93A-1 RCPs, RCS pressure is limited to 2250 psia; for Westinghouse Model 93A RCPs, RCS pressure is to remain bounded by Figure 7.1-2 of TR-FSE-14-1-P, Revision 1.*

CNP Unit 1 and Unit 2 compliance: Normal Unit 1 and Unit 2 operating pressures are 2085 psig and 2235 psig, respectively. Assuming a plant cooldown is initiated at the maximum allowed time of 8 hours following the ELAP and the cooldown and depressurization is completed within 2 hours, it is evident that the plant pressure would remain bounded by Figure 7.1-2 of TR-FSE-14-1-P, Revision 1, which shows a limit of 2250 psig for the first 24 hours. Therefore CNP Unit 1 and Unit 2 comply with this limitation/condition.

(4) *Nuclear power plants that credit the SHIELD® seal in an ELAP analysis shall assume the normal seal leakage rate before SHIELD® seal actuation, and a constant seal leakage rate of 1.0 gallon per minute for the leakage after SHIELD® seal actuation.*

CNP Unit 1 and Unit 2 compliance: A constant Westinghouse SHIELD® RCP seal package leak rate of 1 gpm per RCP was assumed in the applicable analysis, CN-FSE-13-13-R. Assumption of the normal seal leakage rate until

SHIELD® seal actuation occurred would result in a small volume of additional leakage that would have an inconsequential effect on the analysis results. Therefore, CNP Unit 1 and Unit 2 meet the intent of this limitation/condition.

2.4.2 RCS Boration/Inventory Control, Modes 1-4, Phase 2

Strategy

During the cooldown described above in Section 2.3, "Reactor Core Cooling," borated water would be added to compensate for the positive reactivity of the cooldown and xenon decay. Makeup to the RCS would also compensate for inventory contraction caused by cooldown, and the small amount of leakage through the SHIELD® low leakage RCP seals. A portable electric powered FLEX Boric Acid Pump would be used to inject boric acid into the RCS. The pump would be powered by a FLEX 250 kW Boric Acid Pump diesel generator. RCS boration is required to start within 16 hours and be completed within 24 hours of the ELAP to ensure symmetric RCS cooldown and boron mixing in natural circulation. Active SG cooling and natural circulation of all four loops is maintained for at least one hour following boron injection to ensure boron mixing for long term core sub-criticality. RCS Boration is expected to be complete in five to six hours following initiation.

The BASTs would be the primary suction source for the portable FLEX Boric Acid Pumps. The FLEX Boric Acid Pumps would take suction from a hose connected to the Boric Acid Transfer Pump suction header, and discharge to the RCS through a tee connection installed on the CVCS Charging Pumps discharge header. The RCS injection flow path is through the Boron Injection Tank into the RCS through the four RCS cold legs. One BAST contains sufficient volume to maintain core sub-criticality following the cooldown. An alternate connection for RCS Boration and Inventory make up would be available through vent and drain connections on the SIS pump discharge piping using a portable SIS manifold. Blending of the borated water with non-borated water would not be required.

Key Components and Systems

BASTs - There are three BASTs. The tanks are constructed of stainless steel and are at atmospheric pressure. Each BAST has a capacity of 11,000 gallons. The BASTs are located within the Auxiliary Building and are protected from external hazards. The BASTs are classified as Seismic Class I. Sections 8.1.1 and 8.1.2 of the Unit 1 and Unit 2 TRMs require that a functional BAST have a boron concentration of ≥ 6,550 ppm and ≤ 6,990 ppm, and a usable water volume of ≥ 8,500 gallons in Modes 1 through 6.

FLEX Boric Acid Pumps - There are three FLEX Boric Acid Pumps stored in the Auxiliary Building at elevation 587 ft. The pumps are mounted on mobile carts and can be moved to the vicinity of the CVCS Reciprocating Charging Pump or SIS rooms at that same building elevation. The FLEX Boric Acid Pumps are positive displacement pumps rated for 26 gpm at 1550 psig which exceeds the 25 gpm at 1500 psia assumed in plant specific analysis CN-FSE-13-13-R.

FLEX 250 kW Boric Acid Pump Diesel Generator - The FLEX 250 kW Boric Acid Pump DGs are stored in the FLEX Storage building. The deployed location for the generators is outside the Auxiliary Building Crane Bay Rollup door. One FLEX 250 kW DG is capable of powering two FLEX Boric Acid Pumps. Therefore, two FLEX Boric Acid Pumps and one 250 kW DG will provide N capability for the site, and one additional FLEX Boric Acid Pump and one additional 250 kW DG are available to provide N+1 capability for the site.

Connection Point for FLEX Boric Acid Pump Suction - The connection points for the FLEX Boric Acid pumps suction are at newly installed valves 1-CS-645 in Unit 1 and 2-CS-645 in Unit 2. The branch lines to these valves, the valves themselves, and the downstream piping with connectors were added to an existing BAST common discharge header per Unit 1 EC-0000053173, "RCS Inventory and Boric Acid Make-up for FLEX," and Unit 2 EC-0000053181, "Unit 2 RCS Make-up to CVCS for FLEX."

Primary Connection Point for FLEX Boric Acid Pump Discharge – The primary connection points for the FLEX Boric Acid pumps discharge are at newly installed valves 1-CS-314 in Unit 1 and 2-CS-314 in Unit 2. The branch lines from these valves, the valves themselves, and the upstream piping with connectors were added to the existing Reciprocating Charging Pump discharge header per Unit 1 EC-0000053162, "Unit 1 RCS Make-up to CVCS for FLEX," and Unit 2 EC-0000053179, "Unit 1 RCS Make-up to CVCS for FLEX."

Alternate Connection Point for FLEX Boric Acid Pump Discharge - The alternate connection points for the FLEX Boric Acid pumps discharge are at existing valves 1-SI-112S, 1-SI-112N, 1-SI-113, 1-SI-114, 1-SI-115S, 1-SI-115N, 1-SI-116N, 1-SI-118S, and 1-SI-118N in Unit 1; and 2-SI-112S, 2-SI-112N, 2-SI-113, 2-SI-114, 2-SI-115S, 2-SI-115N, 2-SI-116S, 2-SI-118S, and 2-SI-118N in Unit 2.

Equipment Layout Diagrams

The equipment layout for the 250 kW FLEX Boric Acid Pump DG and the FLEX Boric Acid Pump discharging to the Charging Pumps discharge header for Unit 1 is shown in Figure 3. The Unit 2 layout is similar.

The equipment layout for the 250 kW Boric FLEX Acid Pump diesel generator and the FLEX Boric Acid pump discharging to SI pump discharge piping for Unit 1 is shown in Figure 4. The Unit 2 layout is similar.

Implementing Procedures

1/2-OHP-4027-FSG-801, "RCS Boration - Makeup Equipment Deployment," provides direction for deployment and connection of:

- The 250 kW Boric FLEX Acid Pump DG and the associated cables for connection to the FLEX Boric Acid pump.

- The FLEX Boric Acid pump and associated hose connections to the primary connection point, the Charging Pumps discharge header.
- The FLEX Boric Acid pump and associated hose connections to the alternate connection point, the SI pump discharge piping using a portable SIS manifold.

12-OHP-4027-FSG-811, "FLEX Boric Acid Pump Operation," provides direction for operation of the FLEX Boric Acid pump.

12-OHP-4027-FSG-412, "FLEX 250/350 kW DG Operation," provides direction for operation of the 250 kW FLEX Boric Acid Pump diesel generator.

1/2-OHP-4027-FSG-8, "Alternate RCS Boration," provides direction for establishing RCS conditions for boration, and provides directions for adding the necessary quantity of boron to the RCS using the FLEX Boric Acid pump discharging to the Charging Pumps discharge header, or discharging to SI pump discharge piping. The FSG provides directions for initiating RCS makeup flow prior to losing two phase natural circulation such that reflux cooling does not occur.

1/2-OHP-4027-FSG-1, "Long Term RCS Inventory Control," provides direction for adding borated makeup to maintain adequate Pressurizer level as needed after the necessary quantity of boron has been added per 1/2-OHP-4027-FSG-8. The borated makeup may be added using the FLEX Boric Acid pump discharging to the Charging Pumps discharge header, or discharging to SI pump discharge piping. The FSG provides directions for initiating RCS makeup flow prior to losing two phase natural circulation such that reflux cooling does not occur.

Plant Modifications

Unit 1 and Unit 2 Engineering Changes EC-0000053173 and EC-0000053181, respectively, provided instructions for installation of connection points at the suction of the installed Boric Acid pump in each unit. These connections would be utilized to draw borated water from the BAST for injection into the RCS.

Unit 1 and Unit 2 Engineering Changes EC-0000053162, and EC-0000053179, respectively, provided instructions for installation of connection points in the CVCS Reciprocating Charging Pump discharge headers of each unit.

Analyses and Calculations

Westinghouse document CN-FSE-13-13-R provides the basis for the following:

- Commencement of RCS boration within 16 hours, and completion of RCS Boration within 24 hours of the ELAP to ensure symmetric RCS cooldown and boron mixing in natural circulation.
- Sizing of the FLEX Boric Acid Pumps to deliver 26 gpm at 1550 psig, which exceeds the assumed 25 gpm at 1500 psia.
- Maintaining active SG cooling and natural circulation of all four loops for at least one hour following boron injection to ensure boron mixing for long term core sub-criticality.
- An RCS makeup minimum boric acid concentration of 6550 ppm.
- Crediting the SHIELD® low leakage RCP seals.

CNP calculation MD-12-FLEX-001-S, "DC Cook FLEX- RCS Makeup Hydraulic Analysis," determined the required flow rate and discharge pressure of the FLEX Boric Acid Pump.

CNP calculation 12-E-S-480-FLEX-001, "Boric Acid FLEX Pump Electrical Analysis," determined the minimum diesel generator size to ensure that sufficient voltage and power will be provided to the FLEX Boric Acid Pump motor. The calculation determined that a 100 kW diesel generator would be sufficient to operate two FLEX Boric Acid Pump motors.

2.4.3 RCS Boration/Inventory Control, Mode 5 with SGs Not Available, or Mode 6, Phase 1 and Phase 2

Strategy

In Mode 5 without SGs available or in Mode 6 with the cavity not flooded, there is no Phase 1 FLEX response needed for a loss of Shutdown Cooling or loss of RCS boration/inventory control. In this condition, FLEX equipment deployed in advance of entering the associated plant configuration is credited. Therefore, these strategies are characterized as Phase 2.

The strategies would use a bleed and feed method to provide core cooling and RCS boration/inventory control. If the RWST had sufficient volume to provide a driving head, RCS make up would initially be provided by gravity draining the RWST to the RCS as described in the RHR system AOPs. If the unit was in Mode 5 with the RCS pressurized, the Pressurizer PORVs would be opened to reduce RCS pressure to allow the RCS make up using RWST gravity feed.

If the RWST did not have sufficient volume to provide a driving head, the SI Accumulators would be used to provide the initial RCS makeup. This strategy would be available as the result of pre-establishing the following accumulator configuration and pre-staging the following portable FLEX equipment.

- At least three SI Accumulators will be maintained pressurized with the unit in Mode 5 or Mode 6. Each accumulator will contain at least 7000 gallons of 2400-2600 ppm boric acid solution.
- An N+1 350 kW, 480 VAC, DG and portable 480/600 VAC step-up transformer will be pre-staged to enable operation of the SI Accumulator outlet isolation valves. The associated breakers have been modified to provide a FLEX connection point to repower the accumulator outlet valves. In the event of an ELAP, the seal-in jumpers in the breakers would be cut to provide jogging capability for the SI Accumulator outlet valves.

This strategy would provide at least 58 minutes of RCS injection per SI Accumulator, assuming an average usage of 120 gpm. This would allow sufficient time to establish RCS feed (from the RWST) and bleed using the pre-staged FLEX Blended RCS make-up pump as described below.

RCS feed from the RWST would use a portable, diesel driven, FLEX Blended RCS make-up pump which would be pre-staged near the RWST. The FLEX Blended RCS make-up pump would take suction from the RWST at valve 1/2-SI-176. The injection flow path would be from the FLEX Blended RCS Make-up pump discharge, routed through a FLEX Portable Mixing Manifold, then injected into the RCS via a primary or alternate connection points. The primary plant connection point is a hose connection in the common charging pump discharge header of the CVCS. The alternate plant connection point is through vent and drain connections on the SI pump discharge piping using a portable SIS manifold (multi-connection point tool).

A flow rate of 120 gpm into the RCS would be established. A pressurizer PORV would be opened if necessary to allow RCS heat up and expansion to rupture the PRT relief disc to provide a bleed path. After four hours, the FLEX Portable Mixing Manifold would be used to blend the borated water from the RWST with non-borated water. Although raw water from Lake Michigan is the credited source of non-borated water, water from the Lake Township water supply or the CNP Fire Protection system would be the preferred sources. If raw water from the CW forebay were used, it would be pumped by the diesel driven FLEX Lift Pump. The Portable Mixing Manifold would provide both control and indication of blended RCS make-up flow rate. A flow interruption time of up to 15 minutes has been allocated to allow for transition to blended RCS make-up. A blended flow rate of 60 gpm from the RWST with 60 gpm from the raw water source would be sufficient to avoid incipient boron precipitation in the RCS for up to 72 hours under conditions where a hot leg vent path results in the concentration of boron in the RPV.

Key Components and Systems

SI Accumulators – The SI accumulators are pressure vessels partially filled with borated water and pressurized with nitrogen gas. There are four SI accumulators, each of which is piped into an RCS cold leg. The piping includes a motor operated outlet valve that is normally open during unit operation. The accumulators are located inside Containment and are classified as safety-related and are Seismic Class I. During normal plant operation, the accumulators function as passive ECCS components, with no operator or control actions required for them to discharge their contents into the cold legs if RCS pressure decreases below the accumulator pressure. SI accumulators are isolated during plant shutdown when RCS pressure drops below 1000 psig. In Mode 5 with SGs not available, or Mode 6, at least three SI accumulators will be maintained pressurized with the outlet valves closed, and will contain at least 7000 gallons of 2400-2600 ppm boric acid solution.

350 kW 480 VAC N+1 DG - This generator is described below in Section 2.7, "Electric Power."

350 kW, 480 VAC, DG and 480/600 VAC step-up transformer – The 350 kW, 480 VAC, DG, and the 480/600 VAC step-up transformer with associated cables and connectors are each mounted on their own trailer and stored in the FLEX Storage Building. The trailer would be towed to its pre-staged location near the affected unit.

Connection Points for Power to SI Accumulator Outlet Valves – The connection points for the accumulator outlet valves are located in Unit 1 MCCs 1-EZC-A, -B, -C, and -D, and Unit 2 MCCs 2-EZC-A, -B, -C, and –D. Unit 1 and Unit 2 Engineering Changes EC-0000053165, "Unit 1 FLEX Generator To 600V MCC ABD-B For N-Train Charger (1-EL-03)," and EC-000053168, "Unit 2 FLEX Generator To 600V MCC ABD-B For N-Train Charger (2-EL-03)," respectively, provided electrical plugs in each MCC that would be used to connect cables from the 480/600 VAC step-up transformer. The existing electrical distribution system would then be used for operation of the SI Accumulator outlet valves associated with each MCC.

RWSTs – There is one RWST for each unit. The Unit 1 RWST is located due north of the Unit 1 Containment and the Unit 2 RWST is located due south of the Unit 2 Containment. The RWSTs have a nominal capacity of 420,000 gallons of borated water. The tanks are stainless steel, are vented to atmosphere, and are insulated. As described below under "Analyses and Calculations," only one of the two RWST should be credited for providing the credited volume of 232,000 gallons for RCS injection for all conditions.

FLEX Blended RCS Make-up Pumps - There are two FLEX Blended RCS Makeup Pumps. The pumps are diesel driven and trailer mounted centrifugal pumps, and are stored in the FLEX Storage Building. A pump will be pre-staged near the associated RWST for a unit in Mode 5 with SGs not available, or Mode 6. The pumps are rated for a maximum discharge head of 328 feet of water and a maximum flow of 443 gpm.

Connection Point for FLEX Blended RCS Make-up Pump Suction – The connection point for the FLEX Blended RCS Makeup Pump suction would be at valve 1/2-SI-176.

FLEX Portable Mixing Manifold – There are two FLEX Portable Mixing Manifolds stored on elevation 587 ft. in the Auxiliary Building. The manifolds consist of piping assemblies that may schematically be represented by a "Tee" with a nominal 5 inch inlet connection and a nominal 3 in. inlet connection that are piped together to a nominal 3 in. common discharge connection. The 5 in. inlet piping would be connected to hoses that would receive raw water from the FLEX Lift Pump, and the 3 in. inlet piping would be connected to hoses that would receive borated water from the FLEX Blended RCS Make-up Pump. The 3 in. discharge piping would be connected to either the Primary or Alternate FLEX Blended RCS Make-up connection points described below.

Primary Connection Point for FLEX Blended RCS Make-up – The primary connection points for the FLEX Boric Acid pumps discharge are at newly installed valves 1-CS-314 in Unit 1 and 2-CS-314 in Unit 2. The branch lines from these valves, the valves themselves, and the upstream piping with connectors were added to the existing Reciprocating Charging Pump discharge header per Unit 1 EC-0000053162 and Unit 2 EC-0000053179.

Alternate Connection Points and Manifold for FLEX Blended RCS Make-up - The alternate connection points for the FLEX Boric Acid pumps discharge are at nine existing SIS valves (1-SI-112S, 1-SI-112N, 1-SI-113, 1-SI-114, 1-SI-115S, 1-SI-115N, 1-SI-116N, 1-SI-118S, and 1-SI-118N in Unit 1; and 2-SI-112S, 2-SI-112N, 2-SI-113, 2-SI-114, 2-SI-115S, 2-SI-115N, 2-SI-116S, 2-SI-118S, and 2-SI-118N in Unit 2). A portable SIS manifold with a nominal 3 in inlet connection and nine branches would be used to distribute the blended flow to the nine connection points in the affected unit. There are two SIS manifolds stored on elevation 587 ft. in the Auxiliary Building.

FLEX Lift Pumps – The FLEX Lift Pumps are described above in Section 2.3 "Reactor Core Cooling."

Equipment Layout Diagrams

The layout for the FLEX Blended RCS Make-up pump, the FLEX Lift Pump, the FLEX Portable Mixing Manifold for the primary and alternate Unit 1 plant connection points, taking suction from the Unit 1 RWST, is shown in Figures 5 and 6. The layout for the primary and alternate Unit 2 plant connection points, taking suction from the Unit 2 RWST is similar.

The layout for the FLEX Blended RCS Make-up pump, the FLEX Lift Pump, the FLEX Portable Mixing Manifold, and associated hoses and fittings for the primary and alternate Unit 1 plant connection points, taking suction from the Unit 2 RWST is shown in Figures 7 and 8. The layout for the Unit 2 primary and alternate plant connection points, taking suction from the Unit 1 RWST is similar.

The N+1 350 kW, 480 VAC, DG and portable 480/600 VAC step-up transformer equipment layout for operation of the SI Accumulator outlet isolation valves in Unit 1 is shown in Figure 9. The Unit 2 layout is similar.

Implementing Procedures

1/2-OHP-4022-017-001, "Loss of RHR Cooling," provides guidance for RWST gravity feed to the RCS.

1/2-OHP-4027-FSG-1401, "Shutdown RCS Makeup Equipment Deployment," provides direction to deploy and connect the FLEX Blended RCS Make-up pump, the FLEX Lift Pump, the FLEX Portable Mixing Manifold, and associated hoses and fittings for the primary and alternate plant connection points.

1/2-OHP-4027-FSG-401, "ELAP Power Management Deployment," provides direction to deploy and connect the 350 kW diesel generator and portable 480/600V transformer to power the SI Accumulator discharge valves.

1/2-OHP-4027-FSG-14, "Shutdown RCS Makeup," provides direction for aligning power to the SI Accumulator outlet valves and injecting the accumulator inventory into the RCS. The procedure also provides directions for injecting blended and unblended RWST makeup into the RCS via the primary and alternate connections, using either the affected unit's RWST or the opposite unit's RWST, and directions for venting the RCS. The procedure directs operators to use the water from the Lake Township water system or the CNP Fire Protection system preferentially over raw water from Lake Michigan.

12-OHP-4027-FSG-1411, "FLEX Blended RCS Makeup Pump Operation," provides directions for operation of the FLEX Blended RCS Makeup Pump.

12-OHP-4027-FSG-311 provides directions for operation of the FLEX Lift Pump.

12-OHP-4027-FSG-412 provides instructions for operation of the N+1 strategy 350 kW DG.

PMP-4100-SDR-001, "Plant Shutdown Safety and Risk Management," Attachment 5 provides direction to ensure the following installed components and FLEX equipment is available and pre-staged when SGs are not available for RCS cooling and the Reactor Cavity is not filled:

- Three SI Accumulators meeting inventory, pressure, and Boron Concentration requirements of TS 3.5.1, "Accumulators."
- The FLEX 350kW N+1 portable generator.
- The FLEX N+1 portable 480/600 VAC transformer and associated cables for operating SI Accumulator outlet valves by locally repowering the outlet valve supply breakers.

- A FLEX Blended RCS Makeup Pump and associated suction and discharge hoses.
- A FLEX Blended RCS Makeup Mixing tee.
- A FLEX Lift Pump and associated hoses and suction strainer.

Plant Modifications

Unit 1 and Unit 2 Engineering Changes EC-0000053162 and EC-0000053179, respectively, provided instructions for installation of a connection point in the common charging pump discharge header of the CVCS in each unit. These connections would allow the injection of borated RCS make-up.

Unit 1 and Unit 2 Engineering Changes EC-0000053165, "Unit 1 FLEX Generator to 600v MCC ABD-B for N-Train Charger (1-EL-03)," and EC-0000053168, "Unit 2 FLEX Generator To 600v MCC ABD-B for N-Train Charger (2-EL-03)," respectively, provided instructions for the installation of the electrical infrastructure that would be used to power the SI Accumulator outlet valves from the 350 kW N+1 DG.

Analyses and Calculations

CNP calculation 51-9225061, "Donald C. Cook CST and RWST Survivability Report," Appendix B, addressed the survivability of the RWST. The calculation determined that the survivability of the RWST is similar to that of the CST with respect to wind loading and overturning as described above in Section 2.3, under "Analyses and Calculations" for "Reactor Core Cooling, Modes 1-4, Phase 1." Similar to the CST, the RWSTs would not be penetrated by tornado missiles in the lower or middle sections of the tank. Penetrations above these sections would not compromise the ability of the tank to provide adequate water inventory.

However, CNP calculation 51-9222950, "Donald C. Cook FLEX CST and RWST Availability Project: Tornado and Intervening Structures Assessment," determined that, due to narrow potential missile pathways to RWST nozzles, piping, and other attachments from the southeast for Unit 1 and northeast for Unit 2, only one of the two RWSTs should be credited for RCS injection for all conditions.

Westinghouse document CN-FSE-13-13-R demonstrates that:

- Injection of 120 gpm blended flow into the RCS would provide adequate core cooling.
- Un-diluted RWST injection may be used for approximately four hours.
- A flow interruption time of up to 15 minutes may be allowed for transition to blended RCS make-up.

- A blended flow rate of 60 gpm from the RWST with 60 gpm from the raw water source would be sufficient to avoid incipient boron precipitation in the RCS for up to 72 hours under conditions where a hot leg vent path results in the concentration of boron in the RPV.

CNP calculation 32-9218372, "DC Cook FLEX – PRT Rupture Disc Burst," determined that the PRT relief disc would rupture to provide a vent path.

CNP calculation MD-12-FLEX-001-S, "DC Cook FLEX- RCS Makeup Hydraulic Analysis," determined the flow rate and discharge pressure of the FLEX Boric Acid Pump.

CNP calculation 12-E-S-480-FLEX-001, "Boric Acid FLEX Pump Electrical Analysis," determined the minimum diesel generator size to ensure that sufficient voltage and power will be provided to the FLEX Boric Acid Pump motor. The calculation determined that a 100 kW diesel generator would be sufficient to start and operate two FLEX Boric Acid Pump motors.

2.4.4 RCS Boration/Inventory Control, All Modes, Phase 3

Strategy

RCS inventory control strategy in Phase 3 would use the same inventory control methods as described above for Phase 2. In Phase 3, core cooling would be provided by the RHR system rather than blended feed and bleed of the RCS. Therefore, the only makeup needed would be that required for RCP seal leakage. The seal leakage would be minimal because the low leakage seals have been installed in both units. Also, there would be no continued concentration of impurities in the RCS from the non-borated water source because the RCS would be maintained less than 200°F.

During recovery actions, RCS chemistry cleanup and RCS makeup water chemistry would be addressed by the ERO. During Emergency Termination and Recovery, the Recovery Team would address water management, including clean-up activities and evaluation of the need for portable filtering systems and expertise. Makeup water filtration and demineralization could be accomplished through installed makeup water systems if available or portable demineralization equipment.

2.5 SFP Cooling

2.5.1 SFP Cooling, Phase 1:

Strategy

For Phase 1, it is assumed that the initial SFP level is in accordance with that required by TSs (23 ft. over the top of irradiated fuel assemblies). Approximately 49 hours would be required to boil off the SFP water to a level requiring cooling or the addition of makeup to preclude fuel damage, conservatively assuming a dual unit, fresh core offload.

Moisture caused by evaporation or boiling will be removed from the Auxiliary Building by natural draft. A vent path would be provided by opening the elevation 609 ft. SFP Building Crane Bay roll up door and opening the SFP roof fire dampers in the Auxiliary Building roof above elevation 650 ft.

Implementing Procedures

12-OHP-4027-FSG-11, "Alternate SFP Makeup and Cooling," provides directions for opening the elevation 609 ft. Auxiliary Building Crane Bay roll up door and opening the roof fire dampers.

Analyses and Calculations

CNP calculation PRA-SFP-HEAT-UP, "SFP Long Term Decay Heat Loads and SFP Heat Up Rates," demonstrates that the time required to reduce the SFP water to a level requiring cooling or the addition of makeup to preclude fuel damage is approximately 49 hours with a dual unit, fresh core offload.

2.5.2 SFP Cooling, Phase 2:

Strategy

For Modes 1-6, Phase 2, the FLEX Lift Pump described above in the Section 2.3, "Reactor Core Cooling," for Modes 1-4, Phase 2 would be used to draw water from Lake Michigan and deliver make-up water to the SFP using hoses and a fire protection monitor nozzle which would be mounted at elevation 650 ft. of the Auxiliary Building adjacent to the SFP. The FLEX Lift Pump is capable of supplying the maximum boil-off rate of 115 gpm. If less than 115 gpm is desired, the hose configuration would allow throttling of the supply flow as required.

Key Components and Systems

FLEX Lift Pumps – The FLEX Lift Pumps are described above in Section 2.3.

Equipment Layout Diagrams

The layout of the FLEX Lift Pump, hoses, and fittings for makeup to the SFP is shown in Figure 10.

Implementing Procedures

12-OHP-4027-FSG-1101, "Alternate SFP Makeup Equipment Deployment," provides directions for deploying the FLEX Lift Pump and associated hoses and fittings.

12-OHP-4027-FSG-11 provides directions for initiating makeup flow to the SFP.

Analyses and Calculations

CNP calculation MD-12-FLEX-002-S and AREVA calculation 32-9197975-000, "Sizing Calculations for DC Cook FLEX Conceptual Design," demonstrate that the pumps, hoses, associated manifolds and fittings will supply the required 115 gpm SFP makeup flow.

2.5.3 SFP Cooling, Phase 3:

Strategy

The Phase 2 strategy would remain in effect for an extended period. No specific Phase 3 strategy is planned.

2.6 Containment

2.6.1 Containment, Modes 1-4, Phases 1 and 2

Strategy

For Phase 1 and Phase 2 with the unit operating in Modes 1-4 and Mode 5 with SGs available, analysis demonstrates that there are no actions required to maintain pressure below 12 psig for over 72 hours, which is adequate time for Phase 3 implementation.

For Phase 2 Modes 1 - 4, the upper and lower containment hydrogen ignitor assemblies will be provided power with connections from either the N Strategy 600 VAC, 500 kW FLEX DG, or the N+1 strategy 480 VAC, 350 kW DG via the existing 480/600 VAC Outside Temporary Outage Power Transformer. The upper and lower containment hydrogen ignitor assemblies are designed to maintain containment integrity by preventing hydrogen deflagration or detonation due to build-up of hydrogen gas in the event of core damage. Providing power to the containment hydrogen ignitor assemblies would ensure there is no buildup of hydrogen gas, even though core damage would not be expected.

Key Components and Systems

Hydrogen Ignitors – The hydrogen ignitors reduce the potential for breach of primary containment due to a hydrogen oxygen reaction in post-accident environments. The system is designed to be capable of functioning in a post-accident environment, is seismically supported, and is capable of actuation from the Control Room. A total of 70 ignitors are distributed throughout the various regions of containment in which hydrogen could be released or to which it could flow in significant quantities. When energized, the ignitors heat to a surface temperature ≥ 1700°F. They would ignite hydrogen gas in the vicinity of the ignitor. The system depends on the dispersed location of the ignitors so that local pockets of hydrogen at increased concentrations would burn before reaching a hydrogen concentration significantly higher than the lower flammability limit.

500 kW FLEX diesel generator and 350 kW DG - These generators are described below in Section 2.7, "Electric Power."

Equipment Layout Diagrams

The equipment layout diagrams for the N Strategy 600 VAC, 500 kW FLEX DG and the 480 VAC, 350 kW N+1 diesel strategy generator are identified below in Section 2.7, "Electric Power."

Implementing Procedures

Implementing procedures associated with the N Strategy 600 VAC, 500 kW FLEX DG, and the N+1 Strategy 480 VAC, 350 kW DG are identified below in Section 2.7, "Electric Power."

Plant Modifications

Modifications associated with the N Strategy 600 VAC, 500 kW FLEX DG, and the N+1 strategy 480 VAC, 350 kW DG are described below in Section 2.7, "Electric Power."

Analyses and Calculations

Westinghouse documents DAR-SCC-14-001, "ELAP Containment Environment GOTHIC Analysis Design Report for the D.C. Cook Unit 1 and Unit 2 Nuclear Plant," and CN-SCC-13-004, "D.C. Cook ELAP Containment Environment Analysis," demonstrate that containment pressure would not reach the 12 psig maximum design pressure limit for over 72 hours.

Westinghouse document CN-SCC-13-004 determined the maximum expected containment pressure of 10 psig and temperature of 307.9°F in the Pressurizer Compartment. These values would not impact the structural integrity of the containment because they are bounded by the peak Containment design temperature of 324.7°F and the containment design pressure of 12 psig.

2.6.2 Containment, Modes 1-4, Phase 3

Strategy

For Phase 3, the NSRC supplied 4160 VAC turbine generators would be available to provide power to the Train B Containment Hydrogen Skimmer Fan. Initial containment cooling and depressurization would be accomplished by operating one Containment Hydrogen Skimmer Fan and circulating the containment air volume through the Ice Condenser, cooling and depressurizing the Containment.

Key Components and Systems

Ice Condenser - The Ice Condenser is an annular compartment enclosing approximately 300° of the perimeter of the upper containment compartment, but penetrating the operating deck so that a portion extends into the lower containment compartment. The lower portion has a series of hinged doors exposed to the atmosphere of the lower containment compartment, which normally remain closed. At the top of the Ice Condenser is another set of doors exposed to the atmosphere of the upper compartment, which are also normally closed. Intermediate deck doors, located below the top deck doors, form the floor of a plenum at the upper part of the ice condenser. These doors are also normally closed. The ice in the Ice Condenser is contained in baskets. The ice baskets position the ice in an arrangement that promotes heat transfer.

Containment Hydrogen Skimmer Fan System - The Containment Hydrogen Skimmer Fan System is designed to assure the rapid return of air from the upper to the lower containment compartment. The return of this air to the lower compartment and subsequent recirculation back up through the ice condenser would assist in cooling the containment atmosphere and limiting pressure and temperature in containment to less than design values. The Containment Hydrogen Skimmer Fan System consists of two separate trains of equal capacity. Each train includes an air return fan, dampers, two upper compartment headers, and a hydrogen skimmer header with an isolation valve. The system would take suction from several points in Containment and deliver flow to the fan room in the lower compartment. The ice condenser lower inlet doors would open and the system would force flow through the ice condenser.

Equipment Layout Diagrams

Layout diagrams associated with use of NSRC supplied 4160 VAC turbine generators are described below in Section 2.7, "Electric Power."

Implementing Procedures

Implementing procedures associated with use of NSRC supplied 4160 VAC diesel turbine generators are described below in Section 2.7, "Electric Power."

1/2-OHP-4027-FSG-12, "Alternate Containment Cooling," provides direction for restoring Containment cooling with a Containment Hydrogen Skimmer Fan.

Plant Modifications

Modifications associated with use of NSRC supplied 4160 VAC turbine generators are described below in Section 2.7, "Electric Power."

Analyses and Calculations

Westinghouse document CN-SCC-13-004 determined that operation of the Containment Hydrogen Skimmer Fan can reduce Containment pressure from 12 psig (design pressure) to normal values within two to three hours.

2.6.3 Containment, Mode 5 with SGs Available, Phase 1, 2, and 3

Strategy

With SGs available for RCS cooling, the heat added to Containment in Mode 5 would be less than in Modes 1-4. Therefore, the strategy for Modes 1-4 applies to Mode 5 with SGs available, i.e., there are no actions required to maintain pressure below 12 psig for over 72 hours, which is adequate time for Phase 3 strategy implementation. The Phase 3 strategy would be as described above for Modes 1-4.

Analyses and Calculations

Westinghouse documents DAR-SCC-14-001 and CN-SCC-13-004 demonstrate that containment pressure would not reach the 12 psig maximum design pressure limit for over 72 hours.

2.6.4 Containment, Mode 5 with SGs Not Available, and Mode 6, Phase 1 and Phase 2

Strategy

A loss of RHR cooling would require establishing an RCS hot leg vent. Containment over-pressurization would be precluded by establishing a containment vent pathway via the Containment "submarine hatch" in the Containment crane wall (which would establish communication between the upper and lower Containment volumes) and the upper Containment personnel access door. This pathway will be pre-established when SGs are not available for RCS cooling and the Reactor Cavity is not filled.

Implementing Procedures

PMP-4100-SDR-001, Attachment 5 provides direction to ensure the following conditions exist when SGs are not available for RCS cooling and the Reactor Cavity is not filled:

- The elevation 650 ft. containment personnel airlock inner access door is blocked/tied open.
- A blocking device is pre-staged to block the elevation 650 ft. upper containment airlock outer door partially open.
- The Containment "submarine hatch" in the Containment crane wall is blocked open.

1/2-OHP-4027-FSG-14 provides direction for venting the RCS and venting Containment.

2.6.5 Containment, Mode 5 with SGs Not Available, and Mode 6, Phase 3

Strategy

The Containment strategy in these Modes is to restore RHR cooling as described above in Section 2.3.6, "Reactor Core Cooling, All Modes, Phase 3." This would eliminate the major heat and pressure source in Containment, allowing the Containment to cool through ambient losses. The NSRC supplied 4160 VAC turbine generators would be available to provide Containment cooling via a Containment Hydrogen Skimmer Fan and the Ice Condenser as described above in Section 2.6.2, "Containment, Modes 1-4, Phase 3."

2.7 Electric Power

2.7.1 Electric Power, Phase 1

Strategy

Following an ELAP, the CRID and CCRP Inverters would maintain Control Room instrumentation and control features with power supplied from the Train A and Train B station batteries. Secondary inventory make up would be provided by the TDAFW Pump operated from the Control Room with power supplied from the N Train battery. A DC deep load shed would be performed to reduce the Train A and Train B battery discharge rates within the first hour to ensure 12 hours are available to deploy the FLEX Phase 2 generators.

Key Components and Systems

Installed DC Electrical Power - The installed DC electrical power system for each unit consists of the Train A and Train B 250 VDC electrical power subsystems and the N Train 250 VDC electrical power system. The Train A and Train B 250 VDC electrical power system provides the AC emergency power system with control power. It also provides power to selected safety related equipment and preferred AC vital bus power (via inverters). The N Train 250 VDC electrical power subsystem provides a reliable source for power and control of the TDAFW train.

The Trains A, B, and N 250 VDC electrical power subsystems are independent safety related Class 1E DC electrical power subsystems. The Trains A and B 250 VDC electrical power subsystems are also redundant. Each subsystem consists of one full capacity 250 VDC battery, two battery chargers, and all the associated control equipment and interconnecting cabling supplying power to the associated bus within the train. Each Train A and Train B 250 VDC source is obtained by use of one 250 VDC battery consisting of 116 lead acid cells connected in series. The N Train 250 VDC source is obtained by use of one 250 VDC battery consisting of 117 lead acid cells connected in series.

Each Train A, Train B, and N Train DC electrical power subsystem battery charger has ample power output capacity for the steady state operation of connected loads required during normal operation, while at the same time maintaining its battery bank fully charged. Each battery charger also has sufficient excess capacity to restore the battery from the design minimum charge to its fully charged state while supplying normal steady state loads. Train A, Train B, and N Train batteries and associated DC electrical power distribution systems are located within the Auxiliary Building, which is a safety related structure designed to meet applicable design basis external hazards, and would be available to initially power required key instrumentation and applicable DC components for at least 12 hours following an ELAP.

Implementing Procedures

1/2-OHP-4027-FSG-4 provides instructions for performing the DC deep load shed.

Analyses and Calculations

A CNP-specific DC deep load shedding analysis (12-E-S-250D-FLEX-001, "250VDC Battery Deep Load Shed (DLS) Analysis") demonstrated the 12 hour coping capability for the Train A, Train B, and N Train 250 VDC Batteries.

2.7.2 Electric Power, Phase 2

Strategy

N Strategy - For the N Strategy, 600 VAC, 500 kW FLEX DGs would be deployed from the FLEX Storage Building. FLEX power would be supplied to selected loads through 600 VAC Buses 11D-11B (Unit 1) and/or 21D-21B (Unit 2). Loads such as the Train A, Train B, and N Train battery chargers, one Boric Acid Transfer Pump, the Middle Boric Acid Evaporator Feed Pump, Train B hydrogen ignitors, and Train A RVLIS, would be re-energized.

N+1 Strategy - A 480 VAC, 350 kW DG is credited as the N+1 electrical power supply. This generator would re-power the existing 480/600 VAC Outside Temporary Outage Power Transformer, and select loads from 600 VAC Buses. Selected Auxiliary Building MCCs would be powered using electrical jumpers and plugs installed by plant modifications. This provides an alternate capability to deliver power to the N Train battery charger, hydrogen ignitors, and RVLIS.

Deploying the N+1 electrical equipment also establishes power to each CRID distribution panel by connecting 480 VAC power from the N+1 strategy 350 kW, DG via an "E-Cart" containing a 480/120 VAC transformer. The 120 VAC power from the portable power distribution panels would be used to energize each CRID alternate AC supply Isolimiter Transformer output. This allows N+1 strategy 120 VAC power to energize CRID Distribution Panels using the Manual Bypass Control switches on the individual CRID Inverters, and preserves remaining 250 VDC Train A and Train B station battery capacity.

The 350 kW, N+1 480 VAC DG also allows re-powering the SI Accumulator outlet valves using a portable 480/600 VAC transformer through plugs in the individual circuit breakers on 600 VAC MCCs 1/2-EZC-A, B, C, D.

FLEX Boric Acid Pump Electric Power - Two portable FLEX 250 kW diesel generators are available to power the FLEX Boric Acid Pumps as described above in the Section 2.4.2, "RCS Boration/Inventory, Control, Modes 1-4, Phase 2."

FLEX Portable Ventilation Power - Two portable FLEX 26 kW diesel generators are available to power portable ventilation for the Control Room, the TDAFW pump room, and the Train A and Train B battery rooms.

Key Components and Systems

N Strategy 600 VAC, 500 kW FLEX DGs – There are two N strategy 600 VAC, 500 kW FLEX DGs. The DGs are trailer mounted and stored in the FLEX Storage Building, along with the necessary cables and connections. The deployed location for the generators is near the Main Transformer for the affected unit(s).

N+1 Strategy 480 VAC, 350 kW Diesel Generator - There is one N+1 Strategy 480 VAC, 350 kW DG. The generator is trailer mounted and stored in the FLEX Storage Building, along with the necessary cables and connections. A deployed location for the generator is near the RWST and Reserve Feed Transformers for Unit 1, and near the Main Transformer for Unit 2.

FLEX 480/600 VAC Transformer – There is one FLEX 480/600 VAC transformer. The transformer is trailer mounted and stored in the FLEX Storage Building, along with the necessary cables and connections. A deployed location for the generator is near the RWST and Reserve Feed Transformers for Unit 1, and near the RWST and Containment for Unit 2.

"E-Cart" Containing a 480/120 VAC Transformer – There is one E-Cart containing a 480/120 VAC transformer. The E-Cart is stored in the Unit 1 4 kV switchgear room. Its deployed location is near the associated unit isolimiter transformers. Only one E-Cart is needed to provide the N+1 strategy.

FLEX 250 kW DG – The FLEX 250 kW DGs are described above in Section 2.4.2, "RCS Boration/Inventory Control, Modes 1-4, Phase 2."

FLEX 26 kW DG - There are two FLEX 26 kW DGs. The generators are trailer mounted and are stored on elevation 591 ft. under the Unit 2 Main Generator. The deployed location for the 26 kW DG is outside the Unit 2 West Roll-up Door.

CRIDs - The vital bus distribution system is designed to provide a continuous source of power to vital instruments and equipment independent of any momentary interruption of AC power system. The system consists of four separate 120 VAC vital bus distribution systems in each unit. Each distribution system consists of a static inverter, a regulating transformer, and a distribution panel. The vital instrument bus distribution system at CNP is commonly referred to as the CRID. The four CRIDs are designated CRID-I, CRID-II, CRID-III and CRID-IV. The major components of the CRID are the static inverter regulating transformer and the distribution panel. The CRID inverters interface with 250

VDC and 600 VAC systems, since they receive input power from these systems. The CRIDs provide 120 VAC vital power to essential instrumentation and the reactor protection and engineered safety features protection systems. All components of the CRIDs are purchased and maintained as safety related.

The N electrical strategy powers the associated Train A and Train B 250 VDC station battery chargers. This maintains the normal inverter power supply (the CRIDs). The N+1 electrical strategy supplies CRID power by disconnecting the Isolimiter transformer and repowering the CRIDs through the alternate supply.

Equipment Layout Diagrams

The N strategy equipment layout for Unit 1 is shown in Figure 11. The Unit 2 layout is similar.

The N+1 strategy equipment layout for Unit 1 is shown in Figures 12, 13, and 14. The Unit 2 layouts are similar.

The equipment layout for the 26 kW DG power distribution arrangement is provided in Figure 15. The arrangement for a single unit is shown. For a two unit arrangement, a second spider box would be added.

The equipment layout for the 250 kW FLEX Boric Acid Pump DGs is identified above in Section 2.4.2, "RCS Boration/Inventory Control, Modes 1-4, Phase 2."

Implementing Procedures

1/2-OHP-4027-FSG-4 provides instructions for determining which strategy to implement, e.g., Phase 2 (N or N+1) or Phase 3. Procedure 1/2-OHP-4027-FSG-4 also provides instructions for operation of breakers, switches, etc., as needed to implement the applicable strategy.

1/2-OHP-4027-FSG-401 provides instructions for deployment of the N strategy 500 kW DGs, the N+1 strategy 350 kW DG, the E-Cart, and the 480/600 V transformer.

Procedures for deployment of the FLEX 250 kW Boric Acid Pump DG are described above in Section 2.4.2, "RCS Boration/Inventory Control, Modes 1-4, Phase 2."

12-OHP-4027-FSG-501, "FLEX Equipment Staging," provides instructions for deploying the FLEX 26 kW DGs.

12-OHP-4027-FSG-411, "FLEX 500kW DG Operation," provides instructions for operation of the N strategy 500 kW DGs.

12-OHP-4027-FSG-412 provides instructions for operation of the N+1 strategy 350 kW diesel generator and the 250 kW FLEX Boric Acid Generators.

12-OHP-4027-FSG-413, "FLEX 26 kW DG Operation," provides instructions for operation of the FLEX 26 kW diesel generators.

Plant Modifications

N Strategy: Unit 1 and Unit 2 Engineering Changes EC-0000053170, "Unit 1 500 kW FLEX Diesel Generator Connection to Low Voltage Switchgear Bus 11D," and EC-0000053172, "Unit 2 500 kW FLEX Diesel Generator Connection to Low Voltage Switchgear Bus 2-21D," respectively, provided instructions for flexible power cables and connectors that would be used to connect the N strategy 500 kW FLEX DGs to Unit 1 600 volt switchgear bus 1-11D, breaker compartment 1-11D2, and Unit 2 600 volt switchgear bus 2-21D, breaker compartment 2-21D2.

Engineering Change EC-0000053172 also created six new penetrations for routing the Unit 2 Phase 2 FLEX cables through the east wall of the Auxiliary Building to provide power to Train B Engineered Safety System. Existing penetrations were used for Unit 1.

N+1 Strategy: Unit 1 and Unit 2 Engineering Changes EC-0000053165, "Unit 1 FLEX Generator To 600v MCC ABD-B for N-Train Charger (1-EL-03)," and EC-0000053168, "Unit 2 FLEX Generator To 600v MCC ABD-B for N-Train Charger (2-EL-03)," respectively, provided instructions for the installation of the electrical infrastructure that would be used to power the above identified buses and loads from the 350 kW N+1 DG.

N Strategy or N+1 Strategy: Unit 1 and Unit 2 Engineering Changes EC-0000053166, "Installation of Receptacles in MCCs l-EZC-A/B/C/D for FLEX Strategies," and EC-0000053169, "Installation of Receptacles in MCCs 2-EZC-A/B/C/D for FLEX Strategies," respectively, provided instructions for installation of receptacles in Unit 1 MCCs 1-EZC-A/B/C/D and Unit 2 MCCs 2-EZC-A/B/C/D. These MCCs provide power to the respective unit's SI Accumulator outlet valves.

Analyses and Calculations

N Strategy: CNP calculation 1-E-S-600V-FLEX-001, "500kW N Strategy FLEX Event Diesel Generator Analysis," and calculation 2-E-S-600V-FLEX-001, "500kW N Strategy FLEX Event Phase 2 Diesel Generator Analysis," evaluated for Unit 1 and Unit 2, respectively, the use of portable 500 kW, 600V, three phase DGs to repower Unit 1 buses 11B and 11D, and Unit 2 buses 21B and 21D following a BDBEE. The calculations showed that sufficient voltage and power would be provided to the loads required for FLEX Phase 2 strategies during both steady state and motor starting conditions.

N+1 Strategy: CNP calculation 1-E-S-600V-FLEX-002, "Diesel Generator and Cable Sizing and Ampacity for FLEX Phase 2 Strategies," and calculation 2-E-S-600V-FLEX-002, "Diesel Generator and Cable Sizing and Ampacity for FLEX Phase 2 Strategies," evaluated for Unit 1 and Unit 2, respectively, the use of portable 480V three phase DGs and 480/600V Outside Temporary Outage

Power step-up transformer as the "N+1" strategy during FLEX Phase 2 to repower Unit 1 buses 1-ABD-B, 1-AB-C, and 1-AD-D, and Unit 2 buses 2-ABD-B, 2-AB-C, and 2-AB-D. The respective DGs would also provide power to Unit 1 SI Accumulator Valves IMO-110, IMO-120, IMO-130, and IMO-140, and Unit 2 SI Accumulator Valves 2-IMO-110, 2-IMO-120, 2-IMO-130, and 2-IMO-140 using a portable 480/600 step-up transformer. The respective DGs would provide power to the Unit 1 and the Unit 2 CRID panels.

2.7.3 Electric Power, Phase 3

Strategy

Two 1 MW 4kV turbine generators from the NSRC per unit would be connected together using an NSRC provided output bus, paralleling equipment, and necessary cables. The NSRC 4 kV power to Unit 1 Bus 1A and/or Unit 2 Bus 2A would be connected by relocating the Reserve Feed 4kV Bus infeed circuit breaker and FLEX connections at the load side of Unit 1 4kV circuit breaker 1-1A2 and/or Unit 2 4kV circuit breaker 2-2A2. The NSRC 4kV power would be sufficient to restore the Unit 1 Train B 4kV vital pump bus T11A and/or Unit 2 Train B 4kV vital pump bus T21A, and Unit 1 600 VAC bus 11A-11C and/or Unit 2 600 VAC bus 21A-21C. The 4kV power restoration in Phase 3 would be used to re-energize loads such as Train B Containment Hydrogen Skimmer Fan, the West RHR Pump, the West CCW Pump, and Control Room cooling.

Electrical jumpers and plugs would be installed for re-powering the SI Accumulator outlet valves on 600 VAC MCCs 1-EZC-A, -B, -C, -D (Unit 1), and 2-EZC-A, -B, -C, -D (Unit 2), and would be used to backfeed the MCCs as necessary to provide power for the operation of RHR system valves required to establish cooling.

Key Components and Systems

Equipment Provided by the NSRC – The equipment provided by the NSRC would include two 4160 VAC 1 MW generators and paralleling switchgear for each unit. The cables for connection between the 4160 VAC generators and the paralleling switchgear would also be supplied by the NSRC.

The cables between the NSRC-provided paralleling switchgear and the Unit 1 4160 VAC RCP bus 1A would be routed through existing penetrations on the north wall of the Auxiliary Building and terminate in cubicle 1-1A2, to restore power to the Train B engineered safety system. The NSRC generators would repower Buses 1-T11A, 1-11A, 1-11C (through closure of tie-breaker 1-1AC), and associated MCCs which supply CCW, RHR, ESW, and Control Room Cooling (if access to the UHS is available) equipment and auxiliaries.

The cables between the NSRC-provided paralleling switchgear and the Unit 2 4160 VAC RCP bus 2A would be routed through six new penetrations installed under EC-0000053172 on the east wall of the Auxiliary Building and terminate in cubicle 2-2A2 to restore power to the Train B engineered safety system. The NSRC generators would repower Buses 2-T21A, 2-21A, 2-21C (through closure of tie-breaker 2-2AC) and associated MCCs which supply CCW, RHR and ESW, and Control Room Cooling (if access to the UHS is available) equipment and auxiliaries.

Equipment Layout Diagrams

The Phase 3 strategy equipment layout for Unit 1 is shown in Figure 16. The Unit 2 layout is similar.

Implementing Procedures

1/2-OHP-4027-FSG-4 provides instructions for determining which strategy to implement, e.g., Phase 2 (N or N+1) or Phase 3. Procedure 1/2-OHP-4027-FSG-4 also provides instructions for operation of breakers, switches, etc., as needed to implement the applicable strategy.

1/2-OHP-4027-FSG-401 provides instructions for deployment of the Phase 3 equipment (NSRC generators, cables, etc.).

Operating instructions for the NSRC generators are provided by the NSRC.

Associated Plant Modifications

Unit 2 Engineering Change EC-0000053172 created six new penetrations for routing the Phase 3 FLEX cables through the east wall of the Auxiliary Building to restore power to Unit 2 Train B Engineered Safety System. Existing penetrations were used for Unit 1.

Associated Analyses and Calculations

CNP calculation 1-E-S-4KV-FLEX-001, "4.16 kV FLEX Event Phase 3 Cable Ampacity and Power Source Sizing," and calculation 2-E-S-4KV-FLEX-001, "4.16 kV FLEX Event Phase 3 Cable Ampacity and Power Source Sizing," determined, for Unit 1 and Unit 2 respectively, the cable ampacity and minimum generator size to power the loads to be used during Phase 3.

2.8 Tabulation of Strategies and Connection Points

Table 1 shows the designation of N strategies, N+1 strategies, and primary and alternate connection points required by NEI 12-06.

2.9 Key Instrumentation Non-Control Room Readout

Control room instrumentation would be available due to the 12 hour coping capability of the station batteries and associated inverters in Phase 1, or the portable DGs deployed in Phase 2. If no AC or DC power was available, key credited plant parameters would be available as described below.

2.9.1 CST Level Indication

An operator would be dispatched to obtain local CST level indication, as necessary, at the 1/2-CLI-110, CST TK-32, level Indicator (located in the TDAFP Room).

2.9.2 Indication Available at the Control Room Protection and Control Racks and Reactor Cable Tunnel

The following indications would be available via temporary hookup of portable meters (e.g. Fluke) and acquisition of readings in the Protection and Control Racks located in the Control Room and the Train B Incore Thermocouple Cabinet located in Reactor Cable Tunnel Quad 3 per 1/2-IHP-4027-FSG-711, "Control Room Instrument Rack Readout Data Acquisition During Extended Loss of AC Power."

- SG Wide Range Level (all four generators)

  1/2-BLI-110, SG1 CG4 Wide Range Level
  1/2-BLI-120, SG2 CG4 Wide Range Level
  1/2-BLI-130, SG3 CG4 Wide Range Level
  1/2-BLI-140, SG4 CG4 Wide Range Level

- Pressurizer Level

  1/2-NLP-153, Pressurizer Level Channel 3

- SG Pressure (all four loops)

  1/2-MPP-210, SG1 Channel 1 Steam Pressure
  1/2-MPP-220, SG2 Channel 1 Steam Pressure
  1/2-MPP-231, SG3 Channel 2 Steam Pressure
  1/2-MPP-242, SG4 Channel 4 Steam Pressure

- RCS Wide Range Pressure (loops 1 and 2)

  1/2-NPS-121, RC Loop 2 Channel 2 Wide Range Pressure
  1/2-NPS-122, RC Loop 1 Channel 3 Wide Range Pressure

- RCS Wide Range Temperature (loops 1 and 3)

  1/2-NTR-110, RCS Loop 1 Channel 3 T-Hot Wide Range Temperature
  1/2-NTR-210, RCS Loop 1 Channel 3 T-Cold Wide Range Temperature
  1/2-NTR-130, RCS Loop 3 Channel 2 T-Hot Wide Range Temperature
  1/2-NTR-230, RCS Loop 3 Channel 2 T-Cold Wide Range Temperature

- Lower Containment Pressure (all four quadrants)

  1/2-PPP-300, Lower Containment Channel 4 Pressure
  1/2-PPP-301, Lower Containment Channel 3 Pressure
  1/2-PPP-302, Lower Containment Channel 2 Pressure
  1/2-PPP-303, Lower Containment Channel 1 Pressure

- Incore Temperature (5 locations)

  1-NTR-20, Incore Temperature
  1-NTR-46, Incore Temperature
  1-NTR-50, Incore Temperature
  1-NTR-52, Incore Temperature
  1-NTR-57, Incore Temperature

  2-NTR-47, Incore Temperature
  2-NTR-49, Incore Temperature
  2-NTR-50, Incore Temperature
  2-NTR-52, Incore Temperature
  2-NTR-53, Incore Temperature

The following indications would be available by use of temporary power from portable generators connected in the CRID inverter room and Train B DG Room, and by acquisition of readings from the Train B RVLIS and the Channel 1 Gamma-Metrics Neutron Flux Monitor.

- On the NIS Channel 1 Panel:

  1/2-NRI-21-CRI-1, Source Range

- On the SIS Panel:

  1/2-NLI-111, Narrow Range Reactor Level
  1/2-NLI-121, Reactor Vessel Upper Plenum Level
  1/2-NLI-131, Wide Range Reactor Level
  1/2-NPS-111, RCS Wide Range Pressure

- On the Flux & Rod Control Panel:

  1/2-NRI-21-CRI3, Wide Range Log Power
  1/2-NRI-21-CRIRM, Wide Range Startup Rate

- On the DTU Panel on 1-MR-9:

  1/2-NTR-110, Loop 1 Wide Range Temperature – Hot Leg
  1/2-NTR-210, Loop 1 Wide Range Temperature – Cold Leg

2.9.3 Indication Available Near the Associated Containment Penetrations

The following indications would be available via temporary hookup of portable meters (e.g. Fluke) and acquisition of readings at locations near the associated containment penetrations per 1/2 IHP-4027-FSG-712, "Local Instrument Readout Data Acquisition During Extended Loss Of AC Power."

1/2-BLP-110, SG1 Narrow Range Level
1/2-BLP-120, SG2 Narrow Range Level
1/2-BLP-130, SG3 Narrow Range Level
1/2-BLP-140, SG4 Narrow Range Level

1/2-NLP-152, Pressurizer Level Channel 2

1/2-NPS-121, RCS Loop 2 Channel 2 Wide Range Pressure

1/2-NTP-140A, RCS Loop 4 T-Hot Narrow Range Temperature (Spare)
1/2-NTP-141A, RCS Loop 4 T-Hot Narrow Range Temperature (Spare)
1/2-NTP-142A, RCS Loop 4 T-Hot Narrow Range Temperature (Spare)
1/2-NTP-240A, RCS Loop 4 T-Cold Narrow Range Temperature (Spare)

1-NTR-20, Incore Temperature
1-NTR-46, Incore Temperature
1-NTR-50, Incore Temperature
1-NTR-52, Incore Temperature
1-NTR-57, Incore Temperature

2-NTR-47, Incore Temperature
2-NTR-49, Incore Temperature
2-NTR-50, Incore Temperature
2-NTR-52, Incore Temperature
2-NTR-53, Incore Temperature

1/2-NLI-110, RVLIS Train A Narrow Range Level (Uncompensated)

1-NRI-23, Gamma-Metrics Source & Wide Range Nuclear Instrumentation

The following indications would be available via local or test Gauges

1/2-MPI-211/212, SG1 Pressure (Stop Valve 1)
1/2-MPI-221/222, SG2 Pressure (Stop Valve 2)
1/2-MPI-231/232, SG3 Pressure (Stop Valve 3)
1/2-MPI-241/242, SG4 Pressure (Stop Valve 4)

1/2-PPX-320, Containment Pressure (Lower)

2.10 Characterization of External Hazards

2.10.1 Seismic

As stated in Section 2.8.6 of the UFSAR, the seismic criteria for CNP include two earthquake spectra: DBE and OBE. The horizontal ground accelerations for the DBE and the OBE are 0.20g and 0.10g, respectively, with two-thirds of these values acting vertically.

As described below in Section 2.11, "Protection of FLEX Equipment," FLEX storage provides adequate seismic protection.

2.10.2 External Flooding

The design basis flood results from a weather driven seiche on Lake Michigan. The potential effect of such a seiche has been evaluated as documented in CNP calculation MD-12-FLOOD-006-N, "Surge and Seiche, Cook Nuclear Plant Flood Hazard Re-evaluation." As documented in that calculation, combining a $1x10^{-6}$ exceedance peak base lake level of 582.3 feet with a 6.9 to 7.1 foot surge and seiche (including 1 standard deviation), and a 3.0 foot wave runup and setup, results in a peak Probable Maximum Surge and Seiche water surface elevation of 593.3 feet when converted to NGVD 29. Calculation MD-12-FLOOD-006-N determined that surge and seiche levels of Lake Michigan will remain below the current lakeside seawall level. Therefore, flooding of the plant site would not occur due to the design basis flood hazard.

2.10.3 High Winds

Figure 7-2 from NEI 12-06 provides a map of the United States in 2° latitude/longitude blocks that shows the tornado wind speed expected to occur at probability of $1x10^{-6}$ /year. The CNP site is in Region 1 of this figure, resulting in a FLEX design wind speed of 200 mph.

As described below in Section 2.11, "Protection of FLEX Equipment," FLEX storage provides adequate protection from high winds. As described above in Section 2.3.1, "Reactor Core Cooling, Modes 1-4, Phase 1," the CSTs are adequately protected from high winds and tornado missiles. As described above in 2.4.3, "RCS Boration/Inventory Control, Mode 5 with SGs Not Available, or Mode 6, Phase 1 and Phase 2," at least one of the two RWSTs would survive high winds and tornado missiles such that an adequate water inventory would be available.

2.10.4 Ice, Snow, and Extreme Cold

Figure 8-2 in NEI 12-06 is a Maximum Ice Storm Severity Map based on a database developed by EPRI which summarized ice storms that occurred in the United States from 1959 to April 1995. Using Figure 8-2, it was determined that the CNP site is located in an ice severity level 5 region, "Catastrophic destruction to power lines and/or existence of extreme amount of ice."

As described below in Section 2.11, "Protection of FLEX Equipment," and Section 2.14, "Habitability and Equipment Operating Conditions," FLEX equipment is adequately protected from ice, snow, and extreme cold.

2.10.5 High Temperatures

Records indicate that the highest temperature recorded for the nearest municipality, Bridgman, Michigan, was at 103°F in July 1999.

As described below in Section 2.11, "Protection of FLEX Equipment," FLEX equipment is adequately protected from high temperatures.

2.11 Protection of FLEX Equipment

All Phase 2 equipment required to implement the FLEX strategies is stored in locations within the Owner Controlled Area.

2.11.1 Indoor Storage Outside the PA

Most of the FLEX equipment will be stored outside the PA in the FLEX Storage Building, which was designed and constructed for that purpose per EC-0000053178, "Unit 1 & 2 Design and Construction of FLEX Equipment Storage Facilities." The FLEX Storage Building is located about 600 feet north-east of the current plant PA boundary. The building is a stand-alone, reinforced concrete structure, consisting of a reinforced concrete slab-on-ground foundation and reinforced pre-stressed pre-cast concrete walls and roof members.

Because it is outside the PA and does not affect the safety of the plant, the FLEX Storage Building was designated as a non-safety related building. However, special requirements were applied. The building was designed to meet Class I design requirements, which meets NEI 12-06 provisions. The building was designed to meet CNP site specific seismic spectra corresponding to the OBE and DBE.

The FLEX Storage Building was designed for tornado wind loads resulting from a maximum tornado wind velocity of 360 mph (a tornado with a forward progression of 60 mph with rotational wind speed of 300 mph) and a coincidental pressure drop of 3 psi applied within three seconds, which is consistent with the CNP UFSAR. The building was designed for protection against the following tornado generated missiles per UFSAR Table 5.1-1

- Bolted wood decking- 12 ft. x 12 ft. x 4 in., 450 lbs. traveling at 200 mph.
- Corrugated sheet siding- 4 ft. x 4 ft. 100 lbs. traveling at 225 mph.
- Passenger car- 4000 lbs. traveling along the ground at 50 mph.

The FLEX Storage Building was designed for snow load in accordance with the Michigan Building Code. All other design loads, such as the dead load, live load and load combinations were in accordance with ASCE 7-05, "Minimum Design

Loads for Buildings and Other Structures" or ACI 318-63, "Building Code Requirements for Reinforced Concrete." The building's external dimensions are 82.0 ft. by 62.0 ft., with 60 ft. by 80 ft. of usable area. The building floor elevation of 625 ft. 6 in. is well above grade.

The FLEX Storage Building ventilation system is designed to limit the minimum internal temperature to 50°F based on a 0°F outdoor air temperature. Therefore, the system would be expected to maintain an internal temperature of 30°F with an external temperature of -20°F. The system consists of a single exhaust fan, fixed and manually operated louvers, and two 15 kW electric heaters. Additionally:

- All FLEX water pumps are stored dry.
- The FLEX Storage Building heat calculation was performed in accordance with applicable codes and standards, including their inherent conservatisms. The calculation assumed 30 kW heat input from the installed HVAC heating system. The calculation additionally assumed that a normally secured exhaust fan was in continuous operation (11.8 kW heat loss), and took no credit for the heat added by diesel engine block heaters inside the building (17.1 kW heat gain).
- The block heaters would provide additional heat input equal to over 50% of the installed HVAC system heaters. This additional heat would be expected to increase the FSB internal temperature to over 55°F with an external temperature of -20°F.

The FLEX Storage Building has the following features:

- Two steel personnel entry doors, one each on the north and south wall.
- One large motor operated horizontal steel rolling door for equipment entry and exit. The door can also be opened via hand crank, by use of the installed motor powered by a portable generator, or by manually applying horizontal force to the door
- One knock-out opening in the concrete wall which can be used in an emergency for equipment entry and exit in case the equipment door is rendered non-functional.
- Ramps for the vehicles to enter and exit through the rolling door or the knock-out panel openings.
- A manually operated vehicle barrier in front of the knock-out panel to protect it from rolling vehicles.
- Concrete blocks around the building to protect the building against accidental rolling vehicles.

The FLEX Storage Building is powered from an existing 12 kV line via a dedicated transformer bank. The power feed is via overhead cabling. A 100A generator receptacle is installed inside the building for connection of a backup source of power in the event of loss of external power. An evaluation determined that tie-downs for securing major equipment within the FLEX Storage Building is not required. This conclusion was reached by evaluating the most limiting component, the 500kW generators, for sliding and overturning.

2.11.2 Outdoor Storage Outside the PA

The FLEX equipment includes two Caterpillar 930H front end loaders for post BDBEE debris removal. They are stored in two separate outside locations. One location is stored next to the FLEX Storage Building, and the other is stored near the ISFSI area (see Figure 17B). These locations are sufficiently separated that there is assurance that at least one of the front end loaders would survive the applicable site hazards, such as a tornado.

2.11.3 Storage Within the PA

FLEX equipment is stored in multiple locations within the PA in accordance with EC-0000053820, "Permanent Placement and Storage of FLEX Equipment," and EC-0000053507, "Permanent Placement and Storage of U2 FLEX Equipment."

The scope of EC-0000053820 included placement of nine equipment storage boxes, and the two FLEX Boric Acid Pumps, two 26 KW DGs, two mixing manifolds, two SIS manifolds, two 480/120V E-Carts, a battery powered equipment mover, and radio communication equipment. Walkdowns were performed to ensure there would be no adverse impacts to surrounding Safety Related equipment, and to ensure that existing plant equipment would not damage the staged FLEX equipment.

The scope of EC-0000053507 included placement of a FLEX Storage Shed on the elevation 633 ft. of the Turbine Building, three additional equipment storage boxes, one additional FLEX Boric Acid Pump, one additional mixing manifold, ventilation fans, and addition communications equipment. Walkdowns were performed to ensure there would be no adverse impacts to surrounding Safety Related equipment, and to ensure that existing plant equipment would not damage the staged FLEX equipment.

2.11.4 Deployment

For protection against extreme cold at their deployed locations, the liquid cooling systems for the FLEX DGs are treated with anti-freeze, and the lubricating oil in the major FLEX diesel engines is consistent with the vendor recommendation for operation at -20°F.

All equipment was purchased as commercial grade, following the manufacturer's recommendations associated with coolant and lubricating oil for the diesel engines provides assurance the engines will operate at temperatures as low as -20°F.

2.11.5 Verification

The equipment required to implement the FLEX strategies for CNP has been verified to be stored in its required locations by 12-OHP-5030-FSG-523, "FLEX

Equipment Inventory and Checks," which requires periodic inventory of the equipment.

2.12 Deployment of FLEX Equipment

2.12.1 Haul Paths

Procedure 12-OHP-4027-FSG-501, provides optimal priorities for the areas for debris removal as follows (see Figures 17A and 17B):

- Plant access road from the FLEX Storage Building to the plant.
- PA as needed.
- Plant Access road from the FLEX Storage Building to the main thoroughfare providing a route to the site (Red Arrow Highway).
- Plant access road to the site switchyard.
- NSRC on-site staging area.

Procedure 12-OHP-4027-FSG-501, also identifies the following debris removal equipment available from the FLEX Storage Building:

- Pickup trucks equipped with snow plows.
- Chain saws.
- Plasma cutter with air compressor.
- Power saws.
- Hydraulic spreader and cutter.
- Bolt cutters.
- Miscellaneous tools.

Additionally, at least one of two large Caterpillar 930H front end loaders would be available for debris removal in haul paths and other areas as needed. One Caterpillar 930H front end loader is normally stored outside, near the FLEX Storage Building. The other 930H front end loader is normally stored outside near the ISFSI area (see Figure 17B).

A FLEX haul path evaluation was performed which qualitatively evaluated the potential for liquefaction of soils beneath the haul path for FLEX equipment from the FLEX Storage Building to the point of deployment within the PA. The evaluation used BDB ground motion response spectra. The evaluation determined estimated haul path settlements of up to 3 in., which may slow traffic but should not impair transport vehicles from proceeding to the power block area.

The evaluation was amended to include the haul path from NSRC Staging Area B (as defined below in Section 2.11, "Offsite Resources"), and the north side of the ISFSI area, to the main plant access road. The revised evaluation therefore encompasses the entire path from NSRC Staging Area B to NSRC Staging Area A in the PA. The evaluation determined that the conclusion of the original evaluation (settlements may slow traffic but should not impair transport vehicles from proceeding to the power block area) remained valid.

The South Bend International Airport would be the single Staging Area C for equipment from either the Memphis or Phoenix NSRC facility. The South Bend International Airport is approximately 20 air miles from CNP. Primary and secondary land routes from Staging Area C to CNP have been identified. Air delivery to the site from Staging Area C to CNP would be used if no viable land route can be identified.

2.12.2 Deployment Vehicles

The larger FLEX portable equipment, such as pumps and generators, is trailer mounted and would be deployed by two pickup trucks procured specifically for this function. The most limiting component weight of 19,485 lbs. (the 500 kW generators) was considered when specifying the towing capability of the pickup trucks. Both pickup trucks are equipped with snow plows, and are stored in the FLEX Storage building. The trailer mounted towable FLEX equipment is sufficiently rugged to function following a BDBEE. A battery powered equipment mover is stored in the Turbine Building for movement of larger equipment, such as the 26 kW DGs described above in Section 2.7.2, "Electric Power, Phase 2."

2.12.3 Fueling of Equipment

The major non-electrically powered FLEX equipment is powered by diesel engines. The general coping strategy for refueling the diesel powered FLEX equipment, i.e., pumps and generators, is to draw fuel oil from the Train A, CD FOST, and the Train B, AB FOST. The Train A, CD FOST, and the Train B, AB FOST, are both below ground tanks. TS Surveillance Requirement 3.8.3.1 requires that at least 46,000 gallons of fuel oil be maintained in each FOST when the associated EDG is required to be operable. The TS requires diesel fuel oil sampling and testing in accordance with applicable ASTM Standards.

Projected fuel oil usage for FLEX equipment is not expected to exceed 232 gph. Therefore, one FOST contains sufficient fuel oil for greater than eight days of continuous use. Since the CNP FLEX strategies are expected to transition from Phase 2 to Phase 3 no later than 72 hours after the event, one FOST would provide sufficient fuel capacity. For Phase 3, the SAFER response team would provide for alternate means (i.e. fuel transfer equipment and air lift fuel containers) of delivery of fuel to the site until normal site access is available. Once normal site access has been restored, I&M would provide for bulk delivery of fuel. If normal access was not restored within 24 hours, I&M would provide for delivery of bulk fuel to Staging Area C (as defined below in Section 2.11, "Offsite Resources").

The FLEX equipment includes three 500 gallon diesel fuel transport trailers and two diesel powered fuel transfer pumps with associated hoses and fittings. The diesel fuel transport trailers are stored in diverse locations (the FLEX Storage Building, the ISFSI area, and a site equipment storage area near the switchyards).

Procedure 12-OHP-4027-FSG-511, "FLEX Equipment Refueling Operation," provides direction to 1) move diesel fuel from the underground emergency diesel

FOSTs to the mobile fuel mules, and 2) from the mobile fuel mules to various FLEX equipment diesel engine fuel tanks.

Procedure 1/2-OHP-4027-FSG-5, "FLEX Equipment Staging," provides direction to commence diesel driven equipment refueling per 12-OHP-4027-FSG-511. The procedure also provides follow up actions to consult with the Emergency Director to obtain diesel fuel from offsite sources before the onsite supplies are expended.

2.13 Offsite Resources

2.13.1 NSRC Equipment Transport

There are two NSRCs (Memphis area and Phoenix area) established to support nuclear power plants in the event of a BDBEE. I&M has established contracts with PEICo to participate in the process for support of the NSRCs as required. Each NSRC holds five sets of equipment, four of which will be able to be fully deployed to CNP when requested. The fifth set allows removal of equipment from availability to conduct maintenance cycles. In addition, CNP BDBEE equipment hose and cable end fittings are standardized with the equipment supplied from the NSRC. In the event of a BDBEE and subsequent ELAP/LUHS, equipment would be moved from one of the NSRCs to a local assembly area, designated as Staging Area C. For CNP Staging Area C is the South Bend International Airport. From there, equipment would be taken to the CNP site and staged at the large parking lot east of the CNP Training Building, designated a Staging Area B, by ground transportation, or by air if ground transportation were unavailable.

Communications would be established between CNP personnel and the SAFER team via satellite phones, and required equipment would be moved to the PA, designated as Staging Area A, as needed. The first arriving equipment would be delivered to the site within 24 hours from the initial request. The order in which equipment is delivered is identified in the "SAFER Response Plan for Donald C. Cook Nuclear Plant."

2.13.2 NSRC Equipment Listing

The CNP credited equipment stored and maintained at the NSRC for transportation to CNP Staging Area C is listed in Table 2.

2.14 Habitability and Equipment Operating Conditions

2.14.1 Habitability

The limiting habitability concern involves local manual operation of SG PORVs during the response to an ELAP. An evaluation was performed to determine if personnel can safely access the Steam Stop Enclosures and locally manually operate the valves. The evaluation utilized an existing SBO calculation, and the guidance in the CNP program that addresses thermal hazards to personnel. The evaluation concluded that conditions in the Steam Stop Enclosure would allow access for manual operation of the SG PORVs.

The following factors would also facilitate operator access:

- Once the RCS cool down is completed, the resulting drop in heat load can be expected to improve the environment in the Steam Stop Enclosure.
- Specialized personal protective equipment, provided as part of the FLEX implementation, will enhance the operator's ability to perform the required function in the expected Steam Stop Enclosure environment.

The details of the SG PORV operator habitability evaluation are as follows.

Required Operator Actions - In order to establish manual control of the SG PORVs, an operator would enter a Steam Stop Enclosure, climb a permanently installed ladder, and cross a platform. The operator would open the two PORVs in that Steam Stop Enclosure and then exit the room. Once the same operation is completed in the opposite Steam Stop Enclosure, the initial operation of these valves would be completed and the plant would be in a cooldown mode. At the direction of Control Room personnel, it may be necessary for the operator to re-enter the room to adjust the PORV position. As with the initial opening of the SG PORVs, this is expected to be accomplished by manual operation of the PORV handwheel(s). Operators are expected to leave the Steam Stop Enclosures when not actually operating the PORV. It is anticipated that initial entry to open the valves, and/or re-entry to adjust the valves would take no longer than 10 minutes for each entry.

Expected Habitability Conditions - The acceptability of the Steam Stop Enclosure environment for responding to an SBO was evaluated in an existing calculation which considered a 150°F temperature in the enclosure. The calculation had been prepared to identify dominant areas of concern during an SBO and provide reasonable assurance that the necessary equipment could be operated given the expected environmental conditions. The calculation was utilized for the ELAP evaluation because conditions under an SBO bound the ELAP for the first four hours. The primary difference between the SBO event and ELAP, as it relates to SG PORV operation, is that the SBO evaluation is limited to a four-hour coping period, while the intermittent SG PORV operation for an ELAP is not limited to a specific duration by the FLEX strategies.

Operators would be expected to initiate the ELAP response cooldown within eight hours. However, operator experience on the simulator shows that the plant cooldown is typically started within approximately 30 minutes of the event. Operators must complete the cooldown within two hours of initiation. This is well within the four hour time frame assessed for the SBO event. Therefore, the calculation which determined the 150°F expected temperature to be acceptable for SBO responses may be considered to bound the expected ELAP response. The acceptability of the 150°F expected temperature for the intermittent SG PORV manual operation is also consistent with the CNP program addressing thermal hazards to personnel.

2.14.2 Equipment Operating Conditions

Control Room - Control Room instrumentation cabinet doors are opened as a 30-minute time-credited-action in the procedure for responding to loss of all AC power (1/2-OHP-4023-ECA-0.0). The applicable procedure step is designed to open the cabinet doors as soon as possible. Vital instrument cooling is assured if the cabinet doors are opened within 30 minutes from loss of all AC power. This action ensures adequate instrument cabinet cooling during the four hour SBO response.

Since the postulated ELAP exceeds four hours, the evaluation described below was performed to determine what actions would be needed to provide adequate Control Room ventilation during the FLEX Phase 1 and Phase 2 response. Based on the evaluation, the FSG for FLEX equipment staging (12-OHP-4027-FSG-501) directs installation of temporary fans similar to the fire protection program based response for loss of Control Room ventilation. The sketch provided in 12-OHP-4027-FSG-501 shows the approximate fan locations.

The acceptability of this action was determined by qualitatively extrapolating the results of the calculation for Control Room temperatures during a postulated fire event. This calculation used a GOTHIC model and showed a nominal 117°F maximum resultant Control Room temperature with a similar temporary fan flow rate. The GOTHIC time transient model served to verify that adequate time existed to install and energize the temporary fans. The following simplified steady state computation validates that the Control Room temperature of 117°F is reasonable given a 104°F turbine building temperature.

Delta T = Q / (cfm x 1.08)

333,000 btu/hr. / (23943 x 1.08) = 12.8°F.

From other calculations, the SBO bounding heat load in the Control Room is 125,343 btu/hr., which is much less than the 330,000 btu/hr. assumed in the calculation for Control Room temperatures during a postulated fire event. This SBO heat load reflects equipment powered by the station batteries and is a conservative representation for longer term loss of power events. With this reduced heat load, the temperature rise over the temperature of the Turbine Building and Auxiliary Building (each of which includes a portion of the Control Room) is less than 5°F. Therefore, even considering elevated outside temperatures up to 110°F, the Control Room temperature would remain bounded by the 117°F previously evaluated in the calculation for Control Room temperatures during a postulated fire event.

TDAFW Pump Room

High Temperatures - Procedure 12-OHP-4027-FSG-501 directs personnel to open the doors to the affected TDAFW Pump Room. This would increase the volume of air available to dissipate heat. The FSG also directs personnel to install a temporary portable ventilation fan with an exhaust duct routed out of the room and outside the hallway to the Turbine Building. The nominal fan capacity is 6,700 cfm. The flow path will exhaust heated air out of the TDAFW pump room.

An exhaust fan capacity of 6,700 cfm is judged to be adequate to exhaust hot air from the room to the general area in the turbine building with margin to account for the normal cooling being unavailable. The engineering judgment considers that the heat load (20,517 BTU/hr.) from calculation MD-12-HV-018-N, "Auxiliary Feed Water Pump Room and Hallway Heat Load Calculation," can be characterized as sensible heat. The sensible heat load and required air volume to keep temperature constant at various temperature differences between entering air and room air can be calculated. The sensible heat in a heating or cooling process of air (heating or cooling capacity) can be expressed as:

$$h_s = 1.08\ q\ dt$$

where

h_s = sensible heat (Btu/hr.)
q = air volume flow (cfm)
dt = temperature difference (°F)

Therefore: $20{,}517 = 1.08\ (6{,}700)\ dt$
And $dt = 2.8°F$

This rise in temperature inside the TDAFW Pump Room would not preclude personnel entry to perform FLEX strategy related activities or adversely impact the pumps or supporting equipment.

Low Temperatures - It is expected that the initial temperature in the TDAFW pump room would be approximately 104°F. Since operation of the TDAFW pump involves steam flow through the turbine and associated piping, the reasonably expected low outside temperatures would not have an adverse effect on the TDAFW pumps or supporting equipment during implementation of the FLEX strategy.

Spent Fuel Operating Deck Area - The components of concern in the Spent Fuel Operating Deck Area are the beyond-design-basis level instruments installed pursuant to NRC Order EA-12-051, "Order Modifying Licenses With Regard to Reliable Spent Fuel Pool Instrumentation." The environmental temperature concerns for these instruments were addressed in the response to RAI #6(a) transmitted by letter AEP-NRC-2014-16 from J. P. Gebbie, I&M, to the NRC, dated February 27, 2014, "Donald C. Cook Nuclear Plant Units 1 and 2, Six Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)," (ADAMS Accession No. ML14063A041). As stated in that response, the level instruments are certified to function properly during and after exposure to temperatures from -10 to +55 degrees Celsius (14 to 131°F).

Boric Acid Rooms

High Temperatures - There would be no additional heat input to the Boric Acid Rooms from internal sources during initial implementation of the FLEX strategies. Additionally, the primary concern in the Boric Acid Rooms would be low temperature resulting in boric acid precipitation. Therefore, high outside temperatures would not be expected to result in an adverse effect on the Boric Acid Rooms or supporting equipment.

Low Temperatures – The primary credited borated water sources are the BASTs. The BASTs are maintained at 105°F minimum by automatically controlled immersion heaters The boric acid concentration solubility limit is 53°F at the specified weight percent (6550 ppm). The strategy for RCS make-up would initiate RCS injection from the BAST no later than 16 hours after the ELAP with required injection in support of criticality control completed within 24 hours.

Therefore, both the location of the BAST and associated piping inside a temperature controlled building and the initial fluid temperatures would preclude the significant loss of heat required for boric acid precipitation upon loss of all AC power within the FLEX assumed timeframes for the use of the BAST contents. Additionally, the response to a potential loss of heating in the Auxiliary Building is to disable the ventilation system. Disabling the ventilation system under such conditions has been shown to significantly slow the cool down of the Auxiliary Building, maintaining building temperatures in the area of the BASTs above the operability limit of 63°F.

Therefore, due to the loss of building ventilation during ELAP there is little cooling of the systems and piping containing boric acid during the timeframes considered until Phase 3 power enables restoration of ventilation.

Battery Rooms

The minimum design temperature for the Train A and Train B station batteries is 60°F, and the minimum design temperature for the N Train batteries is 45°F. The maximum design temperature for all three battery trains is 90°F. As discussed in IEEE Standard 484, "Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications," lead acid batteries are typically rated at 77°F. The standard also states that low temperatures may decrease battery capacity, while prolonged high temperatures may shorten battery life and increase maintenance cost. The potential battery temperature effects for each FLEX phase are discussed below.

Phase 1

An ELAP event would result in loss of the normal power sources for the battery chargers. A deep load shed would then be performed to assure that the Train A, Train B, and N Train 250 volt batteries maintain adequate voltage for at least 12 hours. The lower discharge rate at higher temperatures will cause less life reducing damage; and lower discharge rate at lower temperatures will not challenge the battery capacity. The specific considerations for abnormally high temperatures and for abnormally low temperatures are described below.

High Temperatures - The extreme high temperature may be assumed to be 110°F. This is reasonable because:

- The bulk electrical heat input to the Auxiliary Building HVAC system is significantly reduced, and
- Records indicate that the highest temperature recorded for Bridgman, Michigan was at 103°F in July 1999.

Using the calculation described in Annex H of IEEE Standard 450, "Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications," a 15-year rated battery at a temperature of 107°F for one month would result in a degradation of approximately 2% of its overall battery life expectance. Therefore, the ability of the batteries to supply the deeply reduced load for the 12 hours assumed for Phase 1 would not be affected.

Low Temperatures - The potential effects of low temperatures on the Train A station battery, Train B station battery, and the N Train battery were considered in the calculation demonstrating the Phase 1 battery capabilities (calculation 12-E-S-250D-FLEX-001). The calculation assumptions for low temperature are based on minimum room temperatures of 60°F for the Train A and Train B station batteries, and 45°F for the N Train battery. These minimum temperatures are detailed in calculation MD-12-HV-026-N, CD Battery Room Steady State Station Blackout Transient Temperatures," and calculation MD-12-HV-029-N, "N Battery Room Station Blackout Temperature Analysis,"

The Unit 1 Train B station battery has >65% margin and Unit 2 Train B station battery has >10% margin based on calculation 12-E-S-250D-FLEX-001. Document DB-12-SBO, "Design Basis Document for Station Blackout," demonstrates the Train A station battery room temperature is more limiting than the Train B station battery room temperature.

The Unit 1 Train A station battery has >5% margin and Unit 2 Train A station battery has >28% margin based on calculation 12-E-S-250D-FLEX-001. Calculation MD-12-HV-026-N, "CD Battery Room Steady State Station Blackout Transient Temperatures," Figure 8-1 and Figure 8-3 show that the temperature decrease rate after four hours would be less than 0.7°F/hr. This rate would not increase because the temperature differential between the battery rooms and their surroundings would continue to decrease. A 0.7°F/hr. decrease rate during the additional eight hours of Phase 1 would not challenge the battery performance.

The Unit 1 and Unit 2 N Train batteries have >11% margin based on calculation 12-E-S-250D-FLEX-001. The temperature for the N Train batteries is lower than the temperature for the Train A and Train B station batteries, and is compensated with a larger temperature correction factor (1.25 for the N Train batteries vs 1.15 for the Train A and Train B station batteries). This temperature correction effectively requires more battery capacity to supply the loads at the expected temperatures. MD-12-HV-029-N, "N Battery Room Station Blackout Temperature Analysis," Figure 8-1 and 8-2 show that the temperature decrease rate after four hours would be less than 1°F/hr. This rate would not increase because the temperature differential between the battery rooms and their surroundings would continue to decrease. A 1°F/hr. decrease rate during the additional eight hours of Phase 1 would not challenge the battery performance.

Phase 2

The Phase 2, N strategy will use a portable generator to reenergize the 600 VAC buses 11D and 11B (21D and 21B) which would restore power to the associated battery chargers and room fans. The fans would draw air as designed through the battery rooms and the room temperatures would trend toward the ambient air temperature of the auxiliary building interior, which would not be expected to change rapidly.

If the N+1 strategy is implemented during Phase 2, a different electrical strategy using a different portable generator will be used to supply power to the CRIDs and will not re-power the AB and CD battery chargers. The Unit 1 and Unit 2 N Train battery chargers and the Unit 1 battery room fans would be powered during the N+1 strategy. Again, the fans would draw air as designed through the battery rooms and the room temperatures would trend toward the ambient air temperature of the auxiliary building interior, which would not be expected to change rapidly.

Phase 3

In Phase 3, the NSRC generators would be deployed to supply the Train B 4kV electrical buses, and associated loads. However, the Phase 2 portable generators would also remain available to power the battery room fans as described above.

Containment Temperature

I&M has determined that the containment temperatures would not prevent the FLEX credited components from performing their functions required by the FLEX strategies. The associated evaluations are documented in EQER 2015-001 and EQER 2015-002. These evaluations determined (for Unit 1 and Unit 2 respectively) that the expected containment temperatures would not preclude instrumentation, MOVs, and ventilation fans located in containment and credited in the FLEX strategies from performing the credited functions.

Adverse Containment values listed in the implementing procedures will be applied when ELAP is declared until Pressurizer and SG Containment subcompartment temperatures can be verified below 196.8°F. The use of this criterion is specifically limited to BDB (ELAP/FLEX) response.

2.14.3 Heat Tracing

NEI 12-06 Section 3.2.2, guideline (12) states that heat tracing is used at some plants to ensure cold weather conditions do not result in freezing important piping and instrumentation systems with small diameter piping. The two functions of concern would be Reactor Core Cooling and RCS Boration/Inventory Control.

Reactor Core Cooling

Phase 1: As described above in Section 2.3, "Reactor Core Cooling," the Phase 1 FLEX strategies would provide core cooling using the SGs. SG cooling would be provided by operation of the TDAFW Pump taking suction from one or both units' CSTs. Manual SG PORV operation is credited for cooling the SGs. The Phase 1 strategy is assumed to last 12 hours.

Extreme cold is not expected to impact CST availability. The CSTs and interconnecting piping outside the Auxiliary Building are insulated and adequately protected from extremes of hot and cold weather. The volume and initial temperature of the CST contents and associated piping would preclude the significant loss of heat required for freezing upon loss of all AC power within the Phase 1 timeframes. The TDAFW pump and SG PORVs are located inside buildings and contain steam and water at elevated temperatures.

Phase 2: The Phase 2 FLEX strategies would continue to provide core cooling using the SGs. However, an alternate cooling source would need to be aligned to maintain secondary inventory makeup when the CST is depleted or becomes unavailable. The credited strategy is to provide makeup to the SGs using a FLEX lift pump delivering Lake Michigan water from the CW system intake forebay to the TDAFW pump suction. When the FLEX lift pump is deployed in Phase 2, the required 327 gpm at 300 psia can be delivered to the SG feed ring.

The UHS (Lake Michigan) is assumed to be available as the cooling water source. Lake Michigan is not susceptible to large scale freezing. The CW intake tunnels maintain communication with Lake Michigan below the anticipated level of winter ice cover. The piping which would be used is not small diameter and would require flow rates that would be expected to preclude freezing.

Phase 3: As described in Section 2.7.3, "Electric Power, Phase 3," the Phase 3 equipment includes two turbine generators supplied from the NSRC for each unit. These generators will repower 4kV RCP busses 1A and 2A. This allows repowering Train B 4kV safety related motors, 600VAC buses, related 120VAC lighting and low voltage electrical distribution circuits. Among the Train B loads that can be repowered are 4kV safety related pumps such as the CCW pumps, the RHR pumps, the MDAFW pumps, and the ESW pumps. If an ESW pump is not available, the West ESW pump discharge strainer lid in the affected unit(s) will be removed and replaced with a temporary lid equipped with hose connections to accept discharge of the NSRC raw water pump. This provides the system connection into the ESW pump discharge piping system. Lake Michigan water would be pumped from the CW system intake forebay to the NSRC raw water pump suction using two NSRC high flow, low discharge pressure, floating lift pumps.

Lake Michigan may be assumed to be available based on the considerations described above. The large system volumes and flow rates of the ESW, CCW, and RHR systems, and the indoor location of the affected portions of these systems, provide reasonable assurance that freezing would not be a concern.

RCS Boration/Inventory Control

Phase 1, 2, and 3: In Mode 5 with the SGs unavailable or in Mode 6, core cooling and RCS boration/inventory control would initially be available by gravity draining the RWST to the RCS, and subsequently by using a portable makeup pump for RCS feed and bleed. Similar to the CST, extreme cold is not expected to impact RWST availability. The RWSTs and interconnecting piping outside the Auxiliary Building are insulated and adequately protected from extremes of hot and cold weather. The volume and initial temperature of the RWST contents and associated piping would preclude the significant loss of heat required for freezing upon loss of all AC power within the Phase 1 and Phase 2 timeframes. The TS upper limit on RWST boron concentration, 2600 ppm, is below the solubility limit at 32°F. Therefore, boron precipitation would not be a concern.

The other credited systems and components are located inside the Auxiliary Building and the Containment. The large mass and interior volume of these buildings is expected to retain heat for a period sufficient to prelude concerns regarding freezing and boron precipitation in the required tanks and piping.

2.14.4 Frazil Ice

NEI 12-06 requires that the potential for frazil ice formation be addressed. Frazil ice is a surface and sub-surface phenomena associated with large bodies of water under extremely cold, windy, and turbulent conditions. This results in emulsified ice crystals in the surface and subsurface of the large water body. The CNP intake structure and forebay connect to Lake Michigan through three large intake tunnels with intake cribs mounted on the lake bottom. The intake cribs are significantly below the lake surface. During an ELAP event, the CW, ESW and NESW pumps will all be stopped. Under the drastically reduced flow rates considered during ELAP, the forebay acts as a stilling well. Communication with Lake Michigan maintains the water supply while shielding the forebay from the adverse effects of surface freezing and frazil ice production. Based on the construct and design of the lake intake structures and CW system forebay, reasonable assurance exists that induction of frazil ice will not be a concern.

Additionally, with lake water temperatures in the range required for frazil ice formations, one of the unit's CW systems would normally be aligned in the de-ice mode of operation. Therefore the water temperature in the forebay would be greater than 32°F at the start of the BDBEE. Since frazil ice formation requires supercooled liquid, the initial BDBEE conditions would inhibit the formation of frazil ice.

Formation of frazil ice at the floating lift pumps deployed in Phase 3 would not be expected for the following reasons:

- As described above CW system operation in the de-ice mode would assure that the forebay temperature would be above freezing at the start of the BDBEE. The floating lift pumps would be located in the east portion of the forebay (i.e., the portion closest to the plant). This portion of the forebay would not experience any significant flow from the lake during Phase 1 and Phase 2. The absence of flow prior to Phase 3 and the very low flow with respect to the total forebay volume during Phase 3 would inhibit the formation of frazil ice crystals.
- A contributor for the formation of frazil ice is the radiant heat loss of the liquid to the atmosphere. The water in the forebay is shielded from such losses by the Screen House concrete floor. Should the forebay water surface temperature decrease to 32°F, the water surface would freeze precluding the formation of supercooled liquid.

2.15 Lighting

I&M has conducted reviews which documented consistency of the CNP Unit 1 and Unit 2 FLEX validation actions with those prescribed in the NEI document titled "FLEX Validation Process." The reviews were conducted to determine if there would be adequate resources for simultaneous implementation of FLEX strategies at both units within the required constraints identified for Phases 1 and 2, and included consideration of light for personnel to perform the required actions. The reviews identified actions for which headlamps, flashlights, and portable lighting may be needed. The availability of flashlights, headlamps, and portable lighting is identified in 12-OHP-4027-FSG-501.

2.16 Communications

Letter AEP-NRC-2012-83 from M. H. Carlson, I&M, to the NRC, titled "Donald C. Cook Nuclear Plant Units 1 and 2, Communications Assessment Requested by Nuclear Regulatory Commission Letter, 'Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding

Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident,' dated March 12, 2012," dated October 31, 2012, (ADAMS Accession No. ML12318A176) transmitted a CNP communication assessment. The communication assessment identified recommendations to further evaluate or enhance the CNP communications capabilities, and identified actions to be evaluated as part of the mitigation strategies for BDBEEs.

The letter from T. J. Wengert, NRC, to L. J. Weber, I&M, titled "Donald C. Cook Nuclear Plant, Units 1 And 2 - Staff Assessment in Response to Recommendation 9.3 of The Near Term Task Force Related to the Fukushima Dai-ichi Nuclear Power Plant Accident (TAC Nos. ME9950 and ME9951)," dated June 6, 2013, (ADAMS Accession No. ML13148A294) transmitted an NRC Safety Assessment which included a review of the communication enhancements identified in I&M letter AEP-NRC-2012-83. The NRC Safety Assessment documented the staff's conclusion that the enhancements identified by I&M, in conjunction with other communication system attributes, would help ensure that communications are maintained.

Letter AEP-NRC-2014-91 from J. P. Gebbie, I&M, to the NRC titled "Donald C. Cook Nuclear Plant Units 1 and 2, Update to Communications Assessment Implementation Actions and Timeline - Fukushima Dai-ichi Near-Term Task Force Recommendation 9.3, 'Emergency Preparedness,'" dated December 16, 2014, (ADAMS Accession No. ML14352A250) addressed each previously identified communication enhancement and reported that I&M had either completed the enhancement or determined that the enhancement was not needed.

In the event of a BDBEE, communications equipment will be deployed in accordance with 12-OHP-4027-FSG-501. The FSG provides instructions for deploying the following in either or both units:

- Radio system repeaters (four total), antenna, and battery power supplies.
- Portable radios from in-plant storage boxes.
- Bi directional amplifier.

2.17 Shutdown and Refueling

CNP procedure PMP-4100-SDR-001 controls the management and assessment of shutdown and outage risk. This procedure has been revised to be consistent with the recommendations provided in the NEI position paper "Shutdown / Refueling Modes," as endorsed by the NRC in the letter from Jack R. Davis (NRC) to Joseph E. Pollock (NEI) dated September 30, 2013 (ADAMS Accession No. ML13267A382). The revision provides for pre-deployment of FLEX equipment for Modes 5 and 6 in defined conditions.

The shutdown and refueling strategies are described above in the following sections:

- Section 2.3.3, "Reactor Core Cooling, Mode 5, with SGs Available and RCS Intact, Phase 1 and Phase 2"
- Section 2.3.4, "Reactor Core Cooling, Mode 5, with SGs Not Available or Mode 6 with the Refueling Cavity Not Flooded, Phase 1 and Phase 2"
- Section 2.3.5, "Reactor Core Cooling, Mode 6 with the Reactor Cavity flooded, Phase 1 and Phase 2"
- Section 2.3.6, "Reactor Core Cooling, All Modes, Phase 3"
- Section 2.4.3, "RCS Boration/Inventory Control, Mode 5 with SGs Not Available, or Mode 6, Phase 1 and Phase 2"
- Section 2.4.4, "RCS Boration/Inventory Control, Mode 5 with SGs Not Available, or Mode 6, Phase 3"
- Section 2.5, "Spent Fuel Pool Cooling"
- Section 2.6.3, "Containment, Mode 5 with SGs Available, Phase 1, 2, and 3"
- Section 2.6.4, "Containment, Mode 5 with SGs Not Available, and Mode 6, Phases 1 and 2"
- 2.6.5, "Containment, Mode 5 with SGs Not Available, and Mode 6, Phase 3"

2.18 Sequence of Events

Table 3 presents the sequence of events and associated times based on reviews which established consistency of the CNP Unit 1 and Unit 2 FLEX validation actions with those prescribed in the NEI document titled "FLEX Validation Process."

2.19 Programmatic Elements

2.19.1 Overall Program Documents

PMI-4027, "Beyond Design Basis External Event." – PMI-4027 is the highest tier document specific to the FLEX program. The PMI establishes the administrative controls for the diverse and flexible strategies, establishes administrative controls for an ELAP and LUHS occurring simultaneously on both units, and assigns supervisory responsibilities for implementation of these administrative controls.

In accordance with PMI-4027, the Emergency Preparedness Manager is responsible for ownership, direction, and oversight of the administrative controls related to a BDBEE for CNP, and functions as the program's interpretation contact, technical content owner, and administrative controller. The PMI also describes the responsibilities of the SAFER organization, the Operations Director, the Design Engineering Director, the Maintenance Manager, and the Training Manager, with respect to the FLEX program for mitigating BDBEEs.

PMI-4027 identifies activities encompassed by the program, including:

- Control Room accessibility – lighting and ventilation.
- Communications.
- Preventative maintenance for the FLEX equipment.

- Procedures for maintenance, operation and abnormal response issues associated with FLEX.
- Strategies to ensure core cooling, Containment Integrity and SFP cooling are maintained.
- Staffing
- Training using the Systematic Approach to Training.

The following lower tier documents implement the program required by PMI-4027.

PMP-4027-FSG-003, "FLEX Program" - PMP-4027-FSG-003 establishes actions and responsibilities to ensure readiness for mitigation and indefinite coping after a BDBEE. The PMP establishes requirements for:

- Strategy change control
- Procedure Change Control
- Configuration Control
- Equipment Quality
- Equipment Storage

PMP-4027-FSG-003 identifies the external hazards that are applicable to CNP. The PMP provides an overview of each specific FLEX strategy for assuring that the following are maintained:

- Reactor Core Cooling
- RCS Boration/inventory Control
- SFP Cooling
- Containment
- Electric Power

PMP-4027-FSG-003 identifies by number, title, and function procedures that implement or support the FLEX strategies. These procedures include:

- Parent FSGs
- Deployment FSGs
- Operational FSGs
- Abnormal & Emergency Operating Procedures
- Extensive Damage Mitigation & Severe Accident Management Guidelines

PMP-4027-FSG-002, "FLEX Equipment Program" – PMP-4027-FSG-002 describes the processes for ensuring that FLEX Equipment is maintained to the standards of NEI 12-06. The PMP includes programmatic requirements for determining unavailability of FLEX equipment and potential compensatory actions, programmatic controls for the deployment, maintenance, operation, and testing of FLEX equipment, and programmatic controls for changes to the plant connection points for FLEX equipment. PMP-4027-FSG-002 provides guidance for:

- FLEX Equipment
- FLEX Support Equipment
- FLEX Defense-In-Depth Equipment

PMP-4027-FSG-002 requires that the Emergency Preparedness Manager assign a FLEX Program Owner who defines requirements for FLEX equipment inspection, testing, and preventive maintenance, including inspection type and frequency, preventive maintenance type and frequency, inspection and testing methodology, and acceptance criteria. The PMP requires that preventive maintenance for the FLEX equipment follow CNP procedure PMI-5030, "Preventive Maintenance," and the recommendations of NEI 12-06.

PMP-4027-FSG-002 provides requirements regarding the unavailability of FLEX equipment, including tracking the unavailability of equipment and plant connection points, and evaluating the impact on FLEX strategies of unavailable equipment or connection points. The PMP identifies the FLEX equipment credited for various strategies. The PMP references TRM 8.11.1, "FLEX Plant Connection Points," and TRM 8.11.2, "FLEX Plant Connection Points Combined with FLEX Portable Equipment," which specify required actions and time limits for unavailable FLEX equipment and plant connection points. PMP-4027-FSG-002 also identifies installed plant equipment that is important to FLEX strategies.

<u>PMP-4027-FSG-001, "FLEX Support Guideline (FSG) Maintenance"</u> – PMP-4027-FSG-001 provides details for maintaining the CNP FSGs. The PMP also describes the responsibilities of the Operations Director, the EOP Program Manager, the Training Manager, Design Engineering, the Probabilistic Risk Assessment Group, System Engineering, Nuclear Safety & Analysis, Regulatory Affairs, FSG writers, and other Department Directors/Managers, with respect to maintaining the FSGs. PMP-4027-FSG-001 provides specific requirements for developing, altering, or cancelling the Parent FSGs, the Deployment/Operational FSGs, and the Parent FSG Plant Specific Background Documents. The PMP provides direction for verification and validation of the Parent FSGs.

<u>12-EHP-5040-MOD-009, "Engineering Change Reference Guide"</u> – 12-EHP-5040-MOD-009 provides checklists and descriptions of engineering, design, licensing, and plant technical issues to be used as a guide for Engineering Change impact evaluation. The procedure includes attachments to be used as guidelines to determine the potential impacts, interfaces, and updates required by the Engineering Change. The procedure includes an attachment specifically addressing FLEX strategies. The attachment provides a general description of the strategies and identifies key external and internal documents. The procedure includes an Engineering Review and Scoping Screen Worksheet that is used to determine the topics impacted by an Engineering Change. The worksheet includes FLEX related considerations.

2.19.2 Procedural Guidance

Due to the impracticality of predicting all combinations of plant conditions and external hazards that may require the use of FLEX equipment, it is not feasible to provide specific procedural guidance for each potential condition and hazard. Therefore, 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 BDBEEs, and are not used inappropriately in lieu of existing procedures. Where FLEX strategies supplement EOPs, AOPs, or fire response procedures, the applicable EOP, AOP, SAMG or EDMG directs the entry into and exit from the appropriate FSG.

The CNP Mode 1 through 4 FSGs have been developed in accordance with PWROG guidelines. The CNP Mode 5 and 6 FSG were developed prior to issuance of the PWROG Mode 5 and 6 guidelines. The FSGs provide available, pre-planned FLEX strategies for accomplishing specific tasks in the EOPs or AOPs. The FSGs would be used to supplement the existing procedure structure that establishes command and control for the event.

Procedural Interfaces have been incorporated into 1/2-OHP-4023-ECA-0.0 as necessary to provide appropriate reference to the FSGs, and provide command and control for responding to an ELAP. Additionally, procedural interfaces have been incorporated into the following procedures to include appropriate reference to FSGs:

- 1/2-OHP-4022-001-005, "Loss of Offsite Power with Reactor Shutdown"
- 1/2-OHP-4022-017-001, "Loss of RHR Cooling"
- 12-OHP-4022-018-001, "Loss of Spent Fuel Pit Cooling"

Initial FSG validation was performed using the NEI FLEX validation process. FSG maintenance and validation will be performed in accordance with PMP-4027-FSG-001. As implemented by CNP procedures, NEI 96-07 Revision 1, "Guidelines for 10 CFR 50.59 Implementation," will be used to evaluate changes to procedures, including the FSGs, to determine the need for prior NRC approval. Per the guidance and examples provided in NEI 96-07, changes to procedures (EOPs, APs, EDMGs, SAMGs, or FSGs) that perform actions in response to events that exceed a site's design basis will likely screen out as not involving a change to the design basis as described in the UFSAR. The applicable procedures will be changed to assure that changes to the FSGs will also be evaluated in accordance with NEI 12-06 Section 11.8.3 to determine if the change involves a FLEX strategy change that requires prior NRC approval.

2.19.3 Staffing

Using the methodology of NEI 12-01, "Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities," assessments of the capability of the CNP on-shift staff and augmented ERO to respond to a BDBEE were performed for Phase 1 and for Phase 2. The results were transmitted to the NRC in the following letters:

- Phase 1: Letter AEP-NRC-2013-30 from J. P. Gebbie, I&M, to the NRC, titled "Donald C. Cook Nuclear Plant Units 1 and 2, Indiana Michigan Power Company's Response to March 12, 2012, Request For Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendation 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident; dated March 12, 2012 (Emergency Preparedness)," dated April 30, 2013.

- Phase 2: Letter AEP-NRC-2014-30 from J. P. Gebbie, I&M, to the NRC, titled "Donald C. Cook Nuclear Plant Units 1 and 2 Phase 2 On-Shift Staffing Assessment Report Requested by U. S. Nuclear Regulatory Commission Letter, 'Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident;' dated March 12, 2012, dated May 23, 2014.

The assumptions for the CNP Phase 1 and Phase 2 scenarios postulate a BDBEE that results in:

- An ELAP
- Impact on both units (both units are in operation at the time of the event)
- Impeded access to the plant by off-site responders as follows:
    - 0 to 6 Hours Post Event – No site access.
    - 6 to 24 Hours Post Event – Limited site access. Individuals may access the site by walking, personal vehicle or via alternate transportation capabilities (e.g., private resource providers or public sector support).
    - 24+ Hours Post Event – Improved site access. Site access is restored to a near-normal status and/or augmented transportation resources are available to deliver equipment, supplies and large numbers of personnel.

Subject matter experts and consultants were assembled to provide analysis support for the staffing assessment. The assessment was conducted via a tabletop procedural analysis using CNP procedures.

The NRC reviews of the CNP staffing assessments were documented in the following letters:

- Phase 1: Letter from M. G. Evans, NRC to L. J. Weber, I&M, titled "Response Regarding Licensee Phase 1 Staffing Submittals Associated With Near-Term Task Force Recommendation 9.3 Related to the Fukushima Dai-Ichi Nuclear Power Plant Accident," dated October 23, 2013, ADAMS Accession No. ML13233A183.

- Phase 2: Letter from M. Haller NRC, to L. J. Weber, I&M, titled "Response Regarding Licensee Phase 2 Staffing Submittals Associated with Near-Term Task Force Recommendation 9.3 Related to the Fukushima Dai-Ichi Nuclear Power Plant Accident (TAC Nos. MF4310, MF4311, MF4312, MF4313, MF4321, MF4322, MF4323, MF4324, MF4325, MF4326, and MF4327)," dated September 29, 2014, ADAMS Accession No. ML14262A296.

As documented in these NRC letters, the NRC concluded that I&M's Phase 1 and Phase 2 staffing submittals adequately addressed the response strategies needed to respond to the subject event using the CNP procedures and guidelines.

2.19.4 Training

Training Program Description TPD-600-FLEX, "FLEX Training Program Description," describes the BDBEE response Training Program. The program includes identification of required training for Operations, Maintenance, Engineering and ERO personnel. These program lessons were developed and/or revised to assure that personnel proficiency in the mitigation of BDBEEs is adequate and maintained. These programs and controls were developed and have been implemented in accordance with the Systematic Approach to Training process.

For key ERO personnel, initial training has been provided and periodic training will be conducted on BDBEE response strategies and implementing guidelines. Personnel assigned to direct the execution of mitigation strategies for BDBEE responses have received the necessary training to ensure familiarity with the associated tasks, considering available job aids, instructions, and mitigating strategy time constraints.

The CNP simulator models have been upgraded to allow the Operations Control Room crews to train on implementation of FLEX strategies. The changes allowed simulation of voltage at breakers used to introduce power, and pressure at locations used to introduce water into systems following an ELAP. The simulator modeling allows training on a BDBEE occurring with the unit at power or shutdown.

Training on BDBEE response was conducted for licensed operators on the simulator prior to FLEX implementation for the first CNP unit (Unit 1) prior to unit re-start following its fall 2014 refueling outage. Simulator modeling is available for use during periodic retraining as directed by the CNP Curriculum Review Committee.

Care has been taken to not give undue weight (in comparison with other training requirements) for Operator training for BDBEE mitigation. The testing/evaluation of Operator knowledge and skills in this area has been similarly weighted. Operator training includes use of equipment from the NSRC where applicable.

Where appropriate, integrated FLEX drills will be organized on an ERO team or Operations crew basis and conducted periodically, with time-sensitive actions evaluated over a period of not more than eight years. These drills will not involve operation of permanently installed equipment or connection of FLEX equipment.

2.19.5 Equipment

Key components and systems for each strategy are listed in Section 2.3 through 2.7. Procedure 12-OHP-4027-FSG-523 provides a complete list of FLEX equipment, including the minimum quantity and storage location for each item. 12-OHP-4027-FSG-523 is used to conduct periodic inventory and checks of the equipment. Procedure PMP-4027-FSG-002 provides a listing of installed plant equipment important to FLEX for each unit. PMP-4027-FSG-002 also identifies the credited equipment and plant connection points. TRM 8.11.1 and TRM 8.11.2 specify Required Actions and Completion Times if the credited equipment or connection points are unavailable.

The CNP FLEX equipment meets or exceeds the quantity of hoses and electrical cables needed to meet N+1 requirements. I&M will continue to comply with the provisions of the May 18, 2015 letter (ML15125A442) from J. R Davis, NRC, to J. E. Pollock, NEI, which approves the following method of meeting the N+1 criterion:

> Method 1: Provide additional hose or cable equivalent to 10% of the total length of each type/size of hose or cable necessary for the N capability. For each type/size of hose or cable needed for the N capability, at least 1 spare of the longest single section/length must be provided.

2.19.6 Equipment Maintenance and Testing

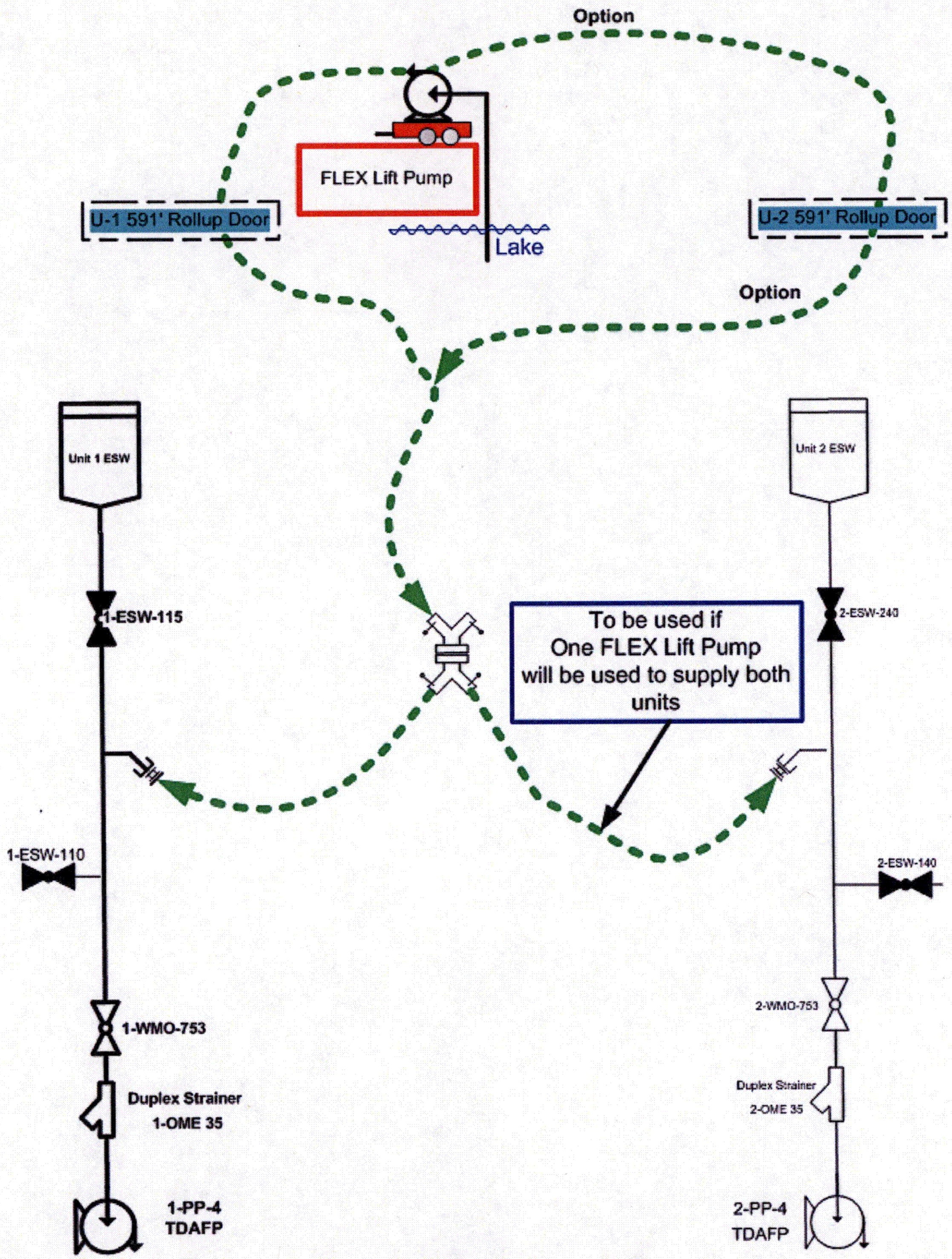
Phase 2 Equipment: PMP-4027-FSG-002 provides the guidance to ensure that Phase 2 FLEX equipment is maintained per the guidance provided in NEI 12-06. The program describes:

- Ownership and responsibilities,
- Planned and unplanned unavailability tracking and source data,
- Preventive maintenance and testing of equipment.

The FLEX Equipment Program ensures the equipment is maintained to the standards of NEI 12-06, which endorses the guidance of INPO AP 913, “Equipment Reliability Process,” and the EPRI associated bases to define site specific maintenance and testing.

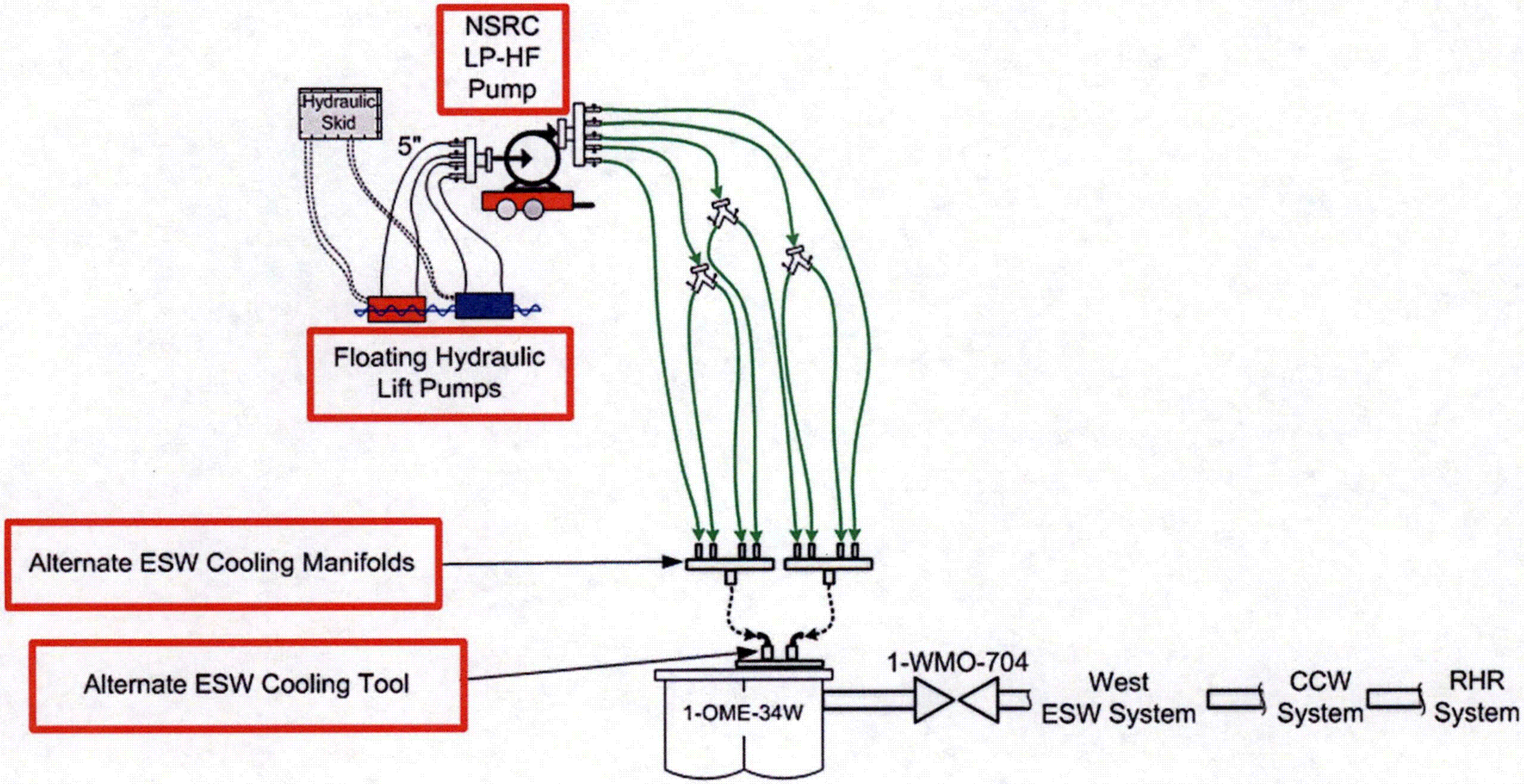
Phase 3 Equipment: For NSRC equipment, SAFER uses and aligns with EPRI recommended maintenance templates and the PRPs which require equipment in the program be maintained in a serviceable, deployable condition. The SAFER team uses the PIM program which has warehouse storage and maintenance procedures to ensure that detailed storage and maintenance requirements are implemented. The PIM program identifies items having limited shelf life or operating life or cycles, and institutes program controls to procure and/or install items for which shelf life has expired. The PIM program is responsible for maintaining the equipment in a serviceable condition and is responsible for initiating nonconformance reports to document deficiencies affecting equipment.

3. FIGURES



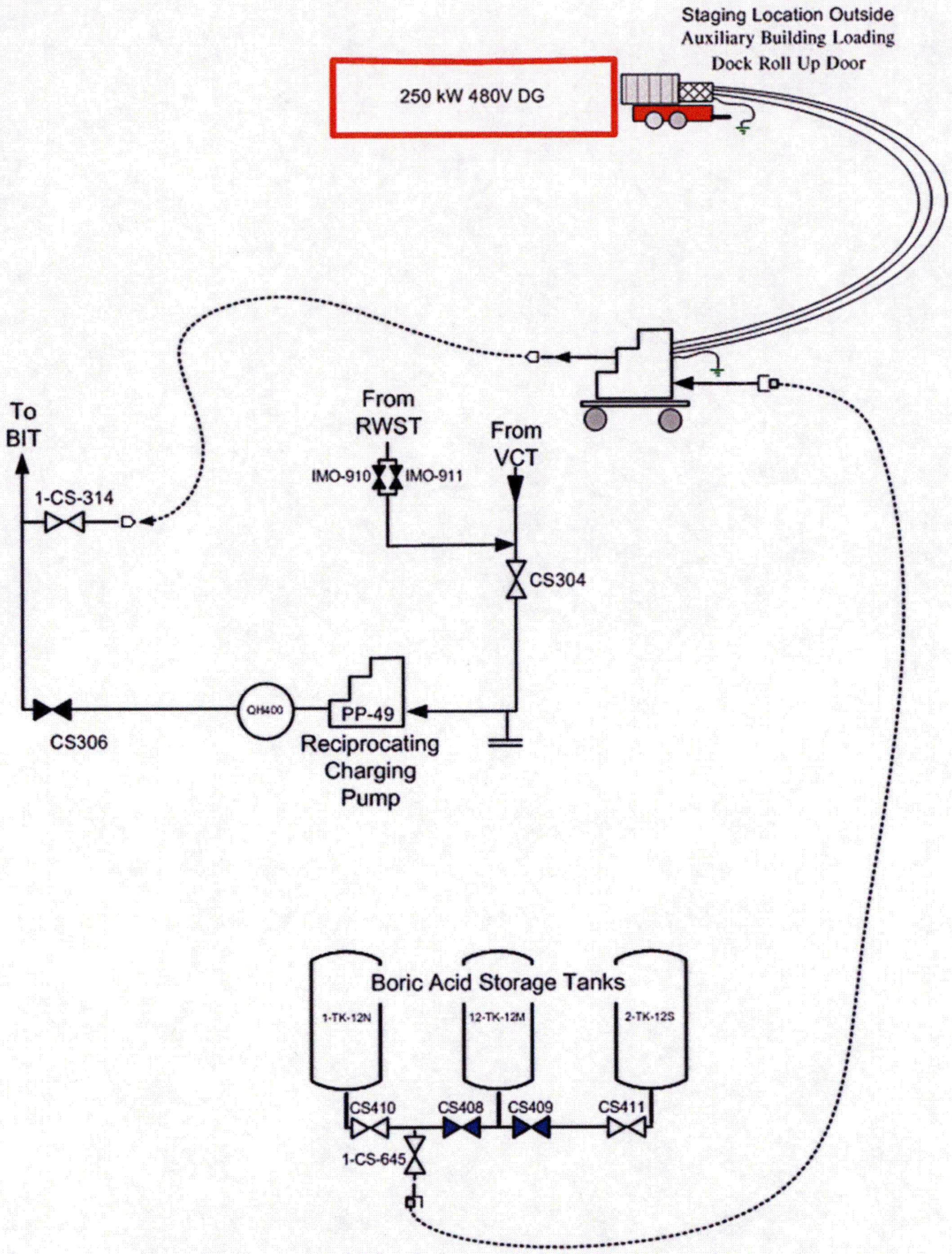
Lake to TDAFP Suction

FIGURE 1



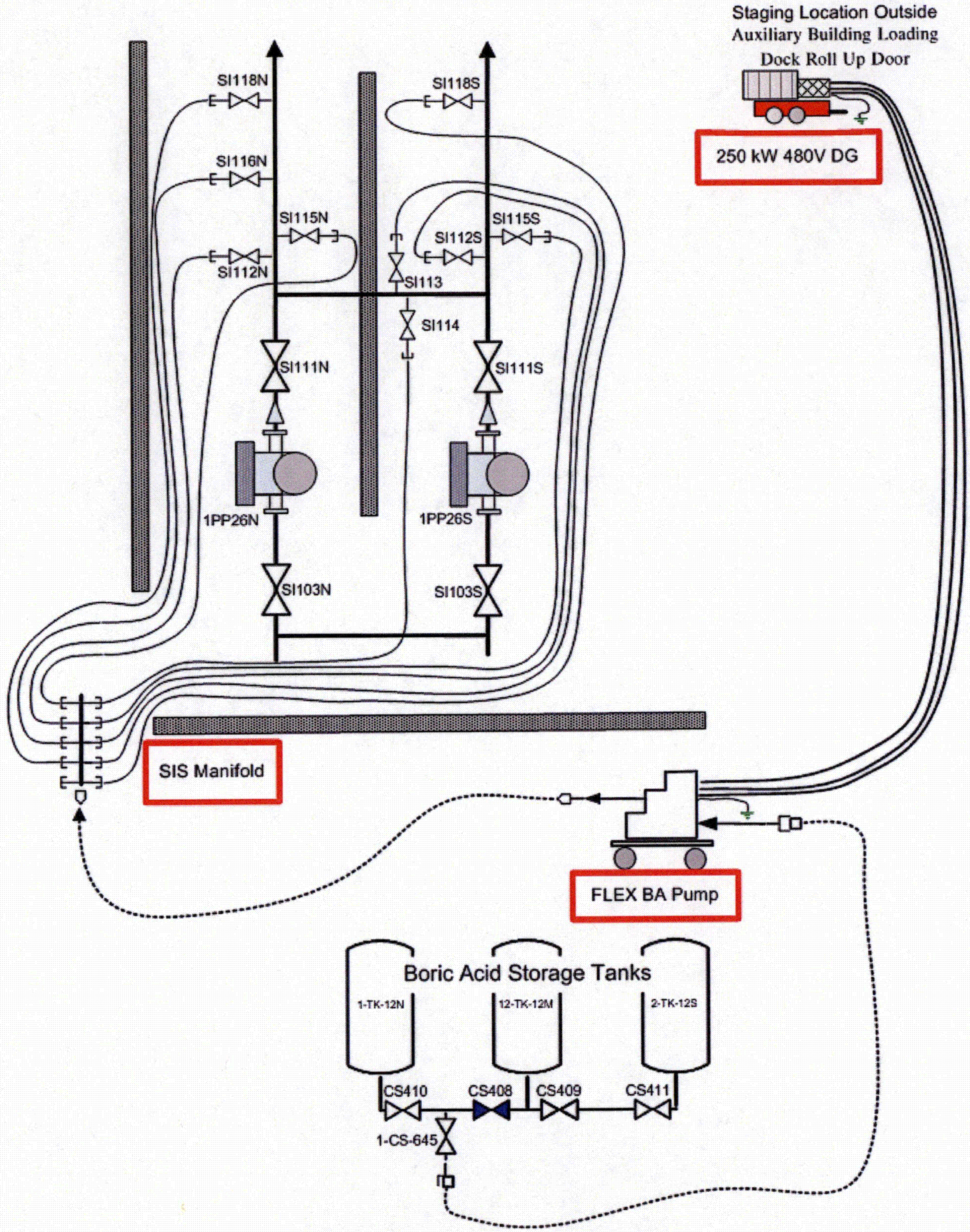
NSRC Low Pressure – High Flow Pump to U1 West ESW Pump Strainer

FIGURE 2



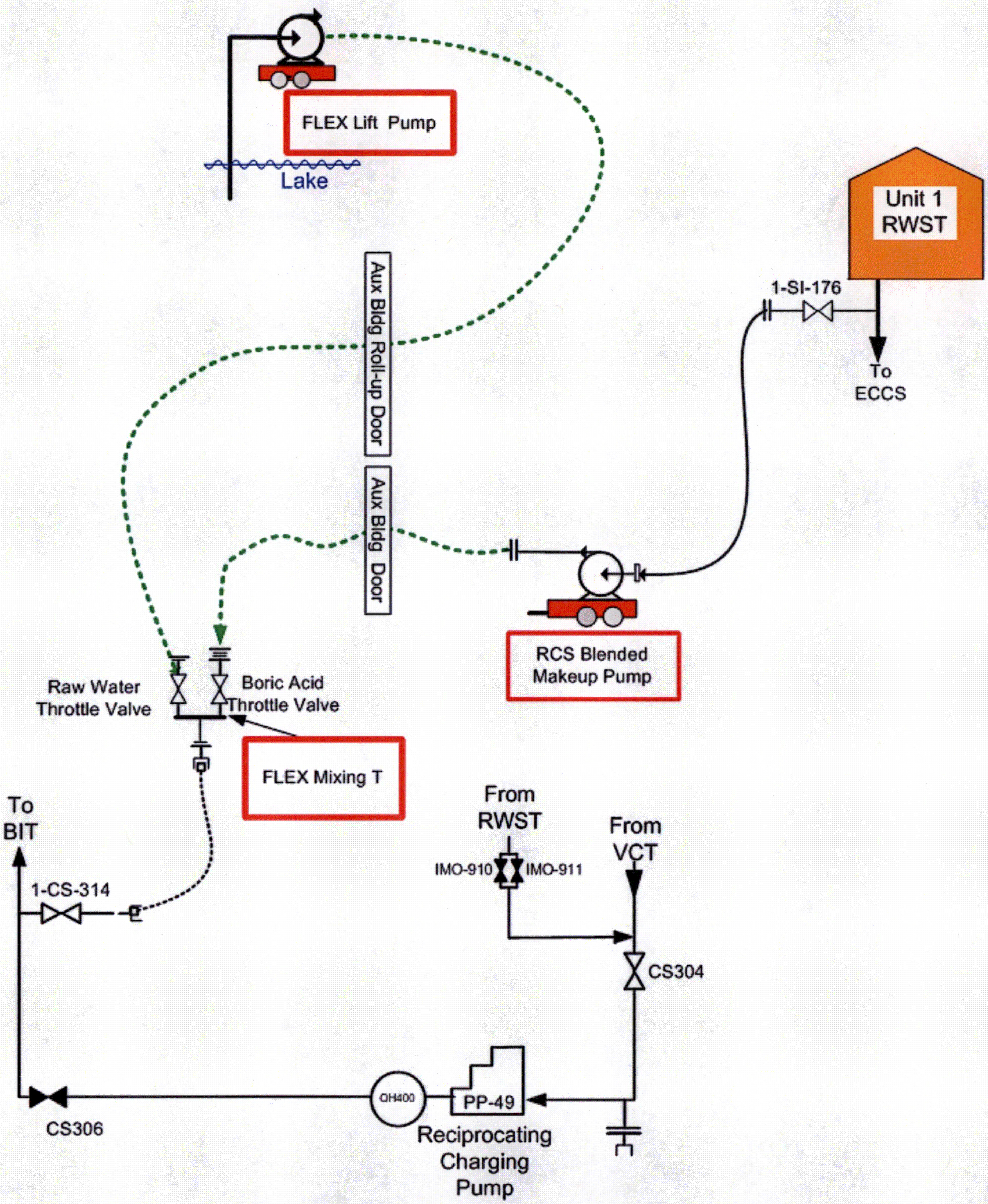
Flex BA Pump to Recip Charging Discharge

FIGURE 3



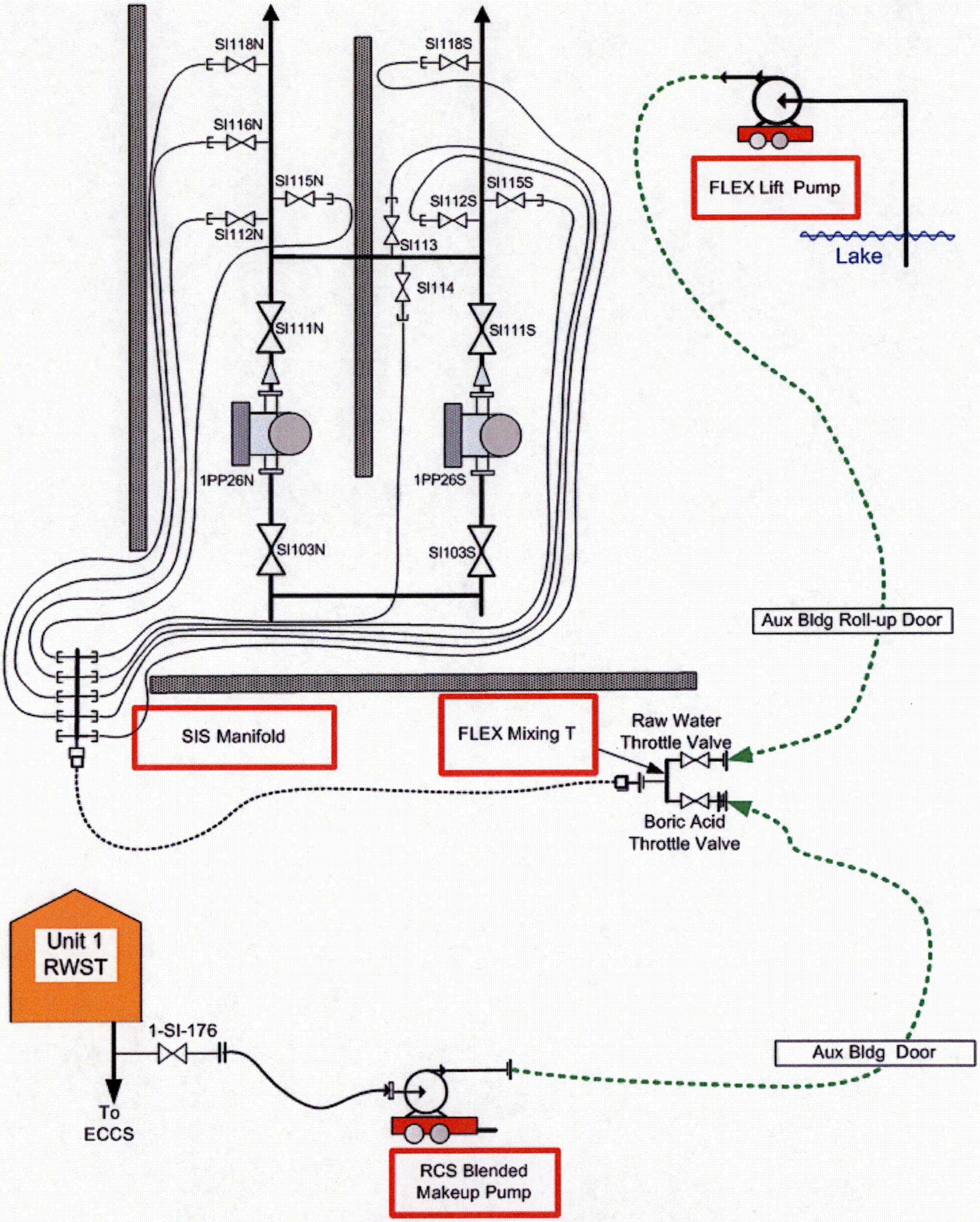
Flex BA Pump to SI Pumps

FIGURE 4



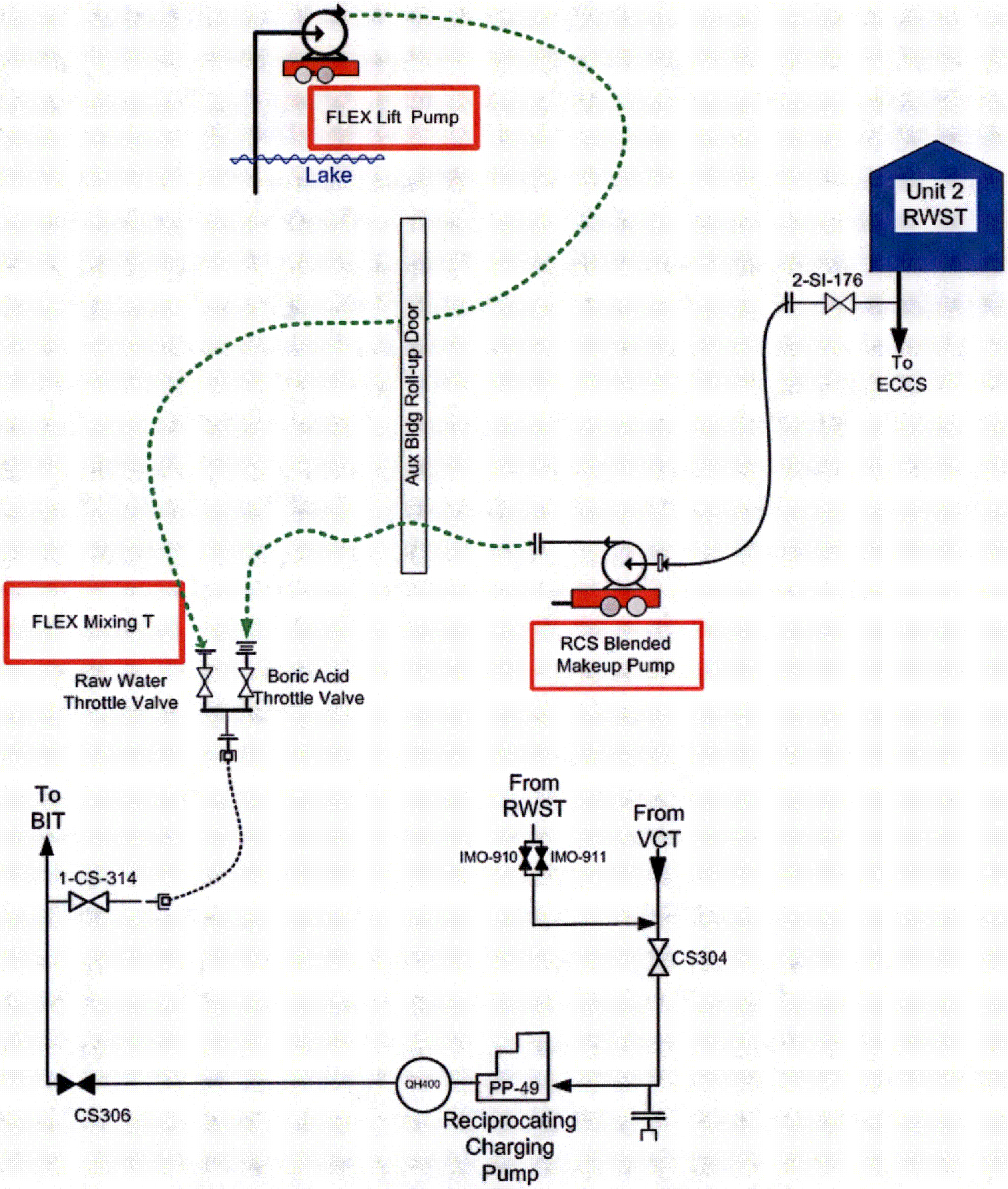
RWST Makeup Blended with Lake Michigan to Recip Charging Pump Discharge

FIGURE 5



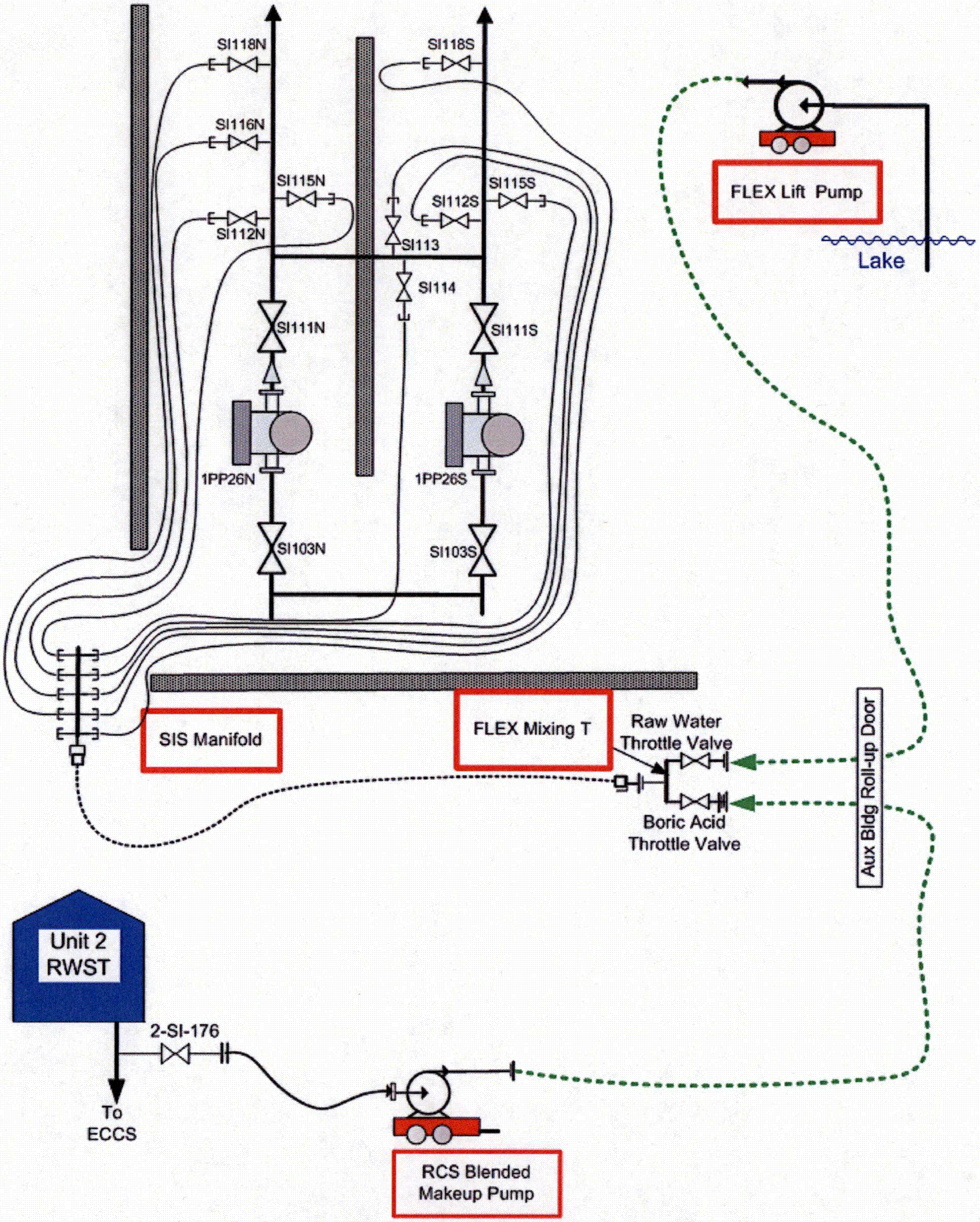
RWST Makeup Blended with Lake Michigan to SI Pump Discharge

FIGURE 6



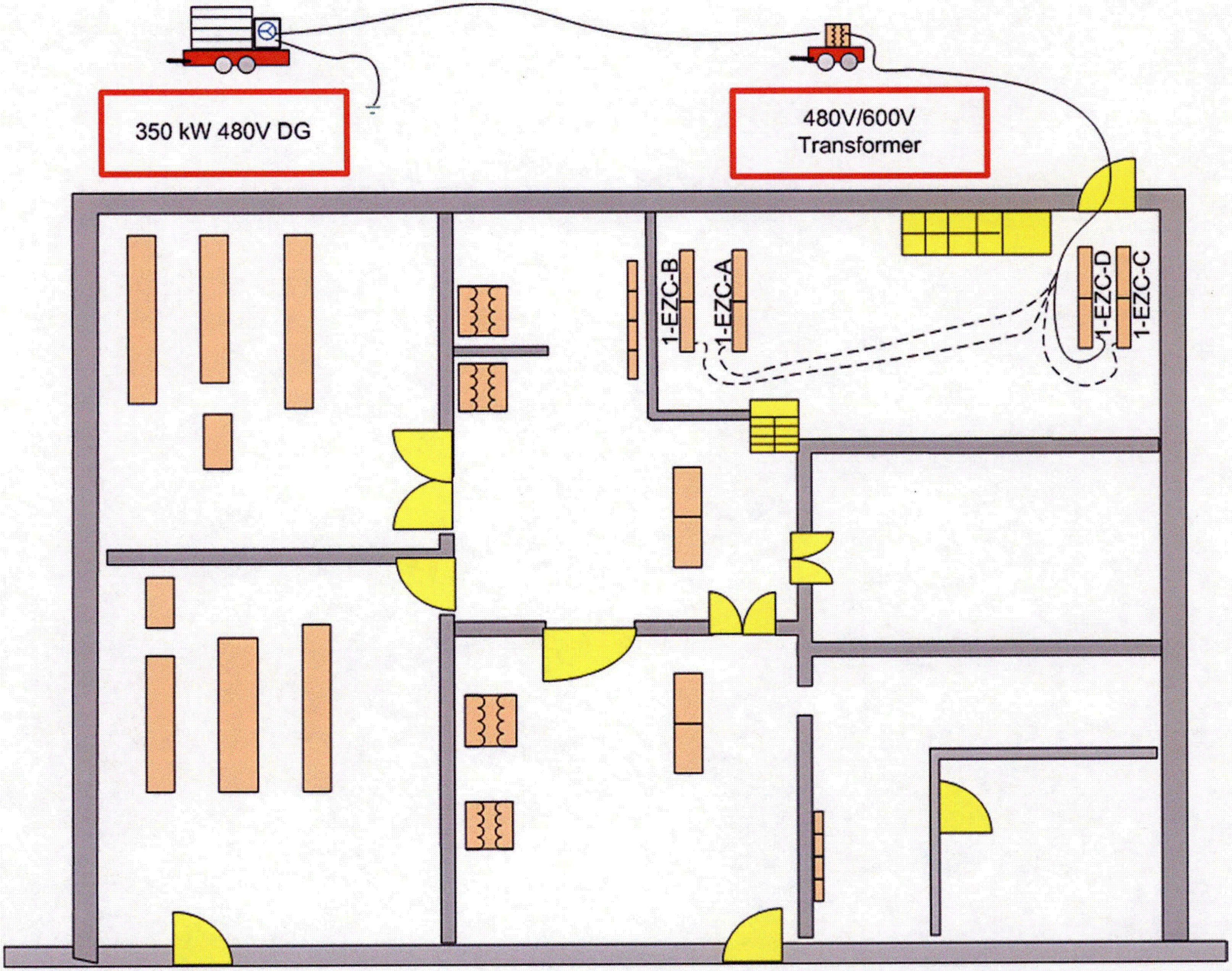
Unit 2 RWST Makeup Blended with Lake Michigan to Recip Charging Pump Discharge

FIGURE 7



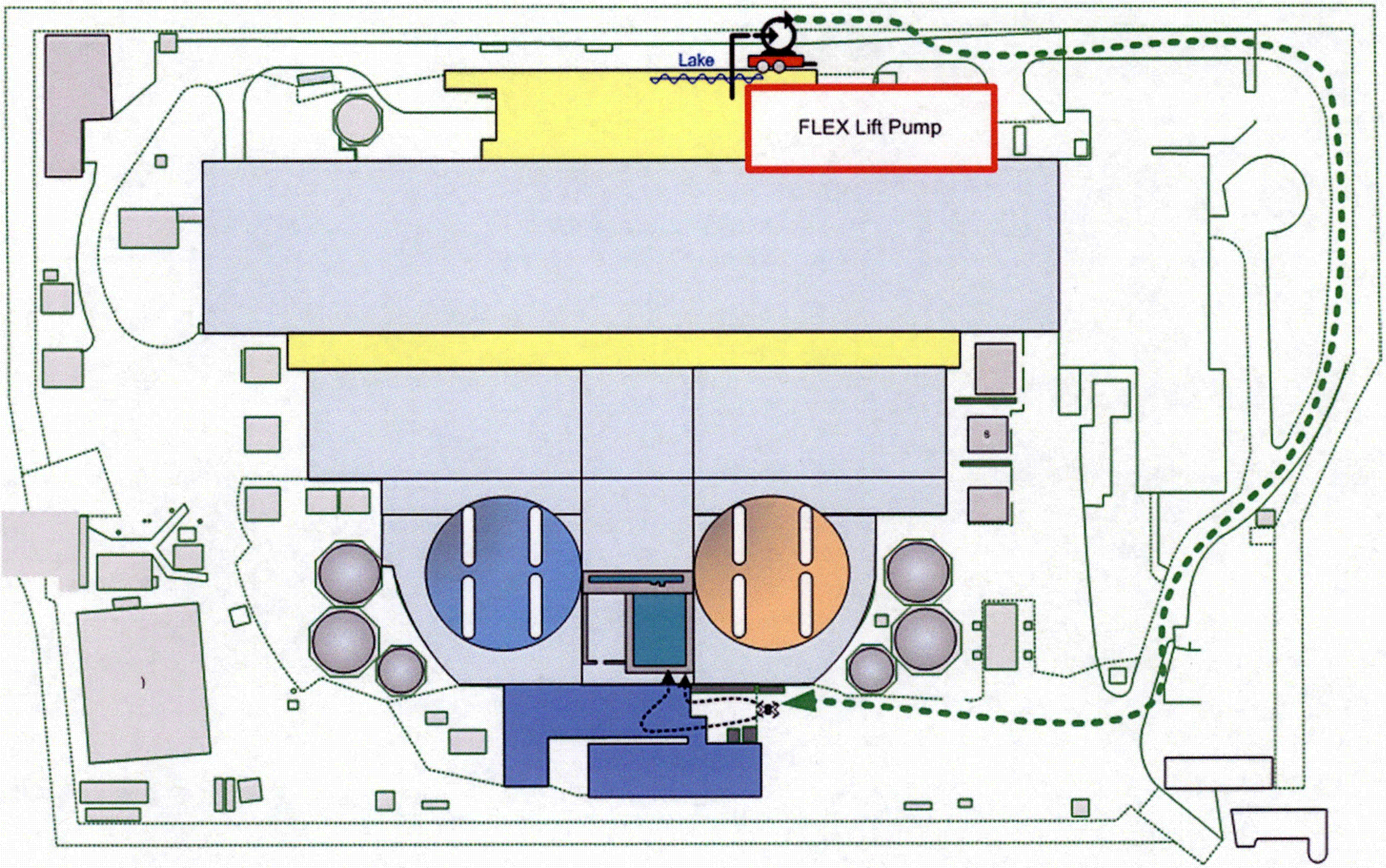
Unit 2 RWST Makeup Blended with Lake Michigan to SI Pump Discharge

FIGURE 8



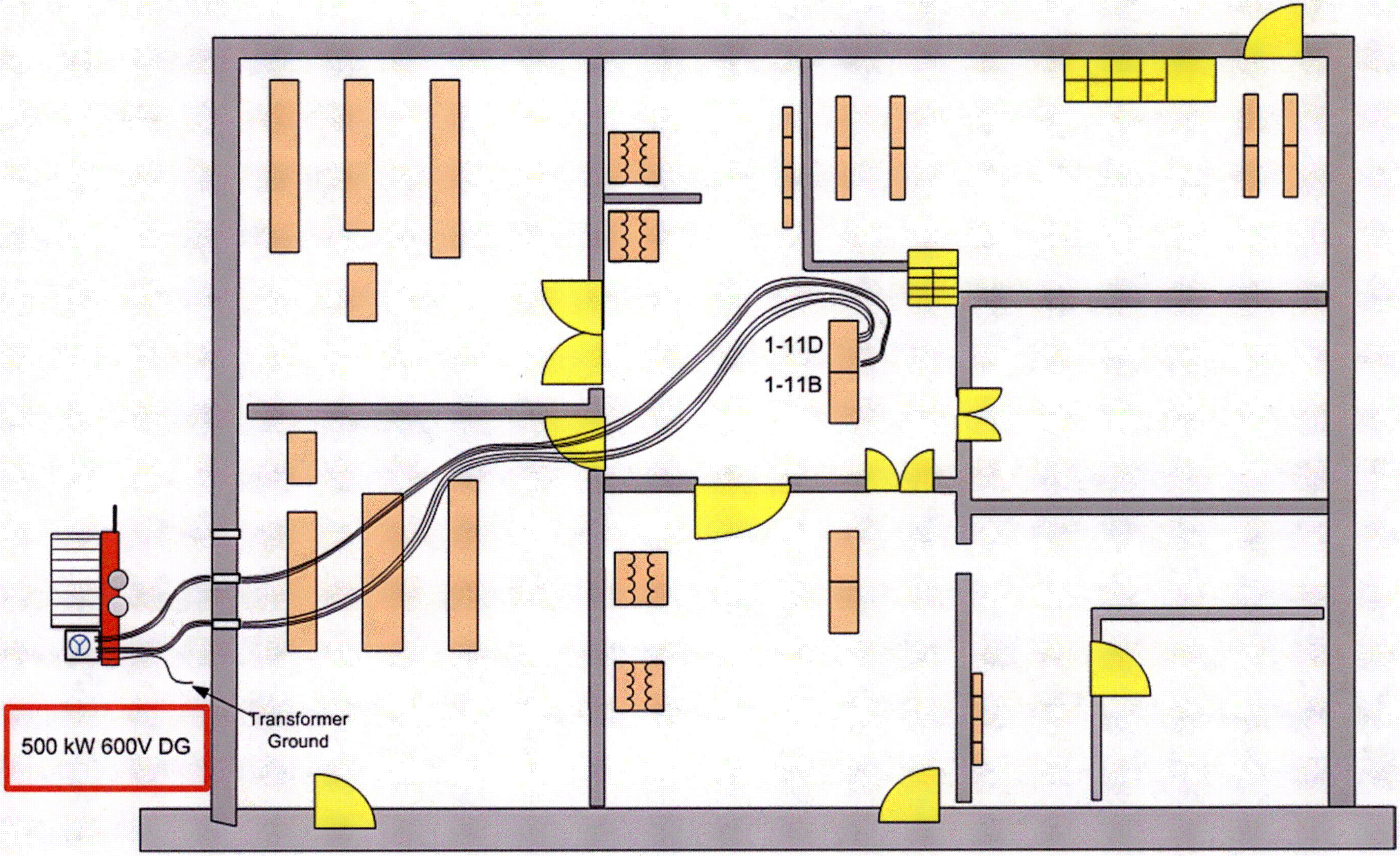
350 kW DG to SI Accumulator Valves

FIGURE 9



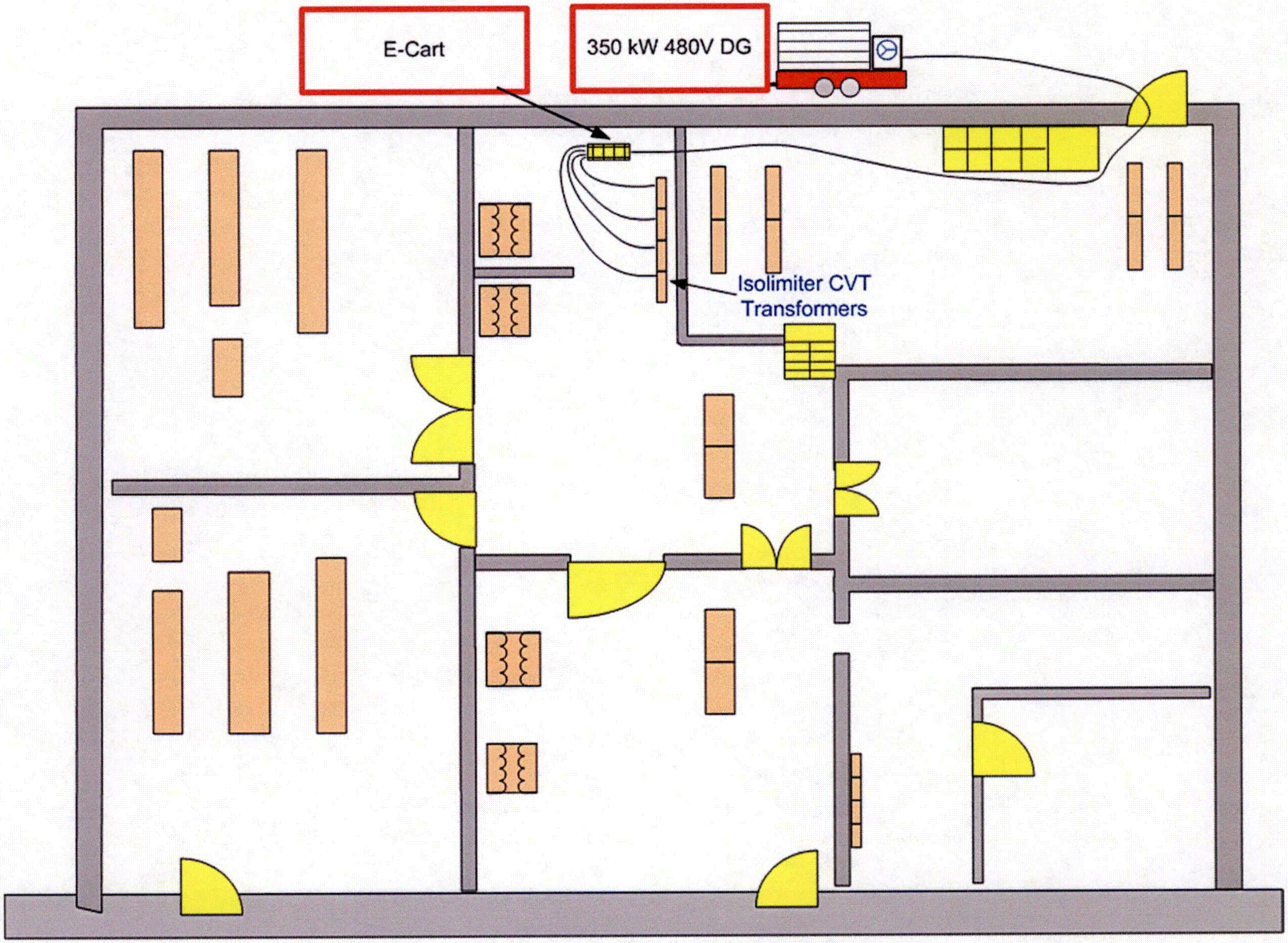
FLEX Lift Pump to SFP Makeup

FIGURE 10



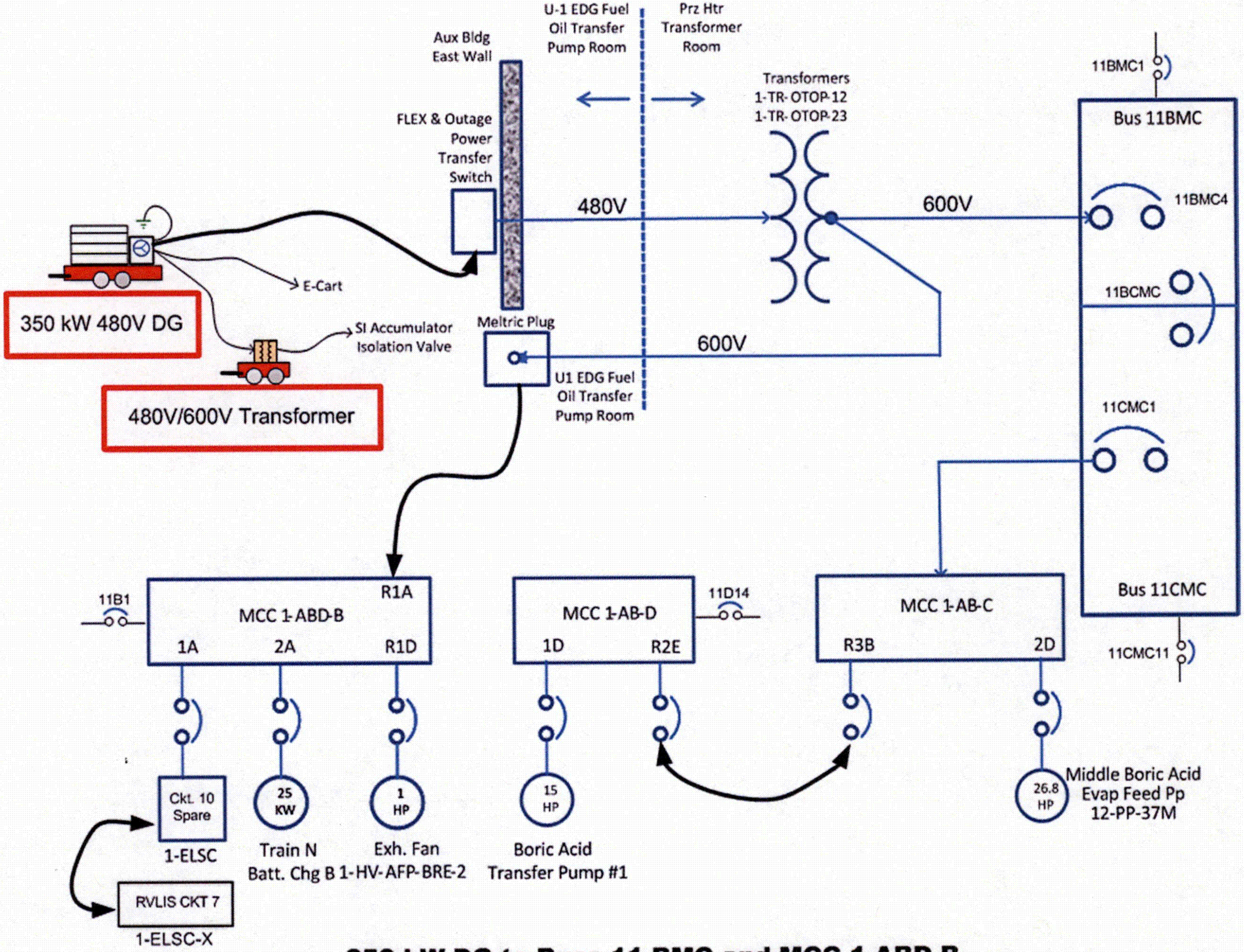
500 kW DG to Bus 11D/11B

FIGURE 11



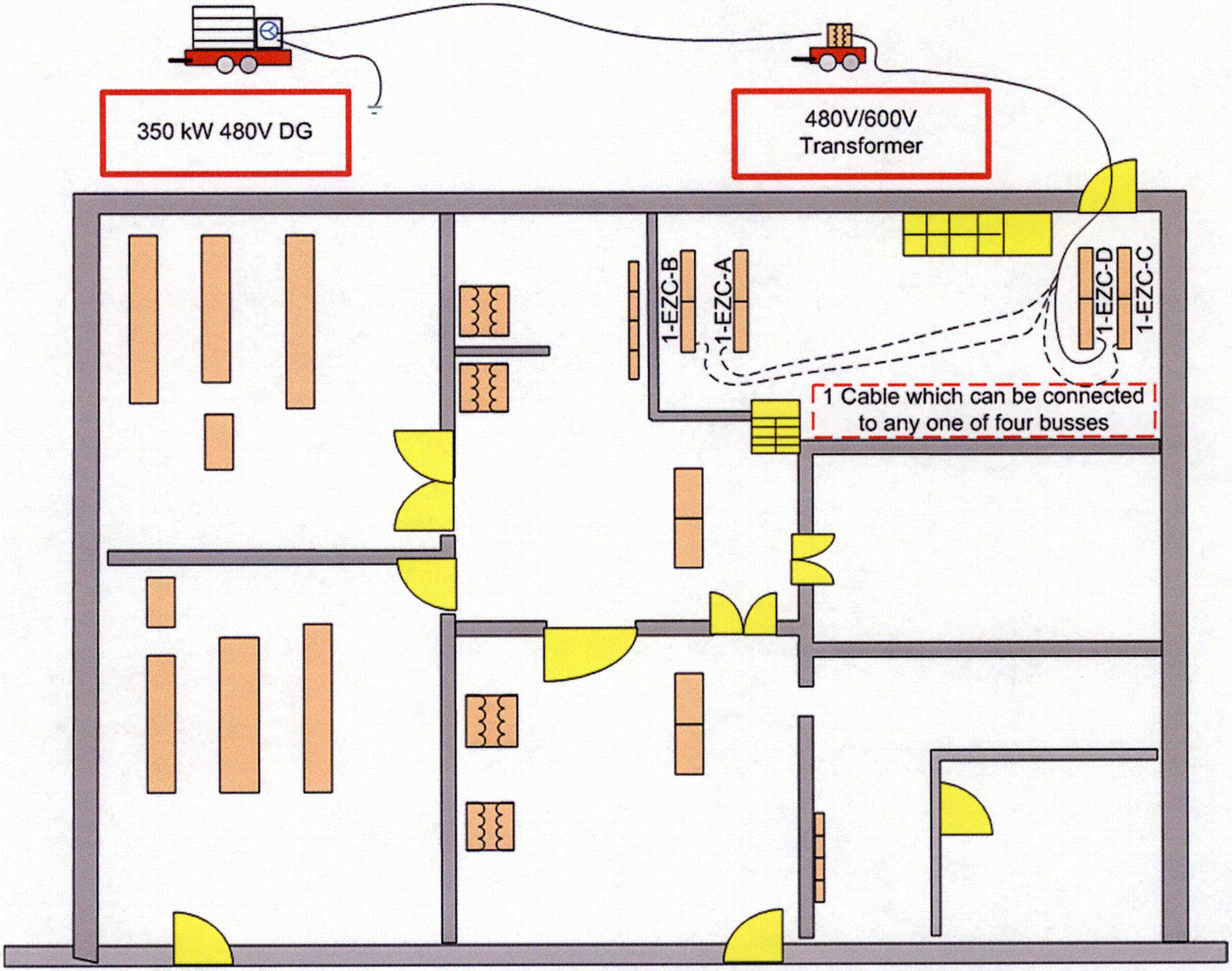
Temporary Power to CRIDs

FIGURE 12



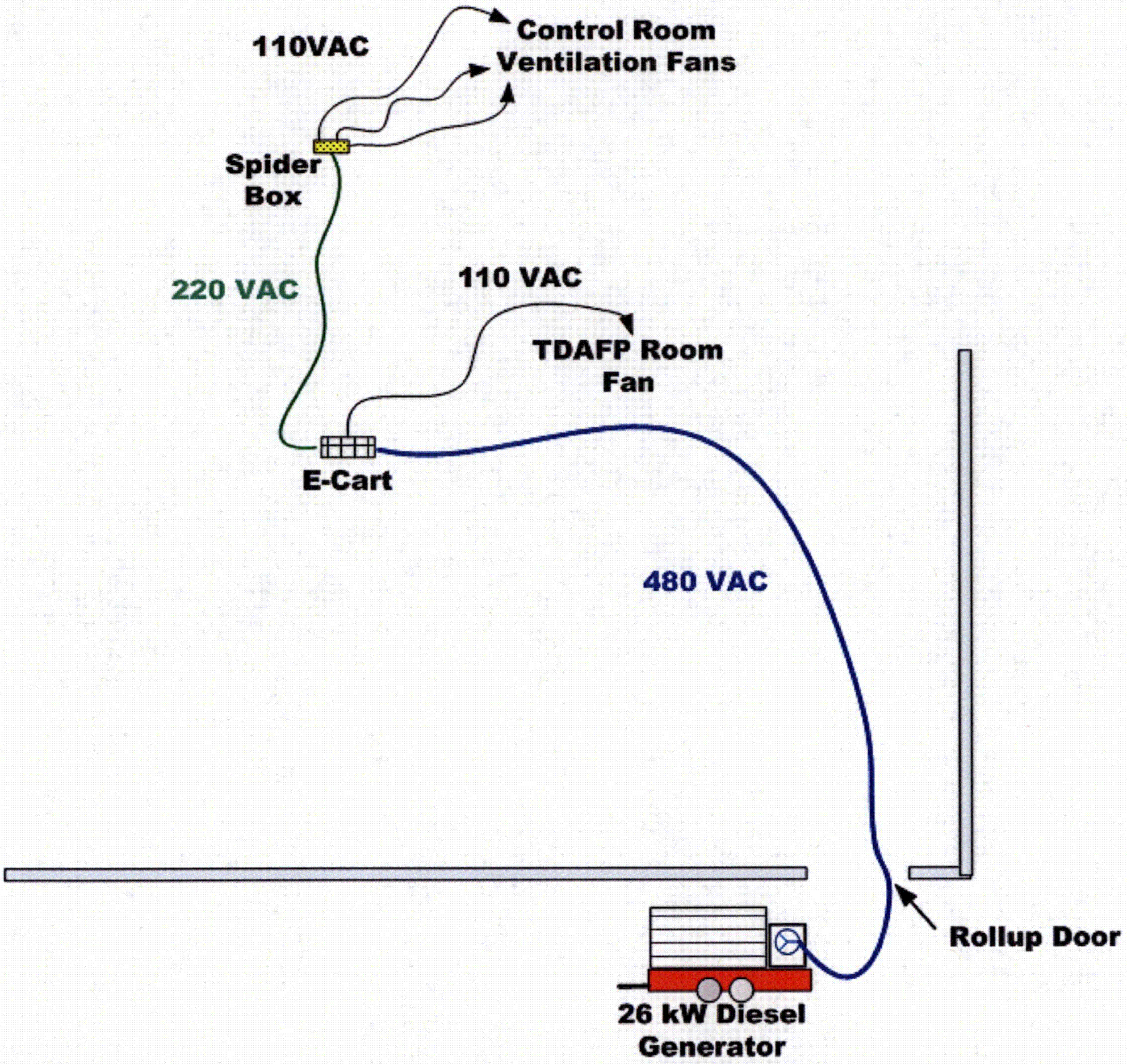
350 kW DG to Buss 11 BMC and MCC 1-ABD-B

FIGURE 13



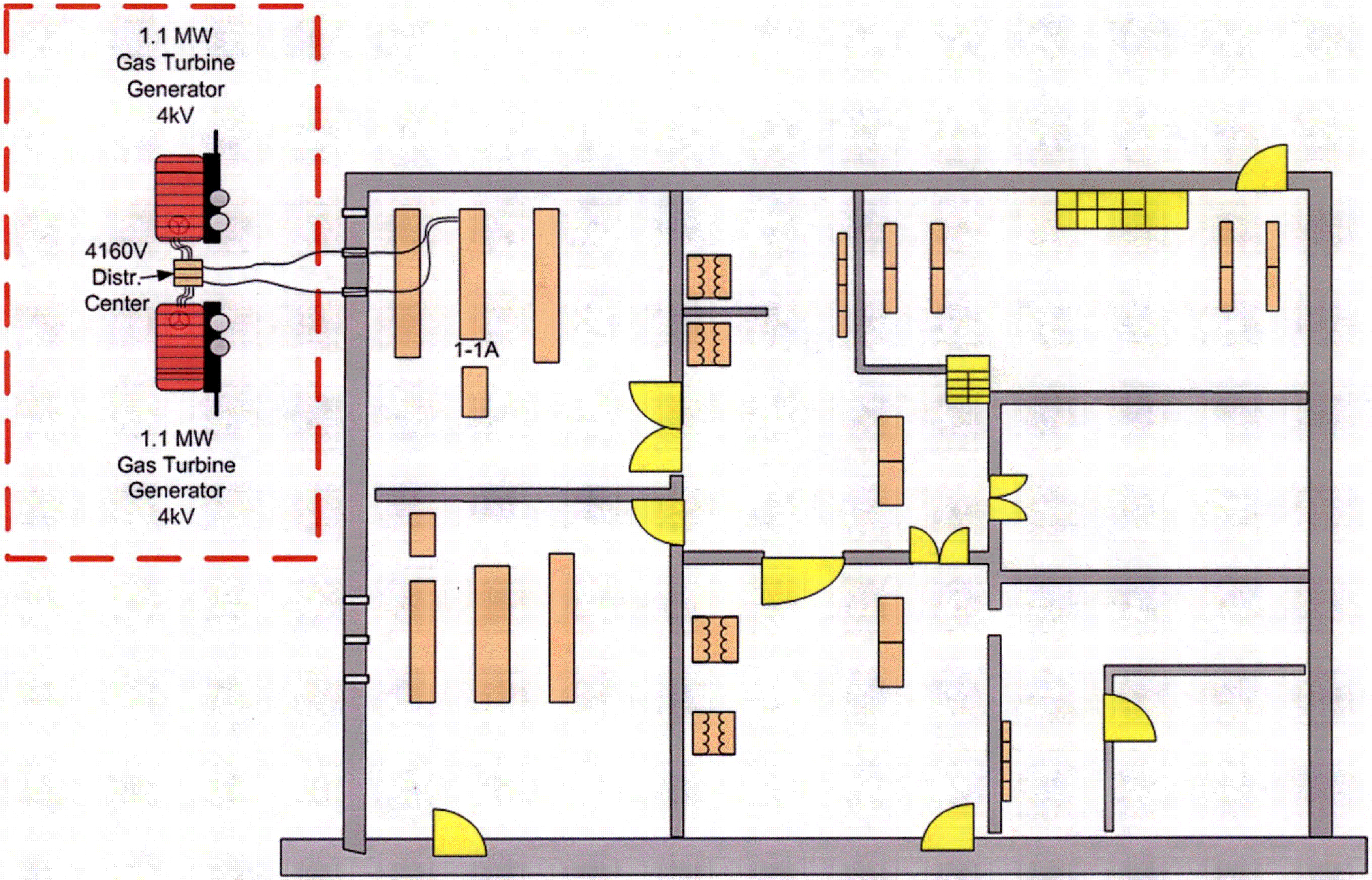
350 kW DG to SI Accumulator Valves

FIGURE 14



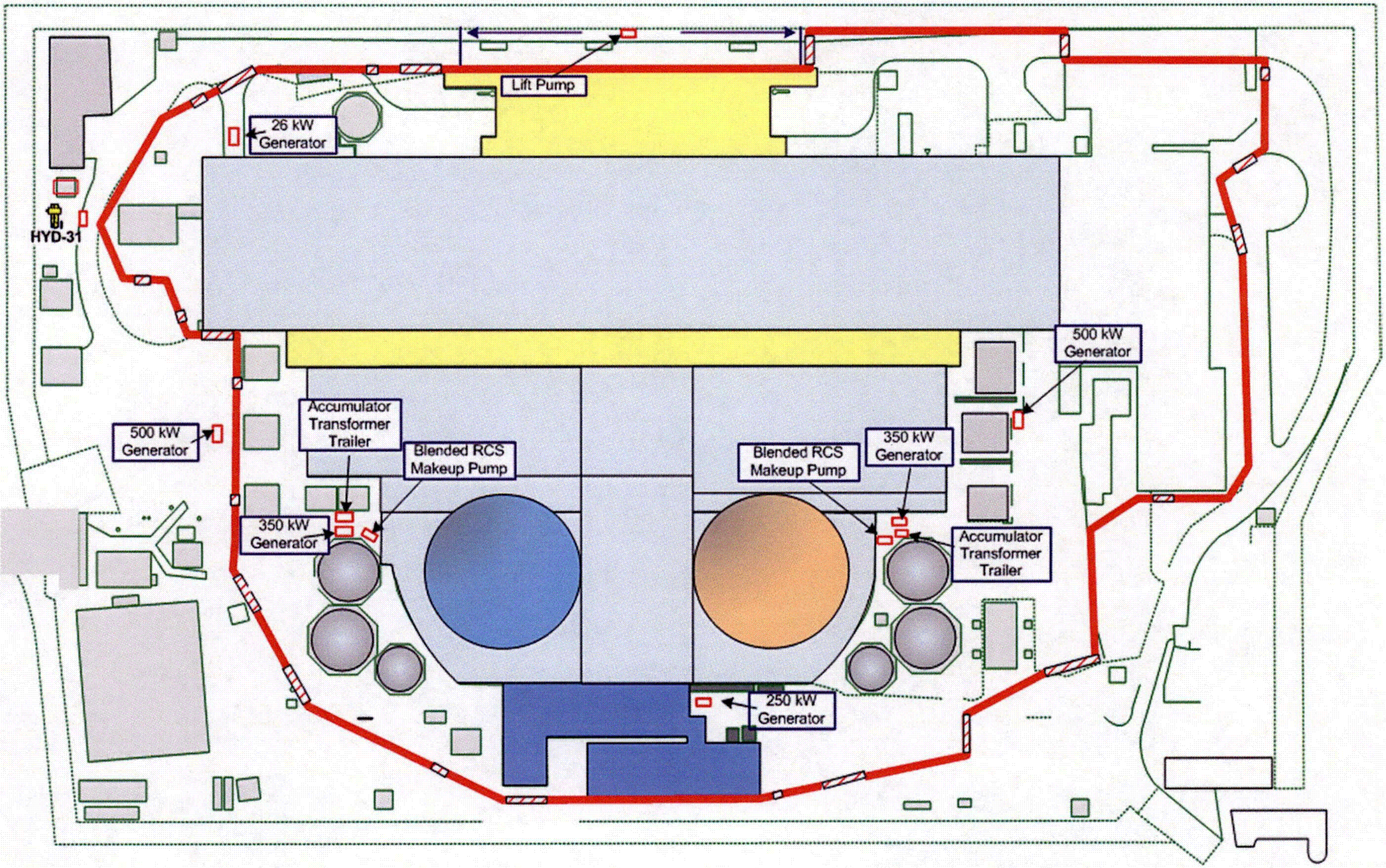
26kW Diesel Generator Layout

FIGURE 15



Phase III Power to Bus 1A

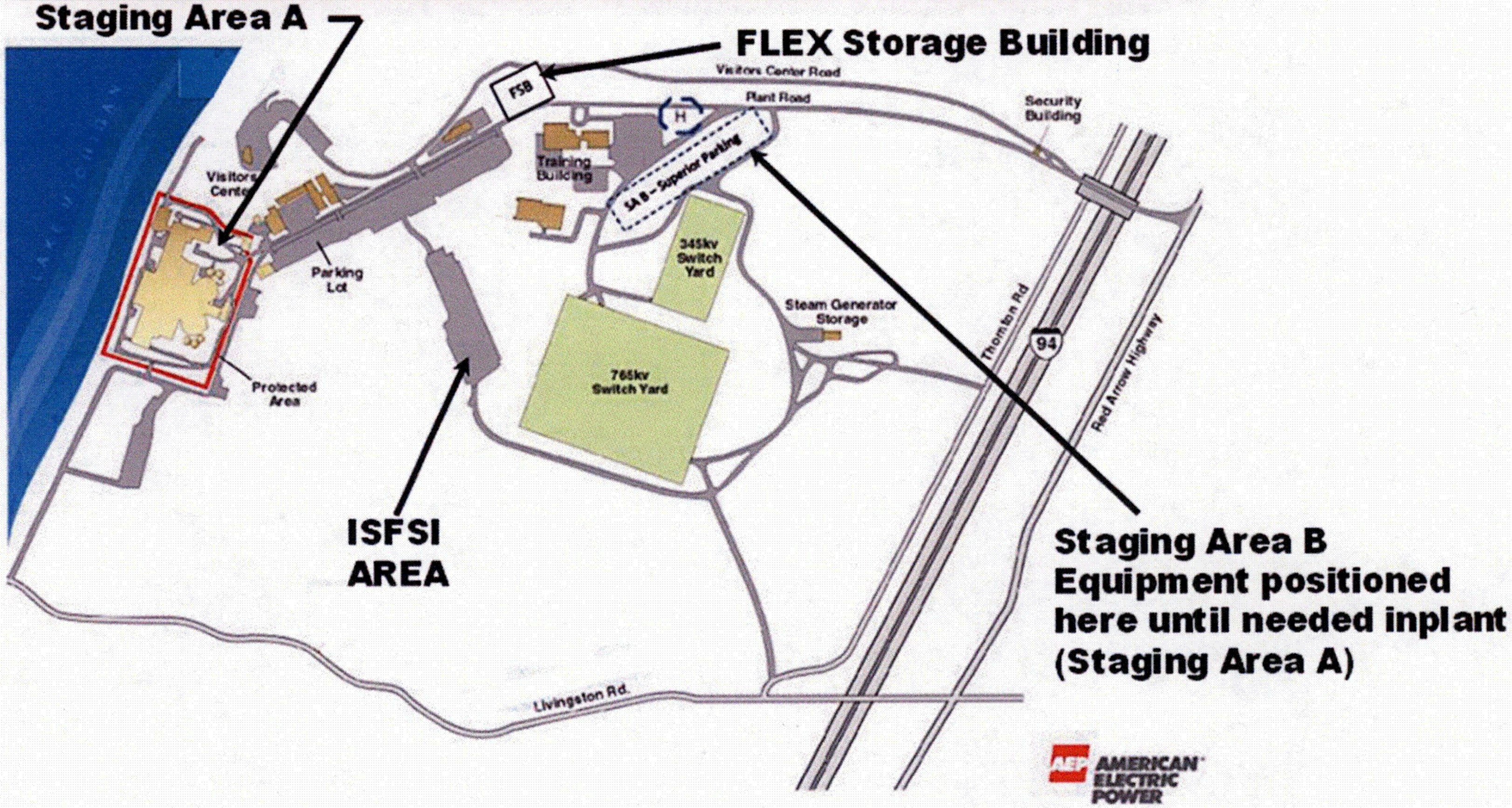
FIGURE 16



FLEX Equipment Deployment Locations

FIGURE 17A

Cook Nuclear Plant – Site Layout



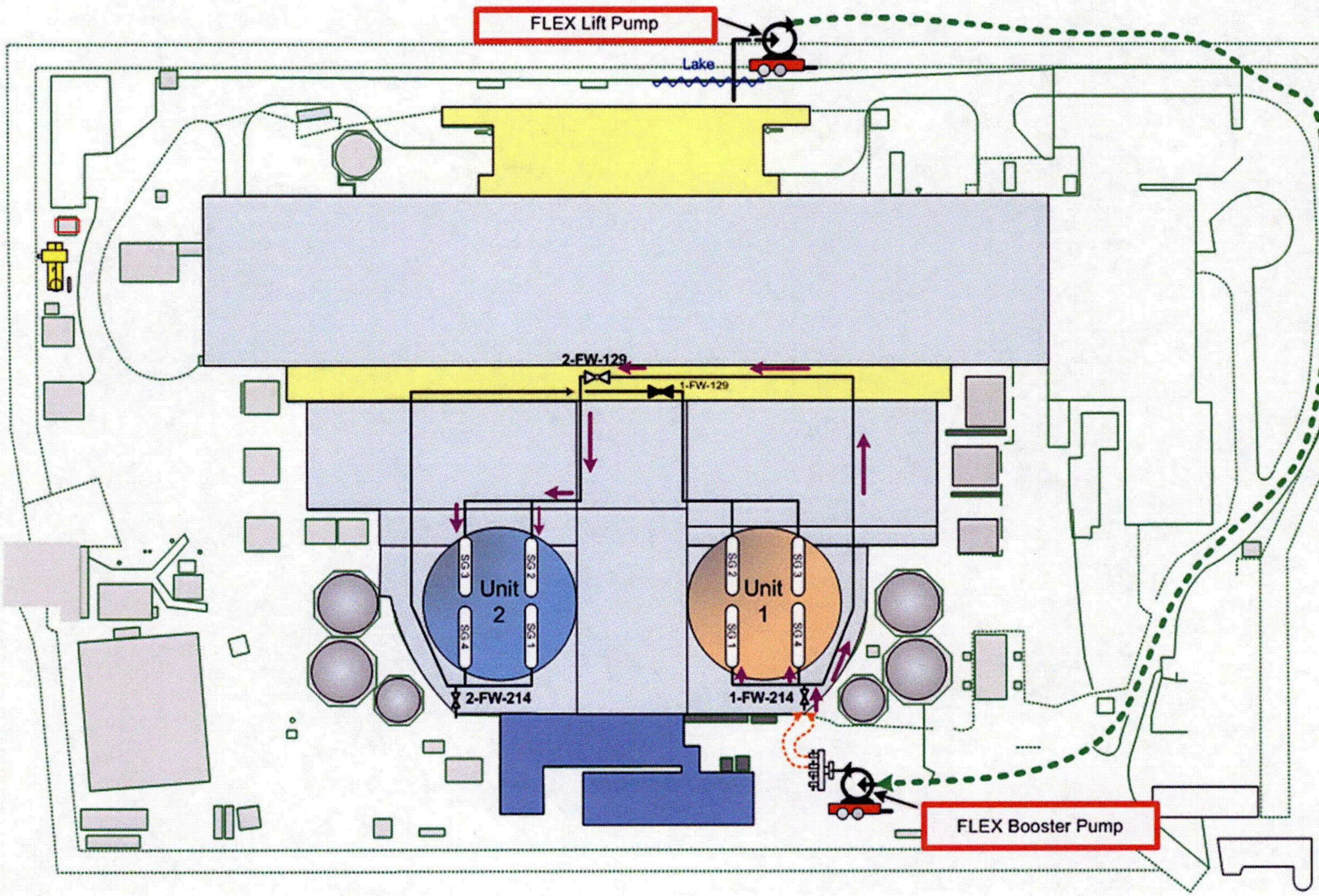
Staging Area A

FLEX Storage Building

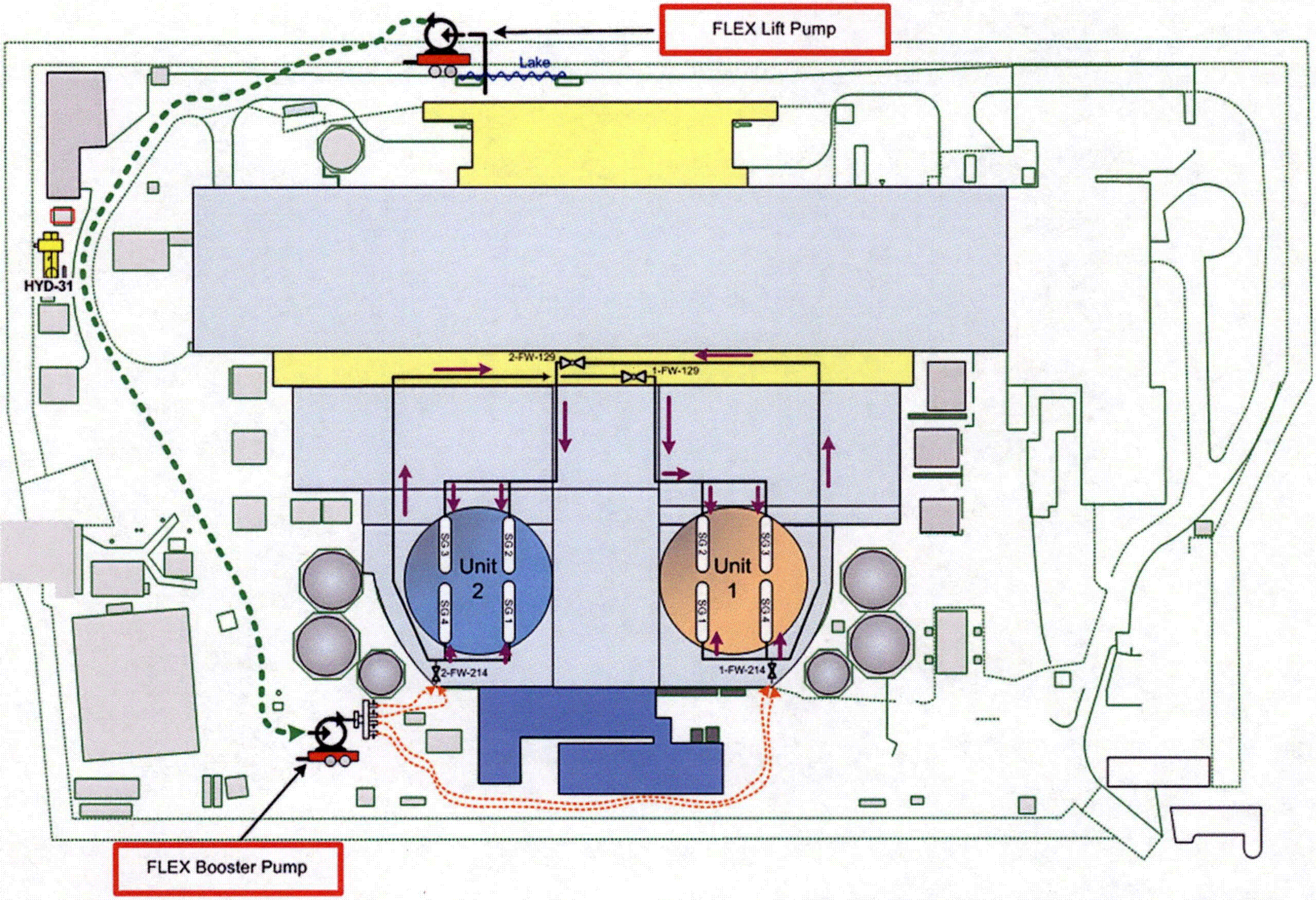
ISFSI AREA

Staging Area B Equipment positioned here until needed inplant (Staging Area A)

FIGURE 17B



**Lake Michigan To Unit 1 and Unit 2
Steam Generators via 1 FW-214
Figure 18A**



Lake Michigan To All Unit 1 and Unit 2 Steam Generators via 1 FW-214 and 2 FW-214
Figure 18B

4. TABLES

Note: Procedure designations in these tables were shortened for conciseness. The shortened designations and the corresponding full designation and title are listed below.

- ECA 0.0 = 1/2-OHP-4023-ECA-0.0, “Loss of All AC Power”
- FSG-2 = 1/2-OHP-4027-FSG-2, “Alternate AFW Suction Source”
- FSG-3 = 1/2-OHP-4027-FSG-3, “Alternate Low Pressure Feedwater”
- FSG-4 = 1/2-OHP-4027-FSG-4, “ELAP Power Management”
- FSG-5 = 1/2-OHP-4027-FSG-5, “FLEX Equipment Staging”
- FSG-8 = 1/2-OHP-4027-FSG-8, “Alternate RCS Boration”
- FSG-201 = 1/2-OHP-4027--FSG-201, “Alternate AFW Suction Source Equipment Deployment”
- FSG-301 = 1/2-OHP-4027-FSG-301, “Alternate Low Pressure Feedwater Equipment Deployment”
- FSG-401 = 1/2-OHP-4027-FSG-401, “ELAP Power Management Deployment”
- FSG-801 = 1/2-OHP-4027-FSG-801, “RCS Boration - Makeup Equipment Deployment”
- FSG-1101 = 12-OHP-4027-FSG-11, “Alternate SFP Makeup and Cooling”

Table 1 – N Strategies, N+1 Strategies, Primary and Alternate Connection Points
(N = Number of units at a site)

Strategy	Primary/ Alternate	FSG Strategy and Procedure	Connection Point(s)	N Equipment	N+1 Equipment	Mode of Applicability
Reactor Core Cooling	Primary	H2.3 FSG-2	ESW cleanout downstream of 1-ESW-115, ESW cleanout downstream of 2-ESW-240	One FLEX Lift Pump	Second FLEX Lift Pump	Modes 1-5
	Alternate	H3.1-2 Or H3.1-4 FSG-3	1- FW-214 or 2-FW-214	One FLEX Lift Pump and One FLEX Booster pump	Second FLEX Lift Pump and Second FLEX Booster Pump	
Electrical Power	Primary	E4.1 FSG-4	Breakers 11D2/21D2	Two 500 kW DGs	See Alternate Strategy	All Modes
	Alternate	E4.2 FSG-4	1/2-CRID-1-CVT 1/2-CRID-2-CVT 1/2-CRID-3-CVT 1/2-CRID-4-CVT	N/A	One 350 kW DG One 480/120V 45 KVA Transformer	
		E4.3 FSG-4	1/2-JB-OTOP Junction Boxes	N/A	One 350 kW DG	

Table 1 – N Strategies, N+1 Strategies, Primary and Alternate Connection Points
(N = Number of units at a site)

Strategy	Primary/ Alternate	FSG Strategy and Procedure	Connection Point(s)	N Equipment	N+1 Equipment	Mode of Applicability
Boric Acid Injection and RCS Makeup	Primary	H 8.1 FSG-8	1/2-CS-314 1/2-CS-645	One 250 kW DG Two FLEX Boric Acid Pumps	Second 250 kW DG Third FLEX Boric Acid Pump	Modes 1-5 with SGs available
	Alternate	H8.2 FSG-8	1/2-SI-118S 1/2-SI-115S 1/2-SI-114 1/2-SI-113 1/2-SI-112S 1/2-SI-112N 1/2-SI-115N 1/2-SI-118N 1-SI-116N 2-SI-116S 1/2-CS-645	Same as Primary	Same as Primary	

Table 1 – N Strategies, N+1 Strategies, Primary and Alternate Connection Points (N = Number of units at a site)

Strategy	Primary/ Alternate	FSG Strategy and Procedure	Connection Point(s)	N Equipment	N+1 Equipment	Mode of Applicability
Accumulator Isolation	Primary	E10.1 FSG-10	1/2-EZC-C-5C 1/2-EZC-B-1C 1/2-EZC-D-1C 1/2-EZC-A-5C	Crediting E4.1 (500kW DG)	See Alternate Strategy	Modes 1-6
	Alternate	E4.4 FSG-4 FSG-14	1/2-EZC-C-5C 1/2-EZC-B-1C 1/2-EZC-D-1C 1/2-EZC-A-5C	N/A	350kW DG 480V to 600V Transformer	
SFP Makeup	Primary	H11.3 FSG-11	Hose Monitor	One Lift Pump	Second Lift Pump	At all times
	Alternate	H11.3 FSG-11	12-CS-290			

Table 1 – N Strategies, N+1 Strategies, Primary and Alternate Connection Points
(N = Number of units at a site)

Strategy	Primary/ Alternate	FSG Strategy and Procedure	Connection Point(s)	N Equipment	N+1 Equipment	Mode of Applicability
RCS Makeup	Primary	H14.5 FSG-14	1/2-SI-176 1/2-CS-314	One Lift Pump One Blended RCS Makeup Pump	Second Lift Pump Second Blended RCS Makeup Pump	Mode 5 with no SG available & Mode 6
	Alternate	H14.6 FSG-14	1/2-SI-1761/2-SI-118S 1/2-SI-115S 1/2-SI-114 1/2-SI-113 1/2-SI-112S 1/2-SI-112N 1/2-SI-115N 1/2-SI-118N 1-SI-116N 2-SI-116S	Same as Primary	Same as Primary	

Table 2 – Credited Equipment From NSRC

Equipment	Qty. per Unit	Supported Function				Description
		Reactor Core Cooling	RCS Boration/ Inventory Control	SFP Cooling	Containment	
Medium Voltage Generators	2	X	-	-	X	Diesel fuelled, turbine driven generator, 4.16 kV, 1 MW each
Medium Voltage Generator Cables	7 Reels	X	-	-	X	Single conductor cables, 4/0 AWG, 350 ft. of cable on each reel.
Medium Voltage Distribution System	1	X	-	-	X	4.16 kV, 1200 Amp.
Low Pressure - High Flow Raw Water Pump	1	X	-	-	-	Diesel driven centrifugal pump, 150 psi, 5000 gpm
Suction hose for Low Pressure - High Flow Raw Water Pump	12 Hose Sections	X	-	-	-	12 sections of 6 in. dia. hose Each section 10 ft. long
Floating Lift Pumps with Hydraulic Driver	2	X	-	-	-	Hydraulically driven floating centrifugal pump, 26 ft. water lift, 5000 gpm., with one diesel powered hydraulic driver for both pumps.

Table 3 - Overall Sequence of Events

		Elapsed Time per Validation	ACTION	LEVEL OF VALIDATION	PROCEDURE
Action Item	**Time Constraint**	0	Event Starts	Not Applicable	
1	None	15 minutes	Declare ELAP	A	ECA-0.0 step 11
2	1 hour	34 minutes	Complete DC bus deep load shedding	A	FSG-4
3	8 hours	48 minutes	Commence RCS Cooldown	B	ECA-0.0 step 20
4	10 hours	1 hour 48 minutes	Complete RCS Cooldown	B	ECA-0.0 step 20
5	None	6 hours	Augmenting personnel arrive	Not Applicable	Not Applicable
6	10 hours	7 hours 20 minutes	Pre-stage SFP makeup equipment	B	FSG-5 and FSG-1101
7	12 hours	7 hours 50 minutes	Ready to establish lake feed to TDAFP from Lift Pump, if necessary	B	FSG-5, FGS-2 and FSG-201
8	12 hours	9 hours 35 minutes	Bus 11D/21D and 11B/21B energized with battery chargers and hydrogen ignitors energized	B	FSG-4 and FSG-401
9	12 hours	10 hours 40 minutes	Ready to establish low pressure feed to all SGs, if necessary	B	FSG-3 and FSG-301

Table 3 - Overall Sequence of Events

10	16 hours	6 hours 11 minutes	Commence RCS boration	B	ECA-0.0, FSG-8 and FSG-801
11	24 hours	10 hours 1 minute	Complete RCS boration	B	FSG-8 and FSG-801

Table 4 - Abbreviations	
AC, ac	Alternating Current
ACI	American Concrete Institute
ADAMS	Agencywide Document Access and Management System
AFW	Auxiliary Feedwater
Amp.	Ampere
AOP	Abnormal Operating Procedure
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
BAST	Boric Acid Storage Tanks
BDB	Beyond Design Basis
BDBEE	Beyond Design Basis External Event
BTU/hr.	British Thermal Units per hour
CCRP	Critical Control Room Power
CCW	Component Cooling Water
cfm	cubic feet per minute
CNP	Cook Nuclear Plant
CRID	Control Room Instrumentation Distribution
CST	Condensate Storage Tank
CW	Circulating Water
CVCS	Chemical and Volume Control System
DBE	Design Basis Earthquake
DC	Direct Current
DG	Diesel Generator
Dia.	Diameter
EDG	Emergency Diesel Generator
EDMG	Extreme Damage Mitigation Guideline
ELAP	Extended loss of alternating current power
EOP	Emergency Operating Procedure
EPRI	Electric Power Research Institute
ERO	Emergency Response Organization
ESW	Essential Service Water
EQ	Environmental Qualification
°F	Degrees Fahrenheit
FIP	Final Integrated Plan
FOST	Fuel Oil Storage Tank
FSG	FLEX Support Guideline
ft.	Feet
gph	Gallons per Hour

Table 4 - Abbreviations	
gpm	Gallons per Minute
HVAC	Heating , Ventilation, and Air-conditioning
I&M	Indiana Michigan Power
IEEE	Institute of Electrical and Electronics Engineers
in.	Inch
ISFSI	Independent Spent Fuel Storage Installation
ISE	Interim Staff Evaluation
kV	KiloVolt
kW	KiloWatt
LOOP	Loss of Off-Site Power
LUHS	Loss of Ultimate Heat Sink
MC	Moisture Content
MCC	Motor Control Center
MDAFW	Motor Driven Auxiliary Feedwater
MOVs	Motor Operated Valves
MW	Megawatt
NEI	Nuclear Energy Institute
NESW	Non-Essential Service Water
NGVD	National Geodetic Vertical Datum
NPSH	Net Positive Suction Head
NRC	U. S. Nuclear Regulatory Commission
NSRC	National SAFER Response Center
NSSS	Nuclear Steam Supply System
OBE	Operating Basis Earthquake
OIP	Overall Integrated Plan
PA	Protected Area
PEICo	Pooled Equipment Inventory Corporation
PIM	Pooled Inventory Management
PMI	Plant Manager Instruction
PMP	Plant Manager Procedure
PORV	Power Operated Relief Valve
pph	Pounds per hour
Ppm	Parts per million
PRPs	PIM Rules and Procedures
PRT	Pressurizer Relief Tank
psia	pounds per square inch - absolute
psig	pounds per square inch - gage
PWROG	Pressurized Water Reactor Owners Group

Table 4 - Abbreviations	
Qty	Quantity
RAI	Request for Additional Information
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RHR	Residual Heat Removal
RPV	Reactor Pressure Vessel
RV	Reactor Vessel
RVLIS	Reactor Vessel Level Indication System
RWST	Refueling Water Storage Tank
SAFER	Strategic Alliance for FLEX Emergency Response
SAMG	Severe Accident Management Guideline
SBO	Station Blackout
SFP	Spent Fuel Pool
SGs	Steam Generators
SIS	Safety Injection System
SOE	Sequence of Events
SRVs	Safety Relief Valves
SSC	System, structure, and component
TDAFW	Turbine Driven Auxiliary Feedwater
TDAFP	Turbine Driven Auxiliary Feedwater Pump
TRM	Technical Requirements Manual
TS	Technical Specification
UFSAR	Updated Final Safety Analysis Report
UHS	Ultimate Heat Sink
V	Volts
VAC	Volts Alternate Current
VDC	Volts Direct Current
%	Percent
>	Greater Than
<	Less Than
≥	Greater Than or Equal To
≤	Less Than or Equal To