ATTACHMENT 5

FINAL INTEGRATED PLAN

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Entergy

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FINAL INTEGRATED PLAN

Palisades Nuclear Plant

December 2015

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1. Background

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

The US Nuclear Regulatory Commission (NRC) assembled a Near-Term Task Force (NTTF) to advise the Commission on actions the US nuclear industry should take to preclude core damage and a release of radioactive material after a natural disaster such as that seen at Fukushima. The NTTF report (Reference 3.1.1) contained many recommendations to fulfill this charter, including assessing extreme external event hazards and strengthening station capabilities for responding to beyond-design-basis external events.

Based on NTTF Recommendation 4.2, the NRC issued Order EA-12-049 (Reference 3.1.2) on March 12, 2012 to implement mitigation strategies for Beyond-Design-Basis (BDB) External Events (BDBEEs). The order provided the following requirements for strategies to mitigate BDBEEs:

1. Licensees shall develop, implement, and maintain guidance and strategies to maintain or restore core cooling, Containment, and Spent Fuel Pool (SFP) cooling capabilities following a beyond-design-basis external event.

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

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

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

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

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

- Phase 1 - The initial phase requires the use of installed equipment and resources to maintain or restore core cooling, Containment and Spent Fuel Pool (SFP) cooling capabilities.

- Phase 2 - The transition phase requires providing sufficient, portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from off site.

- Phase 3 - The final phase requires obtaining sufficient off-site resources to sustain those functions indefinitely.

NRC Order EA-12-049 (Reference 3.1.2) required licensees of operating reactors to submit an overall integrated plan, including a description of how compliance with these requirements would be achieved by February 28, 2013. The Order also required licensees to complete implementation of the requirements no later than two refueling cycles after submittal of the overall integrated plan or December 31, 2016, whichever comes first.

The Nuclear Energy Institute (NEI) developed NEI 12-06 (Reference 3.1.3), which provides guidelines for nuclear stations to assess extreme external event hazards and implement the mitigation strategies specified in NRC Order EA-12-049. The NRC issued Interim Staff Guidance JLD-ISG-2012-01 (Reference 3.1.4), dated August 29, 2012, which endorsed NEI 12-06 with clarifications on determining baseline coping capability and equipment quality.

NRC Order EA-12-051 (Reference 3.1.5) required licensees to install reliable SFP instrumentation with specific design features for monitoring SFP water level. This order was prompted by NTTF Recommendation 7.1 (Reference 3.1.1).

NEI 12-02 (Reference 3.1.6) provided guidance for compliance with Order EA-12-051. The NRC determined that, with the exceptions and clarifications provided in JLD-ISG-2012-03 (Reference 3.1.7), conformance with the guidance in NEI 12-02 is an acceptable method for satisfying the requirements in Order EA-12-051.

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

2.1 General Elements

2.1.1 Assumptions

The assumptions used for the evaluations of Palisades ELAP/Loss of normal access to the Ultimate Heat Sink (LUHS) event and the development of FLEX strategies are stated below. Note: Assumptions are consistent with those detailed in NEI 12-06, Section 3.2.1, and the Executive Summary of the PWROG Core Cooling Position Paper, LTR-PCSA-12-78:

- 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.
- 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.
- No specific initiating event is used. The initial condition is assumed to be a Loss of Off-site Power (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.
- All installed sources of emergency on-site AC power and Station Blackout (SBO) Alternate AC power sources are assumed to be not available and not imminently recoverable.
- 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.
- Normal access to the ultimate heat sink 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.

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

- Permanent plant equipment that is contained in structures with designs that are robust with respect to seismic events, floods, and high winds, and associated missiles, are available.

- Other equipment, such as portable AC power sources, portable back up DC power supplies, spare batteries, and equipment for 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 (Reference 3.1.3) and has predetermined hookup strategies with appropriate procedures/guidance and the equipment is stored in a relative close vicinity of the site.

- Installed electrical distribution system, including inverters and Battery Chargers, remain available provided they are protected consistent with current station design.

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

- 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.

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

- The main steam system valves (such as main steam isolation valves, turbine stops, atmospheric dumps, etc.), necessary to maintain decay heat removal functions operate as designed.

    - The Safety Relief Valves (SRVs) or Power Operated Relief Valves (PORVs) initially operate in a normal manner if conditions in the primary coolant system (PCS) so require. Normal valve reseating is also assumed.

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

- Sources of expected Pressurized Water Reactor (PWR) reactor coolant inventory loss include; (1) normal system leakage, (2) losses from letdown unless automatically isolated or until isolation is procedurally directed, and (3) losses due to primary coolant pump seal leakage.

- The initial SFP conditions are; (1) all boundaries of the SFP are intact, including the liner, gates, transfer canals, etc., (2) although sloshing may occur during a seismic event, the initial loss of SFP inventory does not preclude access to the refueling deck around the pool, (3) SFP cooling system is intact, including attached piping, and (4) SFP heat load assumes the maximum design basis heat load.

- It is assumed that the Containment isolation actions delineated in current station blackout coping capabilities are sufficient.

- The installed (design) AC independent Auxiliary Feedwater (AFW)/EFW system will function for the mission time required to stage the portable pump following initiation of the ELAP event.

- The portable Steam Generator (SG) feed system is capable of maintaining SG level at the PCS pressure required to prevent nitrogen injection from the Nuclear Steam Supply System (NSSS) applicable passive injection system - CLA, SIT, or CFT.

- The portable SG feed system is capable of maintaining SG level at the PCS temperature required to maintain the reactor subcritical prior to PCS boration.

- The steam relief capability will support the PCS cooldown rate as defined in the NSSS generic ELAP analysis.

- The steam relief capability will maintain the final PCS temperature defined in the NSSS generic ELAP analysis.

<u>Palisades Site Specific Assumptions</u>

- Flood and seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter dated March 12, 2012 (Reference 3.1.9) are not completed and therefore not assumed in this submittal. As the re-evaluations are completed, appropriate issues will be entered into the corrective action system and addressed on a schedule commensurate with other licensing bases changes.

- Staffing augmentation is determined consistent with the guidance provided in NEI 12-01. Specifically,

  a) No site access for six (6) hours following the event.

  b) Limited site access between 6 and 24 hours following the event. Individuals may access the site by walking, personal vehicle or via alternate transportation capabilities (e.g., private resource providers or public sector support).

  c) Improved site access beginning at 24 hours. 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.

- The result of the beyond-design-basis event may place the plant in a condition where it cannot comply with certain Technical Specifications and/or with its Security Plan, and, as such, may warrant invocation of 10 CFR 50.54(x) and/or 10 CFR 73.55(p).

2.2 Strategies

The objective of the FLEX strategies is to establish an indefinite coping capability in order to 1) prevent damage to the fuel in the reactors, 2) maintain Containment integrity and 3) maintain cooling and prevent damage to fuel stored in the Spent Fuel Pool (SFP) using installed equipment, on-site portable equipment, and pre-staged off-site resources as required. This indefinite coping capability will address an extended loss of all AC power (ELAP) and loss of normal access to the Ultimate Heat Sink (LUHS). The loss of AC power includes: loss of off-site power, loss of on-site emergency diesel generators, and loss of any alternate AC sources (as defined in 10 CFR 50.2) but not the loss of preferred AC power to DC buses fed by station batteries through inverters. The loss of Ultimate Heat Sink does not include loss of inventory stored within the boundaries of system piping and structures that is qualified for all applicable external events but does include the loss of the motive force to move the water. This condition could arise following external events that are within the existing design basis with additional failures and conditions that could arise from a beyond-design-basis external event.

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

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

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

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

The strategies described below are capable of mitigating an ELAP/LUHS resulting from a BDBEE by providing adequate capability to maintain or restore core cooling, maintain Containment integrity, and restore and maintain SFP cooling.

2.3 Reactor Core Cooling and Heat Removal Strategy and Primary Coolant System Inventory Control (Modes 1-4)

2.3.1 Phase 1 Strategy

Maintain Core Cooling and Heat Removal

At the beginning of the event, automatic protective actions occur such as insertion of all control rods, turbine trip, automatic start and injection of makeup to the Steam Generators (SGs) with the Turbine Driven Auxiliary Feedwater Pump (TDAFW), etc. MSIV closure is performed as directed by EOP-1.0 (Reference 3.1.52). Operators will enter Station Blackout procedure EOP-3.0 (Reference 3.1.10), which references the FSGs.

Within 20 minutes of the initiation of the event, Primary Coolant Pump (PCP) seal controlled bleedoff (CBO) is isolated to minimize seal leakage as directed by EOP-3.0.

Within 57 minutes, an ELAP is declared. This declaration will require actions from the FSGs necessary to mitigate a long term loss of power. Some of the actions may place the plant and plant systems, structures and components (SSCs) outside of the current licensing basis. The National SAFER Response Center (NSRC) is notified as time permits to request delivery of off-site equipment.

Within 60 minutes, operators conduct a damage assessment of the Primary System Makeup Storage Tank (T-81), and then cross-connect T-81 with the Condensate Storage Tank (CST) in accordance with procedure EOP-3.0 by opening valves CV-2008 and CV-2010. With a PCS cool down two hours into the event, the CST alone only provides 4 hours of inventory for the TDAFW Pump. The tanks must be cross-connected so that the T-81 inventory can be gravity drained into the CST prior to depleting the CST inventory. The combined inventory of the CST and T-81 will provide a minimum of 8 hours of inventory for makeup to TDAFW.

Once an ELAP has been declared at approximately 1 hour into the event, operators are directed to take steps to further minimize the load on the station batteries by shedding unnecessary loads. Load shedding is completed by 2 hours following event initiation to conserve station battery life. With completion of the load shedding by two hours, the station batteries will be available for a minimum of 8 hours without the Battery Chargers in service.

By 2 hours into the event, the Control Room operators open the Atmospheric Dump Valves (ADVs) to commence an early rapid PCS cooldown. The action to perform an early rapid cooldown, reduces pressure acting on the PCP seals to minimize seal leakage and prolong seal life, allows for passive injection of borated water from the Safety Injection Tanks (SITs) and places the PCS and secondary system in a low pressure state allowing for future injection of water from low pressure sources. The initial means of core cooling and heat removal will be achieved with the use of the TDAFW Pump to provide makeup to the SGs for heat removal and ADVs for pressure letdown of the SGs. The plant will cool down at a rate equal or greater to 75°F/hour to a target temperature of no less than 355°F in the PCS (T_{cold}). SG pressure will be approximately 190 psig at the cooldown terminal temperature. Steam pressure to the TDAFW Pump K-8 driver is controlled by throttling steam supply valve CV-0522B. CV-0522B is an air-operated valve backed by a nitrogen supply station. This valve can also be controlled manually. Guidance for manual operation of CV-0522B is currently provided in EOP Supplement 19 (Reference 3.1.53).

By original design, the ADVs are air operated valves backed by bulk nitrogen. Since the air system will be lost during an ELAP and the bulk nitrogen system is not qualified for all applicable external events, a new backup nitrogen station has been installed (Nitrogen Station 9). The new nitrogen station will provide operational capability up to 9.1 hours from the start of the event. Operation of the ADVs will require opening of the nitrogen bottle isolation valves and cross tie valve MV-CA10619 to tie in the new backup nitrogen station 9. Backup Nitrogen Station 9 is located in close proximity to the Main Control Room.

Maintain PCS Inventory Control

Control of PCS inventory during Phase 1 is maintained by commencing a plant cooldown (at the two hour point) at a rate of 75°F/hour to depressurize the PCS, allowing injection of borated inventory from the Safety Injection Tanks (SITs) and also removing driving head on the PCS pumps seals to reduce leakage. Per Reference 3.1.28, this strategy will ensure single phase natural circulation is maintained and demonstrates that additional PCS makeup (other than from the SITs) is not required during Phase 1.

The Palisades ELAP analysis indicates single phase natural circulation flow is maintained without additional makeup for at least 10 hours into the event. The analysis indicates that a pump capable of producing a flowrate of 30 gpm will maintain single phase natural circulation with flow beginning at 8 hours into the event.

Additionally, the Palisades ELAP analysis (Reference 3.1.28) concluded that the core maintains sufficient Shutdown Margin (SDM) up to 13 hours following the event without additional boration (beyond SIT injection). The transition to the Phase 2 strategy is commenced at 8 hours into the event at which time Palisades will have a Charging Pump re-energized for PCS injection. This ensures sufficient time for complete mixing of injected borated water throughout the PCS.

2.3.2 Phase 2 Strategy

Maintain Core Cooling and Heat Removal

At approximately four (4) hours into the event, the operators will begin deployment of the portable diesel driven FLEX pump to the Lake Michigan access area (adjacent to the Service Water Intake Structure) in preparation for its use to provide SG makeup. Flexible hose will be dropped through removable grating (at locations currently utilized for B.5.b pump suction) into the Intake Canal to provide access to the pump suction source, Lake Michigan. Once the pump is staged, hoses will be routed to connections on the Main Feedwater (MFW) system piping or the Auxiliary Feedwater (AFW) system piping prior to using the entire inventory in the CST and T-81.

Depletion of the available combined inventory of the CST and T-81 tanks occurs approximately 8 hours after the start of the event. The Phase 2 strategy will continue to use the installed Steam Generators, supplemented by on-site portable FLEX equipment. A portable, diesel-driven FLEX pump will be placed in service by eight (8) hours into the event to provide the needed makeup to the SGs to maintain core cooling and heat removal. The diesel driven portable FLEX pump will provide a minimum SG makeup capacity of 136.5 gpm at a Steam Generator pressure of 200 psi.

Diverse injection connection points are provided for makeup to the Steam Generators. The primary connection point for Steam Generator by the portable diesel driven FLEX pump is on the Main Feedwater system piping in the Turbine Building. A new connection is installed between valves MV-FW907 and MV-FW909 on Feedwater Heater E-6B. Flexible hoses will be routed from the discharge of the FLEX

Pump to a hose distribution manifold and then to the MFW system piping hose connection. The alternate connection point for SG makeup by the portable diesel driven FLEX pump is on the AFW system piping inside the West Safeguards Room of the Auxiliary Building. A new connection is installed on the discharge piping of AFW Pump P-8C. This alternate strategy will use the same FLEX pump deployed west of the Intake Structure with suction from the Intake Canal (Lake Michigan). Flexible hose will be routed from the discharge of the FLEX pump to a hose distribution manifold and then to the AFW system piping hose connection.

Only one portable diesel driven FLEX pump will be required to meet the needs of the entire Palisades FLEX strategy to maintain key safety functions of reactor core cooling, Spent Fuel Pool cooling, and also provide batch water makeup to borated water batching tank T-77. This pump is sized to meet the needs of the Palisades FLEX strategy. There is more than sufficient hose available in either of the FLEX storage buildings to go around the turbine building to connect the FLEX pump and the AFW core cooling connection, and also to support the hose routings for all three SFP cooling strategies. The planned strategy remains to route the hoses through the turbine building, but there is sufficient hose to support the alternate routings, for defense-in-depth.

By 2 hours into the event, operators will begin deployment of the 400 kW FLEX portable diesel generator to restore power to load control center 19 (LCC-19) or 20 (LCC-20) and other strategy loads. The actions for deployment, staging, and connection of the portable FLEX diesel generator will be completed by 8 hours into the event. This action is completed by 8 hours to prevent station battery (ED-01 and ED-02) depletion. Once LCC-19 (primary connection point) or LCC-20 (alternate connection point) is being supplied power from the portable diesel driven 400 kW FLEX generator, motor control centers MCC-1 or MCC-2 can be energized, which allows 2 of 4 Battery Chargers to be placed in service to recharge the station batteries using the normal Class 1E breakers.

Repowering the station Battery Chargers allows the station batteries to continue supplying power to 1) critical instruments used to monitor key reactor core cooling parameters and 2) controls used for TDAFW flow control to maintain reactor core cooling. Additionally, the portable diesel driven FLEX generator will provide power to the electric driven portable ventilation fan to remove hydrogen from the Battery Rooms, and provide the source of power to the portable electric driven air compressor which will supply air to the ADVs in support of Steam Generator pressure control and PCS temperature control. The batteries will last for at least 8 hours, at which point Phase 2 begins. Once the Battery Chargers are placed in service, a portable electric driven FLEX ventilation fan will be placed in service for the associated Battery Room to maintain hydrogen well below explosive limits. The portable electric driven FLEX ventilation/exhaust fan must be placed in service in the Battery Room by 1.5 hours after battery charging begins, or 9.5 hours after event start. The fan is a lightweight (< 30 lbs.), portable exhauster/blower specifically designed for confined space and hazardous location ventilation and is stationed immediately adjacent and outside of the Battery Room. The exhauster, which is powered from a 120V AC receptacle on the portable diesel driven FLEX generator, has a minimum capacity of 150 scfm. Flexible duct will be routed from the portable exhaust fan in the Cable Spreading Room outside of the Turbine Building such that the hydrogen can be exhausted to the atmosphere, preventing hydrogen accumulation in other areas of the plant.

A portable electric driven air compressor is used to maintain operation of the ADVs after depletion of the backup nitrogen supply bottles. The portable electric driven FLEX air compressor will be utilized to supply air to the valves. This portable electric driven FLEX air compressor will be deployed from the FLEX storage facility. This air compressor is powered from the FLEX generator and provides air to a connection point on the supply piping from new backup Nitrogen Station 9. The deployment of the FLEX air compressor must be completed prior to depletion of Nitrogen Station 9, approximately 9.1 hours after the event occurs. By six (6) hours into the event, the site will commence deployment of the electric driven FLEX air compressor. The compressor will be aligned to the ADVs at hour 8 after placing the diesel driven FLEX generator in service and prior to depletion of Nitrogen Station 9.

The FLEX generator can also be used to power other miscellaneous loads from its low-voltage receptacles, as required. These may include:

- Portable lighting towers
- Portable exhaust fans
- Cooling ventilation

Maintain PCS Inventory Control

The transition to Phase 2 strategies is driven by the need to maintain effective PCS natural circulation heat transfer and to borate the PCS to provide continued subcritical margin as the plant cools and xenon decays. In Modes 1-4, it has been determined that PCS makeup will conservatively be started by 8 hours and boration will be required by 13 hours after the event starts. This requirement ensures continued single phase natural circulation which ensures effective heat transfer.

In order to provide makeup to the PCS, Palisades will utilize one of its two installed positive displacement Charging Pumps. The strategy of repowering installed equipment is allowed per Table D-1 of NEI 12-06 (Reference 3.1.3). However, this conflicts with the guidance provided in NEI 12-06 Section 3.2.2(13). Therefore, the utilization of the installed Charging Pumps is considered an alternate approach to meet the guidance of NEI 12-06. Though this is considered an alternate approach to the guidance of NEI 12-06, this strategy meets the diversity requirements because each pump is powered from a separate load center, and each pump has a primary and alternate strategy for receiving power from the FLEX generator. Diverse injection from the Charging Pump discharge piping is provided through either PCS loop injection piping or through High Pressure Safety Injection (HPSI) Train 2 piping. The selected pump will be powered from the portable Phase 2 FLEX generator through either LCC-11 or LCC-12. LCC-11 and LCC-12 can be cross-connected so that either Charging Pump can be powered by either connection point. Using the portable diesel driven FLEX generator as discussed provides power to either Charging Pump P-55B or P-55C.

The borated water source for the Charging Pumps is the Concentrated Boric Acid Storage Tanks (BASTs), T-53A and T-53B, which contain greater than 9,000 gallons (4,500 gallons each) of highly concentrated boric acid solution (greater than 10,000 ppm boron). The site-specific ELAP analysis assumed a minimum boron concentration 1720 ppm boric acid. This minimum concentration assumption resulted in requiring 7 hours of boration at a rate of 30 gpm once boron injection is started. Since the boric acid concentration of the actual injection source (T-53A and T-53B) for PCS makeup is maintained far in excess of 1720 ppm, the actual injection time required is much less than 7 hours. In addition, the constant capacity Charging Pumps provide a flowrate of 40 gpm which is greater than the 30 gpm assumed by the Palisades ELAP analysis. For an injection source of 10,000 ppm boric acid, the duration of PCS makeup assuming a charging rate of 30 gpm is approximately 1.2 hours to maintain the core indefinitely sub-critical during an ELAP (for PCS temperatures of 355°F after Xe concentration has decayed away).

Due to the elevated boron concentration of the BASTs, the volume required to maintain the core indefinitely sub-critical (2167 gallons) can be accommodated in the PCS without letdown based on the nominal steam volume in the pressurizer of 700 ft^3.

After the injection of 2167 gallons from T-53A and/or T-53B, the core will remain sub-critical indefinitely at 355°F. Therefore, the remaining inventory of borated water in T-53A and T-53B (minimum of 6833 gallons) can be used for PCS inventory control to account for any system leakage. Since the PCS will be at reduced temperature and pressure when the Charging Pumps are placed in service, and PCP seal CBO lines have been isolated, PCP seal leakage will be minimal. The remaining inventory in T-53A and T-53B will be sufficient to maintain PCS inventory control for greater than 24 hours into the event.

Prior to depletion of T-53A and T-53B, boric acid batching operations will begin using the installed Boric Acid Batching Tank (T-77). Water for boric acid batching is from the portable diesel driven FLEX pump. Hose will be routed from the FLEX pump distribution manifold to T-77. With a usable volume of 457.4 gallons (Palisades Final Safety Analysis Report (FSAR) Table 9-18), one batching tank volume every 90 minutes will meet the necessary inventory to account for a system leakage. The required minimum boric acid batch concentration is 1720 ppm. In addition to the turbulent mixing from the injection of lake water to the tank, a paddle will be used to manually mix the boric acid to a concentration greater than 1720 ppm. The mixing water added to T-77 from Lake Michigan could be as low as 32°F. At this temperature, the solubility of boric acid is 2.61 weight percent or 4565 ppm (CRC

Handbook). The boric acid concentration must be below 4565 ppm to ensure the boric acid stays in solution when mixed with cold water, i.e. the concentration of boric acid should be >1720 ppm and <4565 ppm. After completion of mixing, boric acid is gravity drained from Tank T-77 to BASTs T-53A/B.

Due to the high concentration of boric acid in the BASTs, tanks T-53A and T-53B are provided with heaters, and the piping is installed with insulation and heat tracing to prevent precipitation of boric acid due to low temperature. However, the heaters and heat tracing have not been qualified for the seismic event and are assumed to be unavailable. From calculation EA-FP-JSE-1 (Reference 3.1.45), precipitation of boric acid will not occur in T-53A and T-53B until 330 hours after loss of heating. In the insulated CVCS piping, where the highly concentrated boric acid is present, the calculation conservatively determined that precipitation of boric acid will not begin to occur until 7.7 hours after the event. While the operation of the Charging Pumps will not occur until eight hours after the event, the short amount of time (0.3 hours or 18 minutes) when precipitation may occur will not result in significant precipitation such that the charging lines could become plugged, restricting PCS makeup. The calculation also determined that to prevent precipitation in the uninsulated lines downstream of the Charging Pumps, the pumps must be operated for one minute and 45 seconds every 19 minutes. This flow required to prevent precipitation of boric acid in the lines is bounded by the makeup rate to account for system leakage such that the inventory in T-53A and T-53B is not negatively impacted.

2.3.3 Phase 3 Strategy

Maintain Core Cooling and Heat Removal

Steam Generators Available (Modes 1-4)

Palisades will continue with the strategies from Phase 2, refilling the SGs with the portable diesel driven FLEX pump through either the MFW (primary) or AFW (alternate) connections, and removing heat using the ADVs.

At 72 hours after event occurrence, off-site equipment from the National SAFER Response Center (NSRC) is deployed, staged and available to support the Palisades strategy. The NSRC will provide a complete set of FLEX replacement equipment for Palisades existing Phase 2 equipment as well as additional equipment to process water, produce borated water, and assist in long term plant recovery (service water pumps, large generators for energizing complete Class 1E switchgear, Control Room Ventilation Fans, etc.).

The NSRC will provide a large, low pressure/high flow FLEX pump sized for a 5,000 gpm flow rate at a discharge pressure of 150 psig. Additionally, the NSRC will provide a booster pump rated at 5,000 gpm and 26 feet of discharge head to provide the suction lift from Lake Michigan required by the NSRC low pressure/high flow pump. A deployable hose connection header is provided by Palisades to allow the temporary connection of hoses from the NSRC supplied low pressure/high flow pump to the Service Water System (SWS). The header is sized for this flow by having six 5" Storz hose connection points and a 16" flanged connection to allow tie-in to the inlet flange of service water pump strainer F-2C. With flow returned to the Service Water System piping via the NSRC low pressure/high flow pump, the Ultimate Heat Sink function is restored and the installed Shutdown Cooling heat exchangers can eventually be used for reactor core cooling and heat removal during the plant recovery phase.

Prior to this recovery action during Phase 3, the SITs must be isolated from the PCS to preclude nitrogen injection when the PCS pressure falls below 143.6 psia (Reference 3.1.28). The portable diesel driven FLEX generator, its NSRC backup, or the NSRC tandem 4160 VAC generators are all capable of supplying power to the Class 1E switchgear through diverse connections. The SIT isolation valves can be successfully closed by powering up their associated MCCs utilizing cross tie capabilities between LCC 11 and 12.

During Phase 3 the NSRC will provide two FLEX 4160 VAC generators with a combined capacity of 2 MW, including a distribution panel, to connect them to a plant supplied FLEX 4160/2400 VAC transformer. This provides the ability to supply power to one complete train of Class 1E equipment that can be used to bring the plant to cold shutdown and restore other auxiliaries such as Containment Air Coolers. One bus of Class 1E 2400 V switchgear will be energized with the NSRC generator. Specifically, the generator will be used to supply (via a distribution panel and transformer) 2400 VAC power to Bus 1C or Bus 1D. The primary source of power will be Bus 1D, due to its close proximity to where the NSRC generator will be staged. Bus 1C is an alternate source to power redundant loads in case power through Bus 1D fails or is unable to be connected. Because the generator will supply 4160 VAC, a 4160/2400 V transformer is required to step down the voltage to that of Bus 1D/1C. The 4160/2400 V transformer will be connected to Bus 1C or 1D using temporary cables connected directly to the bus bars (all three phases) of an existing breaker 152-213 (or 152-107 on Bus 1C). No breaker modifications are needed, but the connections will replace those from the onsite Emergency Diesel Generator for that bus. The transformer neutral will be grounded on the 4160 V side, and ungrounded on the 2400 V side, to match the system. See Figure 7 and Figure 8 for one-line electrical diagrams showing the primary and alternate connection points for the larger NSRC 4160 VAC generators.

Once the NSRC provided low pressure/high flow FLEX pump has established cooling flow, and the NSRC 2 MW FLEX generators are connected to the 1C or 1D 2400 V bus, Palisades can re-power a Component Cooling Water (CCW) pump and a Shutdown Cooling (SDC) pump to establish Shutdown Cooling.

Maintain PCS Inventory Control

At the beginning of Phase 3, Palisades will continue with the Phase 2 strategies for providing PCS inventory control and PCS boration. The inventory in the BASTs (T-53A and T-53B) is shown to provide PCS makeup inventory for greater than 24 hours. Batch makeup operations are conservatively started at that time using tank T-77 with Lake Michigan water provided from the portable diesel driven FLEX pump. This strategy is sufficient to meet needed boration requirements indefinitely but will be augmented when the NSRC equipment arrives and is deployed beginning no sooner than 72 hours following the event. The NSRC will provide a water purification unit and mobile boration unit for use at Palisades.

The NSRC mobile boration unit in conjunction with a water purification unit, can provide improved water quality for use in make-up and batching operations during Phase 3. The mobile boration unit can be utilized with on-site FLEX pumps or NSRC pumps to either provide makeup to T-77 or directly to the PCS. Two diverse connections for PCS makeup (in addition to the normal piping injection flowpaths for Charging Pumps) are available if direct makeup to the PCS is desired, one in the HPSI system and one in the Low Pressure Safety Injection (LPSI) system. The NSRC pump (or on-site FLEX pump) will take suction from the NSRC supplied mobile boration unit. The pump can then provide makeup to T-77 or inject into the PCS via the HPSI or LPSI connection for long-term PCS inventory control.

2.3.4 Systems, Structures, Components

The SSCs discussed in this section provide a direct role in maintaining the key safety functions of reactor core cooling (w/ SGs available) and Reactor/Primary Coolant System inventory control for the Palisades FLEX strategy. The SSCs are either qualified as robust (as defined by NEI 12-06) as originally designed or have been qualified as robust through additional evaluations and/or modifications per Reference 3.1.27, the Basis for FLEX Strategy Engineering Change (EC). The Basis EC performs the needed evaluations in support of the Palisades strategy but also references additional modifications that have been performed to upgrade the specific SSCs to be able to qualify them as robust for all applicable external events. Section 1.0 of the Basis EC lists the modifications performed to existing SSCs to qualify them as robust in addition to the physical plant changes required to support execution of the Palisades strategy. Refer to Reference 3.1.27 for additional details of the evaluations of each SSC.

Phase 1 SSCs

2.3.4.1 Turbine Building/AFW Pump Room

The Turbine Building and AFW pump room structures maintain integrity following a BDBEE to allow TDAFW pump operation. The Turbine Building contains the Auxiliary Feedwater Pump Room and Electrical Penetration Enclosure along with the main turbine generator and other balance of plant systems. The Turbine Building is a Design Class 3 structure except for the Auxiliary Feedwater Pump Room and Electrical Penetration Enclosure which are Design Class 1. The Turbine Building has been evaluated to be robust for all applicable BDBEEs as described in report PLP-RPT-13-00050 (Reference 3.1.26).

2.3.4.2 Auxiliary Building

Located adjacent to the Containment Building, the Auxiliary Building houses key equipment utilized in the FLEX strategy such as Charging Pumps, Class 1E batteries, Class 1E switchgear, the ADVs, portions of the LPSI and HPSI systems, etc. The Auxiliary Building is a Design Class 1, Seismic Category 1 structure designed to withstand all applicable external events.

2.3.4.3 TDAFW System and TDAFW Pump P-8B

The TDAFW system is a turbine driven pump subsystem of the Auxiliary Feedwater System. TDAFW Pump P-8B will supply makeup water to the SGs for Reactor core cooling for the FLEX strategy. Pump P-8B takes suction from the CST and injects condensate grade water into Steam Generators E-50A and E-50B. The CST is fully qualified for all applicable external events as discussed in the following section. The Auxiliary Feedwater Actuation Signal (AFAS) activates the AFW system on low Steam Generator level. The TDAFW steam supply line delivers steam from SG E-50A to Driver K-8 for operation of the TDAFW Pump P-8B. TDAFW Pump Steam Admission Valve (CV-0522B) and associated control circuits operate to provide steam from E-50A to Driver K-8. Nitrogen Backup Station 2 supports operation of this valve. Note that this valve is also equipped with a handwheel for local manual operation in the event of a loss of nitrogen pressure. AFW Flow Control Valves (CV-0727 and CV-0749) are operated by means of Nitrogen Backup Station 1. Though these valves fail open on loss of air, which allows flow to the Steam Generators, throttling of these valves is required to prevent over filling the Steam Generators. The installed Nitrogen Backup Station will provide sufficient capacity for operation of the flow control valves during Phase 1 (i.e., duration that the TDAFW Pump is used). Flow control valves may be operated remotely from panel C-150 if necessary. The control power to the valves is from Class 1E battery-backed power. AFW piping delivers feedwater from the CST to the Steam Generators. The TDAFW system was evaluated under Reference 3.1.26 and determined to be robust for all applicable events with the addition of design modifications. Design modifications that were necessary to fully qualify the system for all applicable external events were:

- Tornado generated missile protection for the turbine exhaust line, and,
- Stiffening the concrete masonry wall that supports Nitrogen Backup Station 2 for seismic events, and,
- Addition of new pipe supports on line HB-26-6" in the Auxiliary Feedwater Pump Room, and,
- Upgrade of existing pipe supports on condensate make-up and return, HB-26-4".

Through the evaluations and modifications noted above, the TDAFW system is fully protected from all applicable external events. Modifications were also performed internal to the AFW Pump Room to mitigate the potential for internal flooding from non-robust SSCs in the room.

2.3.4.4 Condensate Storage Tank (CST) and Primary System Makeup Tank (T-81)

The Condensate Storage Tank is the normal suction source for TDAFW Pump P-8B. The Primary System Makeup Storage Tank is cross tied to the CST to supplement water inventory in the CST. Between the two tanks, a minimum of 8 hours of water inventory is available to support operation of the TDAFW Pump P-8B for the FLEX strategy. Cross-Connect Valves (CV-2008 and CV-2010) provide a method to cross tie T-81 with the CST. These valves can be manually operated and allow alignment of T-81 to gravity feed the CST to increase the volume of water available for suction from Pump P-8B. Level in the tanks is controlled during normal operation such that there will be sufficient inventory available in a FLEX event to provide at least eight hours of makeup to Steam Generators which is sufficient time to place the FLEX pump in service. Level indication of the CST is provided by seismically robust level transmitters LT-2021/LT-2022, or by pressure indicator PI-0782 located in the AFW Pump Room. An additional method of level indication is using PI-0762 located in the West Engineering Safeguards (WESG) Room in the Auxiliary Building. The CST is a Design Class 1 structure, and with the installation of a modification that installed new wind borne missile protection, the tank is fully protected and qualified for all applicable external events. Tank T-81 was evaluated under Reference 3.1.26 and determined to be robust with the addition of design modifications. Design modifications that were installed to upgrade T-81 and its piping boundaries are:

- The addition of tornado generated missile protection for the cross-connect valves and associated cross-connect piping in the Water Treatment Building, and
- The addition of isolation valves on three sections of piping to maintain the piping boundary from T-81 as robust, and
- The addition of tornado missile protection for the tank itself.

The method of protection for tornado generated missiles for T-81 is an alternate approach to the guidance of NEI 12-06. The tank is fully protected from all design basis missile hazards with the exception of the large missile hazard represented by the automobile. Reasonable protection from the automobile missile hazard is provided by:

- Surrounding structures that intervene and provide protection from the design basis automobile like missiles, and
- Low likelihood of historic tornadic activity at the site/region, and

- Administrative controls in AOP-38 to remove any potential automobile like missiles from the zone of influence given the onset of high winds, and
- Implementation of modifications to restrain existing structures within the zone from becoming automobile like hazards, and
- Administrative controls in FSGs that take action to provide alternative suction inventory from one of several non-robust sources within 3.5 hours of the onset of an ELAP if T-81 is determined compromised.

2.3.4.5 Nitrogen (N_2) Backup Stations 1 and 2

Nitrogen Backup Stations 1 and 2 are part of the nitrogen system designed to provide compressed nitrogen for valve operation and control of selected valves should the pressure for the normal air supply drop below a specified value. The Nitrogen Stations are connected to the instrument air lines for the supported equipment via check valves so that operation of the system is passive, depending only upon the normal instrument air supply line pressure. Nitrogen Backup Station 1 provides nitrogen backup to P-8A/B feedwater control valves CV-0727 and CV-0749 and is located in the Auxiliary Building in the Component Cooling Water (CCW) Room at elevation 590'-0". Nitrogen Backup Station 1, CV-0727 and CV-0749 are Design Class 2 components and qualified for the Safe Shutdown Earthquake (SSE) per the SQUG Screening Evaluation Work Sheets (SEWS). Nitrogen Backup Station 2 provides nitrogen backup to the TDAFW Pump P-8B steam inlet valve CV-0522B and is located in the Turbine Building attached to the south wall of the Lube Oil Storage Room. The supply line SSCs from Nitrogen Backup Station 2 to CV-0522B are Design Class 2. Control Valve CV-0522B is a Design Class 1 Component equipped with a hand wheel for manual operation. Nitrogen Stations 1 and 2 were evaluated under Reference 3.1.26 and determined to be fully protected and qualified for all applicable external events with the implementation of the modification to the concrete masonry wall noted in Section 2.3.4.3 for Station 2.

2.3.4.6 Atmospheric Dump Valves

The Atmospheric Dump Valves CV-0779, CV-0780, CV-0781 and CV-0782, and associated exhaust piping and control circuits are used to control pressure in the Steam Generators and require an air or nitrogen supply for operation. After a turbine trip, the steam dump controller's quick opening signal will cause quick opening of the ADVs to preclude challenging the SG code safety valves. The ADVs will then close/open based on T_{avg} or a manually controlled setpoint from the Steam Dump Controller in the Main Control Room. A Nitrogen Backup System provides backup for the instrument air supply to the ADVs when instrument air pressure drops below 85 psig. The valves are qualified for the SSE per the SQUG SEWS. The pneumatic supply for operation of the ADVs has been modified to include a new backup nitrogen station (Nitrogen Backup Station 9) similar to that discussed above (Nitrogen Stations 1 and 2) which will support greater than 9 hours of operation of the ADVs. Therefore, the ADVs will operate on nitrogen from Station 9 for the duration of the Palisades Phase 1 FLEX strategy. The ADVs (with exception of exhaust piping) and new Nitrogen Backup Station 9 are located internal to the Auxiliary Building, a Category 1 seismic structure. The ADVs (including the new Nitrogen Backup Station 9) and controls are evaluated as seismically robust under the SQUG process. The exhaust piping is located on the roof of the Auxiliary Building and through structures surrounding the piping, is protected from impact from tornado generated missiles. As such, the ADVs are fully protected and qualified for all applicable external events.

2.3.4.7 Nitrogen Backup Station 9

Nitrogen Backup Station 9 is a new nitrogen station installed by EC47346 (Child EC of Reference 3.1.27). Nitrogen Backup Station 9 will provide a backup source of nitrogen for actuation of the ADVs. The backup nitrogen bottles are normally isolated to prevent leakage and inventory loss to ensure that the inventory in Station 9 is maintained until required for plant cool down during Phase 1 after a FLEX event. This ensures that the 7.1 hour capacity of Station 9 is preserved for use starting 2 hours after the event and will last beyond 8 hours. The portable diesel driven FLEX generator and portable electric driven FLEX air compressor will be placed in service at 8 and 9 hours respectively to provide air to the ADVs for continued operation. The new Nitrogen Backup Station 9 is fully protected and qualified for all applicable external events.

2.3.4.8 Safety Injection Tanks (SITs)

The Safety Injection Tanks are part of the Low Pressure Safety Injection System. The SITs are passive devices that will inject borated water into the PCS when PCS pressure drops below approximately 240 psig for the Palisades FLEX strategy. The SITs will provide PCS makeup capability to ensure natural circulation is maintained within the PCS as well as positive reactivity insertion to the PCS during Phase 1. The SITs are provided with a nitrogen cover gas that must be prevented from entering the PCS if pressure in the PCS falls below the cover gas pressure. During the Palisades Phase 1 strategy, the SITs will inject but PCS pressure will be maintained above the cover gas pressure and therefore nitrogen intrusion will not occur. The SITs will be isolated later in the Phase 3 timeline before PCS pressure falls below cover gas pressure. The SITs are Seismic Category 1 tanks located inside the Reactor Building. Therefore, the SITs are fully protected and qualified for all applicable external events.

2.3.4.9 Controlled Bleed Off (CBO) Isolation Valves CV-2083, CV-2099, CV-2091

The primary coolant pump seal controlled bleedoff (CBO) system provides a constant flow of approximately 1 gpm for each PCP seal package, which provides cooling and lubrication to the lower, two middle stages and upper stage shaft seals and balances the pressure differential on each seal stage during normal operations. During an ELAP, should catastrophic seal failure occur to the first three stages, the PCP seal leakage could be as high as 15 gpm through the CBO line limited only by the excess flow check valves (see WCAP 17601-P for generic PCP seal leakage assumptions). It is prudent to isolate CBO early in loss of power events to mitigate the potential for seal failure mechanisms to cause stage failures and to limit PCP seal leakage out through the CBO lines should failure of the first three stages occur (Reference 3.1.30). The Palisades FLEX strategy to isolate the CBO line is completely consistent with the guidance of WCAP 16175 (Reference 3.1.30) and current SBO guidance of EOP-3.0. All three valves are air operated valves located within Seismic Category 1 structures. The isolation valves (CV-2083 and CV-2099) fail close upon loss of air, however the relief stop valve (CV-2091) does not. The relief stop valve is provided with an accumulator and DC controls for operation from the Main Control Room via hand switch HS-2191, located in EC-02. The valves and accumulator for CV-2091 are rugged components and qualified for all applicable external events. The DC controls for CV-2091 are powered from the station batteries and are active for isolation on loss of AC power. Cabinet EC-02 has been evaluated as robust under the Seismic Qualification Utilities Group (SQUG) process. Based on this, all components are qualified for the applicable external events.

2.3.4.10 <u>Station Batteries, ED-01 and ED-02</u>

The station batteries provide support to instrumentation for monitoring parameters and support to controls for SSCs used to maintain the key safety functions (Reactor core cooling, RCS/PCS inventory control, and Containment integrity). The station batteries are safety related Class 1E SSCs fully protected within the Auxiliary Building (Seismic Category 1 structure) and fully qualified for all applicable external events. Load shedding provides for a minimum of 8 hours of service without charging. The portable diesel driven FLEX generator provides the external source of power to the Battery Chargers in Phase 2 to maintain batteries for continued use in the FLEX strategy in Phases 2 and 3. Power to the Battery Chargers for Phase 3 can also be provided from the NSRC backup to Palisades FLEX generator or the NSRC 4160 VAC generators.

Phase 2 SSCs

2.3.4.11 Intake Structure

The FLEX pump, when deployed during Phase 2, will take suction from the Intake Canal located above the Intake Structure. Flexible hose will be dropped through removable grating (at locations currently utilized for B.5.b pump suction) into the Intake Canal to provide pump suction source, Lake Michigan. The portion of the Intake Structure utilized by the FLEX strategy is Design Class 1 and fully protected and qualified for all applicable external events in accordance with FSAR Section 5.5.1.1.2 and FSAR Table 5.2.2.

2.3.4.12 Concentrated Boric Acid Storage Tanks (T-53A and T-53B)

The Concentrated Boric Acid Storage Tanks (BASTs) provide borated water to the installed Charging Pumps for PCS makeup. The tanks are located in the Auxiliary Building at elevation 590'-0" and are qualified for the SSE per the Seismic Qualification Utilities Group (SQUG) Screening Evaluation Work Sheets (SEWS). As such the tanks are fully protected and qualified for all applicable external events.

2.3.4.13 Boric Acid Batching Tank (T-77)

The Boric Acid Batching Tank is used to batch borated water for PCS makeup when the BASTs (T-53A/B) are depleted. After completion of mixing, boric acid is gravity drained from Tank T-77 to BASTs T-53A/B. T-77 is robust against seismic and all other screened in hazards as described in report PLP-RPT-13-00051 (Reference 3.1.29).

2.3.4.14 Chemical Volume and Control System (CVCS) Piping

Segments of the CVCS system piping (discharge of Charging Pumps P-55A/B/C to PCS loops and HPSI Train 2 and from T-77 through T-53A/B to the suction of the relied upon Charging Pumps) relied on for FLEX implementation are Design Class 1 (per EA-SP-033318-02) and located inside the Auxiliary Building. The piping is therefore fully protected and qualified for all applicable external events.

2.3.4.15 Charging Pumps (P-55B and P-55C)

Installed Charging Pumps provide the means for PCS makeup for the Palisades FLEX Strategy. Charging pumps P-55B and P-55C, power supplies and controls are located within the Seismic Category 1 Auxiliary Building. The power supplies from LCC-11 and -12 and associated cabling are safety related Class 1E SSCs. Controls are provided from the Main Control Room located within the Seismic Category 1 Auxiliary Building. Charging Pumps P-55B and P-55C are qualified for the SSE in accordance with the SQUG process. Charging Pumps P-55B, P-55C, power supplies, cabling and controls are fully protected and qualified for all applicable external events per References 3.1.27 and 3.1.29.

Diverse means of injection to the PCS are provided by either the normal Charging Pump header or the alternate HPSI injection flow-paths. Both pumps are capable of being isolated from one another. Use of Charging Pumps is an alternate approach to the guidance of NEI 12-06 (specifies use of portable pumps for PCS inventory control) but is acceptable for the following reasons:

- There are two 100% redundant pumps,
- Each pump is capable of supplying 44 gpm which is in excess of the requirements of the strategy (30 gpm required),
- Use of Charging Pumps eliminates deployment aspects of the portable pumps,
- Operators are well trained on use of the Charging Pumps and are familiar with their operation and flow paths facilitating implementation of the strategy,
- Charging Pumps are located within the permanent plant structures,
- Diverse means of injection are provided, and

- All equipment is fully protected and qualified for all applicable external events.

2.3.4.16 Main Feedwater Piping

The primary strategy for core cooling is to inject water to the SGs with the FLEX pump using a connection point in the main feedwater piping. A new connection point is installed for this purpose between valves MV-FW907 and MV-FW909 on Feedwater Heater E-6B. Flexible hoses will be routed from the discharge of the FLEX pump south of the Intake Structure to the MFW system piping hose connection. The segments of the MFW system piping relied upon for FLEX implementation are seismically qualified, not impacted by flooding, not impacted by extreme temperatures and their location in the center of the Turbine Building provides reasonable protection from the effects of tornadoes and tornado generated missiles. As evaluated in Reference 3.1.27, the MFW piping supporting the Palisades FLEX strategy is fully protected and qualified for all applicable external events.

2.3.4.17 Auxiliary Feedwater Piping

The alternate strategy for core cooling is to inject water to the SGs with the FLEX pump using a connection point in the auxiliary feedwater piping. A new connection point is installed for this purpose in the discharge piping of AFW Pump P-8C. This alternate strategy will use the same FLEX pump deployed west of the Intake Structure with suction from the Intake Canal. Flexible hose will be routed from the discharge of the FLEX pump to the AFW system piping hose connection. The segments of the AFW system piping relied upon for FLEX implementation are seismically qualified and located within Seismic Category 1 Auxiliary Building. All equipment is fully protected and qualified for all applicable external events.

2.3.4.18 Load Control Centers (LCC) 19, 20, 11, 12 and Motor Control Centers 1, 2, 21, 22, 23 and 24 and associated breakers, cables and conduits

Primary and alternate connections for the portable diesel driven FLEX generator utilized in the Palisades FLEX strategy are accomplished utilizing breakers installed in previously spare cubicles of 480 VAC Load Control Centers 19 and 20. The primary connection is at LCC-19 and the alternate is LCC-20. Energizing LCC-19 provides the means to power up MCCs 1, 21, and 23, and backfeed LCC-11. LCC-11 can be cross-tied to LCC-12 through an existing permanently installed Class 1E breaker. Similarly, energizing LCC-20 provides the means to power up MCCs 2, 22 and 24, and backfeed LCC-12 which can be cross-tied to LCC-11 through an existing permanently installed Class 1E breaker. The various MCCs provide power to various system Motor Operated Valves (MOVs) required by the strategy, Class 1E Battery Chargers, emergency lighting panels, Charging Pumps and other components used in the Palisades FLEX strategy. The LCCs, MCCs and breakers are all safety-related, Class 1E components located within the Seismic Category 1 Auxiliary Building. As such, these SSCs are fully protected and qualified for all applicable external events. The downstream battery chargers and Class 1E loads are seismically robust, protected within the Auxiliary Building and are fully qualified for all applicable external events.

2.3.4.19 Emergency Diesel Fuel Oil Storage Tank, T-10A

The Emergency Diesel Fuel Oil Storage Tank (T-10A) supports the portable FLEX equipment refueling strategy. The Fuel Oil Storage Tank is located south of the Intake Structure in a concrete enclosure. The bottom of the tank sits at elevation 577'-0". The tank and its concrete enclosure are Design Class 1. The enclosure and tank is below grade and designed for dead, snow, wind, tornado, seismic and blast loads. An evaluation of flooding concludes that the top of the enclosure is above the ponding depth associated with the probable maximum flood (25.5 inches of rain in 6 hours), and design basis seiche event would be concluded by the time refueling is required. Based on this, T-10A is protected and qualified for all applicable external events.

2.3.4.20 Deployable FLEX Components for Phase 2

The deployable FLEX components below have been evaluated and determined capable of performing the function for which they are specified. This type of equipment is representative of equipment utilized for disaster recovery efforts or emergency situations. Portable towable equipment that is designed for over the road transport typically used in construction/remote sites are deemed sufficiently rugged to function following a BDB seismic event. This equipment is utilized both in Phase 2 and Phase 3 to provide an indefinite coping capability for the BDBEE. The portable equipment is stored in a manner that ensures one set of the equipment is available to support the function provided following a BDBEE.

- Diesel Driven FLEX Pump – Storage, deployment and operation required to provide adequate water to the SGs to support core cooling and to provide makeup water to T-77 for boron batching operations
- FLEX hoses - Storage, deployment and operation required to support connection to SG makeup and boric acid batching
- Electric Driven FLEX Air Compressor - Storage, deployment and operation required to provide compressed air to the ADVs to support core cooling
- FLEX Generator - Storage, deployment and operation required to provide power to the installed Charging Pumps, Battery Chargers, electric driven FLEX air compressor, lighting panels, and electric driven FLEX Battery Room ventilation fan
- FLEX electrical cables - Storage, deployment and operation required to support restoration of 480V AC power
- Electric driven FLEX portable exhauster/blower - To prevent hydrogen accumulation in the Battery Rooms
- Boric Acid Mixing Paddle – To allow mixing of boric acid batches

Phase 3 SSCs

2.3.4.21 Service Water System (SWS) Piping

SWS piping will provide the flowpath for cooling water from the NSRC supplied low pressure/high flow pump for cooling of various plant loads. Pressure boundary must be ensured to credit adequate flow. The service water connection piping is located within the Design Class 1 portion of the Intake Structure. The SWS piping segments utilized to support safety related loads for plant recovery actions (CCW Heat Exchangers, Containment Air Coolers and LPSI pump via CCW) are supplied by the Design Class 1 SWS “A” or “B” critical headers. As such these portions of the system are fully protected and qualified for all applicable external events.

2.3.4.22 Class 1E Electrical Distribution System

Connections for the Phase 3 NSRC generator at Bus 1C and 1D are made at the existing safety-related Class 1E 2400 VAC Switchgear. This switchgear is located within the Seismic Category 1 Auxiliary Building. All associated downstream switchgear providing power to loads used in the Phase 3 strategy are also safety-related, Class 1E SSCs and are also located within the Auxiliary Building. All electrical circuits are fully protected and qualified for all applicable external events.

2.3.4.23 LPSI System

The LPSI pump, associated piping and SDC Heat Exchanger (HX) provide the shutdown cooling function for the station. These components are used in the recovery phase of Phase 3. The associated piping segments and SDC HX of LPSI are Design Class 1 per the FSAR Table 5.2-3 and located inside the Auxiliary Building such that the SSCs are protected from wind and flooding external events. Per FSAR Table 5.2.3, interconnecting valves required to perform recirculation function (including HPSI and LPSI systems) are Class 1 safety-related. The Motor-Operated Valves (MOVs) are powered by Class 1E MCC-1 and, therefore, the MOV motors are completely qualified since they are bounded by the Class 1 SSCs they are connected to. Likewise, the LPSI pump (SDC pump) is Design Class 1 with Class 1E powered motor, located within Auxiliary Building and is fully qualified for all applicable external events. The subject SSCs supporting the FLEX strategy are fully protected and qualified for all applicable external events.

2.3.4.24 HPSI System

The HPSI system connection can also be utilized for PCS injection for Phase 3. The associated piping segments of HPSI are Design Class 1 per the FSAR Table 5.2-3 and located inside the Auxiliary Building such that the SSCs are protected from wind and flooding external events. Per FSAR Table 5.2.3, interconnecting valves required to perform recirculation function (including HPSI and LPSI systems) are Design Class 1 safety-related. The Motor-Operated Valves are powered by Class 1E MCC-1, therefore, the MOV motors are completely qualified since they are bounded by the Design Class 1 SSCs they are connected to. The HPSI system SSCs used in the Phase 3 strategy are fully protected and qualified for all applicable external events.

2.3.4.25 <u>CCW System</u>

Portions of the CCW system utilized in the recovery phase of the Phase 3 FLEX strategy are located outside Containment within the Auxiliary Building. The Auxiliary Building is a Design Class 1 structure that fully protects the equipment from all applicable external hazards. The portions of the system piping outside Containment are safety-related, Seismic Category 1 structures. The CCW pumps are supplied power from Class 1E safety related switchgear and associated cabling/controls. The CCW pumps themselves are seismically qualified, safety related SSCs. Based on the above, all CCW SSCs required for the Phase 3 FLEX strategy are fully protected and qualified for all applicable external events.

2.3.4.26 <u>SIT Outlet Isolation Valves</u>

The SIT isolation valves must be closed prior to PCS pressure dropping below 143.6 psia in Phase 3. These MOVs are powered from MCC-21, MCC-22, MCC-23, and MCC-24, respectively. These motor control centers are located within the Seismic Category 1 Auxiliary Building, and are safety related, Class 1E 480V Power Systems that are qualified for all applicable external hazards. As evaluated in Reference 3.1.27, the valves and motor operators are fully protected and qualified for all applicable external events.

2.3.4.27 <u>Deployable FLEX Components for Phase 3</u>

The deployable FLEX components below are similar in design construction as to those of Section 2.3.4.20. These components have been evaluated and determined capable of performing the function specified. This type of equipment is representative of equipment utilized for disaster recovery efforts or emergency situations. Portable towable equipment that is designed for over the road transport typically used in construction/remote sites is sufficiently rugged to function following a BDB seismic event. The portable equipment is stored in a manner that ensures one set of the equipment is available to support the function provided following a BDBEE.

- FLEX hoses - Storage, deployment and operation required to support connection to SW system
- Deployable Service Water Hose Connection Header – This deployable header will allow multiple hose connections from the NSRC supplied low pressure/high flow pump to provide water to the SW system
- 4160VAC/2400VAC Step Down Transformer – This is a dry-type transformer utilized to step down the voltage from the NSRC 4160 VAC supplied generator to be compatible with Palisades Class 1E Distribution Bus which is a 2400 VAC distribution system.

2.3.4.28 NSRC FLEX Equipment

The deployable FLEX components below are similar in design construction as to those of Section 2.3.4.20. These components have been evaluated and determined capable of performing the function specified. This type of equipment is representative of equipment utilized for disaster recovery efforts or emergency situations. Portable towable equipment that is designed for over the road transport typically used in construction/remote sites is sufficiently rugged to function following a BDB seismic event.

- NSRC supplied FLEX Low Pressure/High Flow Pump – NSRC will supply a pump rated at 5,000 gpm and 150 psi discharge with six 5" FLEX discharge hoses.
- NSRC supplied Suction Booster Lift Pump – NSRC will supply a suction booster lift pump rated at 5,000 gpm and 26 feet of discharge head to provide the suction lift required by the NSRC low pressure/high flow pump.
- NSRC supplied FLEX Mobile Boration Unit – NSRC will supply a 1,000 gallon mobile boration unit, which includes agitator, heaters and controls, hoses and power supplies.
- NSRC Mobile Water Purification Unit – NSRC will supply a mobile water treatment unit and interconnecting hoses to improve the water quality used for SG makeup and/or PCS injection. The water treatment system consist of 4 skids and has an output flow capacity of 500 gpm.
- NSRC 4160 VAC Generator – NSRC will supply two (2) 4160 VAC, 1 MW turbine generators to provide a combined capacity of 2 MW. In conjunction with the Palisades supplied 4160VAC/2400VAC Step Down Transformer, the NSRC supplied generators provide the capability to repower 2400 VAC powered pumps (CCW, LPSI) and Class 1E switchgears (Bus 1C or Bus 1D) for restoration of SDC and other plant recovery actions.
- NSRC Replacement Equipment for Palisades FLEX Phase 2 Equipment (Generator, Pump, Hoses, etc.). See Table 3.

2.3.5 FLEX Modifications

2.3.5.1 Engineering Change (EC) 47338 – Main Feedwater System Tie-In – This Child EC installs a physical connection in the MFW system providing the ability to make-up water to the Steam Generators from Lake Michigan thereby providing for core cooling following a BDBEE.

2.3.5.2 EC 47340 - AFW Connection – This Child EC installs a physical connection in the AFW system providing the ability to make-up water to the Steam Generators from Lake Michigan thereby providing for core cooling following a BDBEE.

2.3.5.3 EC 47342 - HPSI Connection – This Child EC installs a physical connection in the HPSI system providing the ability to make-up water to the Primary Coolant System (PCS) for reactor core cooling, inventory control, and heat removal. This connection is primarily for the Modes 5 and 6 Palisades FLEX strategy but does afford additional diversity for Modes 1-4.

2.3.5.4 EC 47343 - LPSI Connection – This Child EC installs a physical connection in the LPSI system providing the ability to make-up water to the Primary Coolant System (PCS) for reactor core cooling, inventory control, and heat removal. This connection is primarily for the Modes 5 and 6 Palisades FLEX strategy but does afford additional diversity for Modes 1-4.

2.3.5.5 EC 46467 – Storage Buildings – This stand-alone EC installs the storage facilities/buildings that are required for the portable FLEX equipment and components.

2.3.5.6 EC 47345 – EB-19 Modification - This Child EC installs a new breaker in a spare cubicle in LCC-19 to receive power from a portable FLEX diesel generator. The new breaker will be non-tripping and act as a switch. This will power loads during Phase 2. Specifically, power at LCC-19 will be used to power MCC-1, which feeds Battery Chargers No.1 and No. 4 and Emergency Lighting Panel EL-04A. LCC-19 will also backfeed through transformers EX-19 and EX-11 to power LCC-11. This will supply power to the installed Charging Pump P-55C.

2.3.5.7 EC 47346 - ADV Nitrogen Station – This Child EC installs a seismically rugged nitrogen backup supply, including an alternate connection point for a portable air compressor, for the Atmospheric Dump Valves (ADVs) to control Steam Generator pressure and provide a means of rejecting heat from the PCS through the Steam Generators following a BDBEE.

2.3.5.8 EC 47348 – EB-20 Modification - This Child EC installs a new breaker in a spare cubicle in LCC-20 to receive power from a portable FLEX diesel generator. The new breaker will be non-tripping and act as a switch. This will power loads during Phase 2. Specifically, power at LCC-20 will be used to power MCC-2, which feeds Battery Chargers No.2 and No. 3 and emergency lighting panel EL-05A. LCC-20 will also backfeed through transformers EX-20 and EX-12 to power LCC-12. This will supply power to the installed charging pump P-55B. LCC-12 is an alternate source to power P-55B in case the power supply to P-55C, through LCC-11, fails or is unavailable. LCC-20 is an alternate strategy to power MCC-2 in case the power supply to MCC-1 from LCC-19 fails.

2.3.5.9 EC 48187 – This Child EC evaluates the Condensate Storage Tank (CST) and Primary System Makeup Storage Tank (T-81) for the tornado event. This EC provides the design of a missile shield for the CST and T-81 tanks, control valves and the cross-tie piping and valves (CV-2008 and CV-2010).

2.3.5.10 EC 48188 – This Child EC provides physical modifications to qualify as robust the Turbine Driven Auxiliary Feedwater (TDAFW) pump (P-8B) piping and associated components in order to credit operation of the pump after a BDBEE to supply makeup water to the Steam Generators for core cooling.

2.3.5.11 EC 49797 – This stand-alone EC provides physical modifications to the P-8C recirculation piping in order to ensure inventory control of T-81 and the CST after a BDBEE to supply makeup water to the Steam Generators for core cooling. A non-seismic portion of piping is run throughout the turbine building which is required to be modified to ensure that the piping is robust.

2.3.5.12 EC 49798 – This stand-alone EC provides further evaluations to qualify the CVCS system and associated components in order to credit operation to support FLEX after a BDBEE to supply makeup water to the Charging Pumps for PCS inventory control.

2.3.6 Key Reactor Parameters

The instrumentation loops noted below are seismically robust, fed by Class 1E power and are located within the Seismic Category 1 Auxiliary Building/Containment Building/Main Control Room (MCR) and as such are qualified and protected for all applicable external events. The instruments noted are available (at least one channel depending on which train of load shed is performed) for all three FLEX strategy phases (1, 2, and 3). Refer to Reference 3.1.27 for additional details.

Table 1: Instrumentation

Parameter	Instruments
PCS (T_{hot})	TT-0112HC and TT-0112HD
PCS (T_{cold})	TT-0112CC and TT-0122CD
PCS Pressure – Wide Range	PT-0105A PTR-0112 PT-0105B PTR-0122

PCS Pressure – Narrow Range	PIA-0102A, B, C and D
Core Exit T/C	10, 15, 16, 19, 23, 30, 33, 35 2, 5, 9, 11, 25, 27, 31, 36
SIT Level (3 of 4 available)[1]	LIA-0365, 0372, 0368 and 0374
Pzr Level (Wide Range)	LIA-0102A and -0103A
Rx Vessel Level	LTRI-0101A and -0101B
Neutron Flux (SR/WR)	NI-1/3A and 2/4A
AFW Flow	FI-0749A and -0727A
SG Pressure	PIC-0751C, -0751D, -0752C, -0752D
SG Level	LI-0757A, -0757B, -0758A, -0757B
Containment Pressure	LPIR-0383, -0382
Containment Temperature	TI-1812, -1813, -1814, -1815
CST Level	LIA-2021, -2022 or PI-0782 and -0762
Battery Capacity/Voltage	EVI-27/D1, EVI-27D2

1) Load shed limited to 3. Before load shed, 4 are available.

In addition to the above, power for other instrumentations is available (e.g., 120 VAC instrument bus voltage, battery current, AC bus voltages) should the instrumentation survive the event (qualification to survive is not assured – these instruments not credited in strategy).

Portable FLEX equipment is supplied with the local instrumentation needed to operate the equipment. Guidance for this instrumentation is provided in the associated FSGs using the equipment. The guidance is based on inputs from the equipment suppliers, operation experience, and expected equipment function in an ELAP.

In the unlikely event that bus infrastructure is damaged, alternate FLEX strategy guidelines for obtaining the critical parameters locally is provided in an FSG in accordance with the guidelines of NEI 12-06 Section 5.3.3.1 (as clarified by FFAQ 14-001).

2.3.7 Thermal Hydraulic Analyses

Thermal hydraulic calculation EA-EC46465-14 of Reference 3.1.27 was performed to determine the time the Condensate Storage Tank, while gravity fed from T-81, can be used as the source of makeup water to the SGs. This analysis concluded that the combined inventory of the CST and T-81 provide approximately 8 hours of inventory for makeup to the Steam Generators via the TDAFW pump. In addition, the analysis determined that in order to provide 8 hours of makeup to the TDAFW pump for injection to the Steam Generators, the minimum inventory levels in the CST and T-81 must be at 78% and 88%, respectively. The portable FLEX pump must be deployed and operational prior to the depletion of these tanks. Thermal hydraulic analyses performed to determine the requirements of the portable diesel driven FLEX pump are covered in Section 2.3.10.1. The analysis performed to evaluate PCS inventory and natural circulation is discussed in Section 2.3.9.

2.3.8 Primary Coolant Pump Seals

The PCP seals at Palisades are Byron Jackson model DFSS with Flowserve Byron-Jackson Type N-9000 4-stage seals. The Palisades site-specific design provides the capability to isolate the Controlled Bleed-Off (CBO) line through both the CBO header isolation and CBO header relief valve isolation. The practice of isolating the CBO line is institutionalized through the present SBO response procedure, EOP-3.0 (Reference 3.1.10), and will occur within the 20-minute isolation time analyzed in WCAP 16175-P (Reference 3.1.30). Both the CBO header and header relief isolation valves are DC powered air operated valves capable of being remotely isolated from the Main Control Room (see Section 2.3.4.9 for details on qualification of the CBO line SSCs). The Palisades FLEX strategy is conservatively based on a maximum seal leakage rate of 15 gpm/PCP seal which is consistent with the generic Westinghouse industry approved analysis of WCAP 17601-P (Reference 3.1.34). For the purposes of determining long term borated water requirements (i.e., when T-53A and T-53B will be depleted), the analysis assumed a pressure dependent seal leakage rate that decreases with PCS pressure consistent with WCAP-17601-P.

2.3.9 Shutdown Margin Analysis

The Palisades site-specific ELAP analysis (Reference 3.1.28) concluded that the core will remain indefinitely sub-critical during an ELAP (for PCS temperatures of 355°F after Xe concentration has decayed away) given a makeup pump of at least 30 gpm capacity injecting 1720 ppm boron concentration into the PCS beginning 13 hours after the event and injecting for a duration of 7 hours.

Minimum credit is taken for SIT inventory injection as a result of the plant cooldown. The industry approved CENTS computer code was used for all cases. The analysis indicates sufficient shutdown margin from SIT injection alone for the first 13 hours. The Palisades ELAP analysis uses a uniform boron mixing model which requires 60 minutes to assume complete mixing. The time critical action for reactivity control is to begin PCS injection at hour 13, inject for seven hours, and must be completed by 24 hours following the event. Palisades will conservatively begin PCS injection eight (8) hours after the event which ensures sufficient time for complete mixing of injected borated water throughout the PCS.

2.3.10 FLEX Pumps, Water Supplies and Auxiliaries

Component numbers in parentheses in this section represent the N and N+1 compliment.

2.3.10.1 Portable Diesel Driven FLEX Pump (P-1002 and P-1003)

Calculation EA-EC46465-06, Hydraulic Analysis of FLEX Coping Strategies (Reference 3.1.27), provides the sizing analysis of the portable diesel driven FLEX pump. Multiple cases were analyzed, one for each particular FLEX demand and its associated conditions. The portable diesel driven FLEX pump provides core cooling and heat removal, SFP cooling makeup and spray, and boric acid batching supply. Case 1 represents reactor core cooling and heat removal while the SGs are available. Case 2 represents reactor core cooling and heat removal after the SGs have become unavailable. Case 3 represents SFP makeup. Case 4 represents SFP spray. Case 5 represents boric acid batching supply. NPSHa is determined to be 14.8 ft for cases 1, 4, and 5 simultaneously. Table 2 below summarizes the portable diesel driven FLEX pump required flows and pumping pressure requirements.

Table 2

FLEX Demand	Required Flow Rate (gpm)	Required Pump Discharge Pressure (psi)
Core Cooling (Steam Generators Available)	136.5	235
Core Cooling (Steam Generators Unavailable)	100	120
SFP Makeup (Direct to Pool or via SFP Piping)	65	60
SFP Monitor Spray Nozzles	250	145
Boric Acid Batching	15	35

As determined in calculation EA-EC46465-06 from Reference 3.1.27, minimum capacity requirements are conservatively chosen to be 410 gpm at 235 psi discharge pressure. The maximum suction lift required is 18 feet, including suction hose frictional losses. The additional B.5.b pump (utilized for FLEX) purchased by Palisades was confirmed by the nameplate as Hale Products pump model IP1000DJ. Hale provided pump performance Curve No. E-1324A, RSD-M Series Pump Curve for Unit Model IP1000DJ (Reference 3.1.31). From the performance curve, it can be seen that the IP1000DJ has adequate capacity and discharge pressure to meet the simultaneous flow requirements. From the pump curve, the IP1000DJ pump is capable of producing approximately 275 psi discharge pressure at the required flow of 410 gpm. The pump also has a capacity of 1,100 gpm at the required discharge pressure of 235 psi. This performance data confirms the additional FLEX pump purchased by Palisades has adequate discharge capacity and pressure for the Palisades FLEX Strategy.

2.3.10.2 Pump Hose and Fittings

Hose and fittings are selected to be compatible with NSRC components. 5" and 2-1/2" hoses with Storz fittings are utilized where possible. All sizes of hose specified meet the requirements of NFPA 1961 as described in Reference 3.1.27.

2.3.10.3 Hose Manifold (M-1035 and M-1036)

The deployable hose manifold is equipped with one (1) 6" inlet hose connection, a minimum of four (4) 5" discharge hose connections, a minimum of two (2) 2-1/2" discharge hose connections, a relief valve set at 275 psig, and a pressure indicator. Each discharge hose port branch connection is equipped with a valve to provide throttling/isolation capability.

2.3.10.4 Electric Driven FLEX Air Compressor (C-910 and C-911)

The portable electric driven FLEX Air Compressor minimum capacity requirements are 21.08 scfm at 130 psig discharge pressure, and the compressor must be compatible to be powered from the portable diesel driven FLEX generator. The flow rate is based on the bleed-off rate that is required to hold all four ADVs at an open modulating position, which is the typical position of the valves during plant cooldown. An additional flow rate is included to allow actuation of one of the ADVs while still providing the bleed-off of all four valves. The compressor selected in Attachment 9.1 of EC-46465 (Reference 3.1.27) has enough capacity to actuate two valves in addition to the bleed-off rate. The calculation of these flow rates can be found in the nitrogen bottle station sizing calculation EA-EC46465-09 of Reference 3.1.27. The discharge pressure is selected based on typical discharge pressures of 120 VAC portable compressor models and the pressure requirement of the bottle station to provide 90 psig air from the regulators.

2.3.10.5 Air Compressor Hose and Fittings

The air hose and fittings are selected to minimize the pressure drop from the compressor outlet to the permanent connection on Nitrogen Station 9 at valve MV-N2/10025. A 1" flexible air hose will be used with the appropriate fittings for each connection point (Reference 3.1.27).

2.3.10.6 Electric Driven Portable FLEX Ventilation Fans (V-1001 and V-1002)

To mitigate hydrogen concentration in the Battery Rooms during battery charging, a portable ventilation fan is required. This exhaust fan (a confined space blower) is deployed and stationed in the Battery Room and ducted outdoors. The 120 VAC fan is specified with a minimum exhaust flow of 1,000 cubic feet per minute (60,000 ft^3/hr). This flow exceeds the minimum flow of 150 cubic feet per hour calculated in EA-DBD-1.07-001 (Reference 3.1.32) and is consistent with the capacity of most confined space exhaust fans researched. Calculation EA-DBD-1.07-001 documents the hydrogen concentration in the Battery Room is 0.005% with an exhaust flow of 1,000 cubic feet per minute, which is well below acceptable explosive limits.

2.3.10.7 Phase 3 Deployable Service Water Connection Header (M-1037)

The Phase 3 deployable service water connection header is sized to accommodate the capacity of the NSRC Phase 3 low pressure/high flow FLEX pump. Per the National SAFER Response Center Equipment Technical Requirements (Reference 3.1.33), the NSRC low pressure, high flow pump is sized for a 5,000 gpm flowrate. The header is sized for this flow by having six (6) 5" Storz hose connection points and a 16" flanged connection to allow tie-in to the inlet flange of Service Water Pump Strainer F-2C. The header is fabricated from aluminum to minimize weight for deployment (Reference 3.1.27).

2.3.10.8 Cooling and Makeup Water Supplies

Condensate Storage Tank (CST)

The CST is the credited water supply for the TDAFW Pump P-8B in its function to provide makeup to the Steam Generators.

Primary System Makeup Tank (T-81)

T-81 is the credited source of makeup water to the CST via gravity feed.

As previously discussed in earlier sections, levels are procedurally controlled in the two tanks to assure at least an 8 hour coping strategy and all associated equipment is protected and qualified for all applicable external events.

Lake Michigan

Lake Michigan provides an indefinite supply of untreated water to the portable diesel driven FLEX Pump for SG makeup, SFP cooling, and T-77 (boric acid mixing tank) batching operations for the Palisades FLEX strategy. Lake Michigan also provides the water supply to the NSRC low pressure/high flow pump for use during Phase 3. During Phase 3 Lake Michigan water will be treated by NSRC water purification and mobile boration units as required to support recovery actions and/or continuation of Phase 2 strategies.

2.3.10.9 Borated Water Supplies

Safety Injection Tanks (SITs)

The Phase 1 strategy for Reactor core cooling (i.e., PCS cooldown and depressurization) will allow passive injection of borated water from the Safety Injection Tanks (SITs) as previously discussed.

Concentrated Boric Acid Storage Tanks (BASTs) T-53A and T-53B

The installed Charging Pumps are used in Phase 2 (also available in Phase 3) for inventory control. The borated water source for suction to the installed Charging Pumps is from the installed Concentrated Boric Acid Storage Tanks (T-53A and T-53B) as previously discussed.

Boric Acid Batching Tank (T-77)

The BASTs are estimated to provide PCS inventory control for greater than 24 hours after the event. Prior to depletion of T-53A and T-53B, boric acid batching operations will begin using the installed Boric Acid Batching Tank (T-77). The strategy conservatively starts batching makeup operations 24 hours after the start of the event providing margin to when the BASTs will actually be depleted as previously discussed. Water for boric acid batching is supplied from the portable diesel driven FLEX pump.

2.3.11 Electrical Analysis

Batteries

The installed 1E Batteries (D01 and D02) are used to maintain power to critical instrumentation, controls and lighting following a loss of AC power. An ELAP will be declared approximately one hour after the event (0.95 hours), when it becomes evident that AC power will not be restored from onsite or off-site sources. The declaration of an ELAP will initiate actions to perform a deep load shed to extend the life of the batteries. The load shed will complete by 2 hours after the event.

FLEX Diesel Generator

During Phase 2 (and Phase 3 as appropriate), one (1) portable 480 VAC, 400 kW FLEX diesel generator is used to restore power to the Class 1E Battery Charger, power up a Charging Pump, flow path MOVs, emergency lighting, the electric driven FLEX air compressor and the electric driven FLEX portable Battery Room ventilation. The generator is sized to support the loads required by the FLEX Strategy. Additionally, margin exists to accommodate small miscellaneous loads as desired.

NSRC Generators

The NSRC will augment the onsite portable diesel driven 400 KW FLEX generators (N and N+1) with an additional unit of at least the same capacity.

Additionally, the NSRC will provide two (2) 4160 VAC, 60hz, 1 MW generators (Reference 3.1.33), which together will form a 2 MW medium voltage generation unit for use in transitioning to a longer term diverse Phase 3 strategy including plant recovery. The larger NSRC generators have been sized to ensure the capability (as a minimum) to energize a CCW Pump, LPSI Pump, SDC flowpath MOVs, a Spent Fuel Pool Pump, SFP cooling MOVS, and three (3) Containment air coolers.

Palisades Onsite Phase 3 FLEX Step Down Transformer

The Phase 3 dry-type 4160/2400 VAC, 2500KVA step down transformer is sized to accommodate the capacity of two (2) NSRC 1 MW generators.

2.4 Spent Fuel Pool Cooling/Inventory

The basic FLEX strategy for maintaining SFP cooling is to monitor SFP level and provide makeup water to the SFP sufficient to maintain 15 feet of water above the top of racks.

2.4.1 Phase 1 Strategy

Non Outage Conditions

Under non-outage conditions, the maximum SFP heat load is 4.47 MWt. Loss of SFP cooling with this heat load and an initial SFP temperature of 140°F results in a time to boil of 5.63 hours. This does not include the amount of time it takes to reach the top of active fuel once the boiling initiates. Palisades' will use a margin of 15 feet above the top of the spent fuel, which will be reached after 21.3 hours; therefore, completing the equipment line-up for initiating SFP make-up at 18 hours is conservative.

Outage Conditions

The worst case SFP heat load during an outage is 9.02 MW. Loss of SFP cooling with this heat load and an initial SFP temperature of 140°F results in a time to boil of 3.28 hours. With the entire core being located in the SFP, manpower resources otherwise allocated to core cooling in non-outage conditions can be allocated to aligning SFP make-up which ensures the system alignment can be established prior to the point at which SFP conditions become challenged. Palisades will use a margin of 15 feet above the top of the spent fuel, which will occur after 11.07 hours; therefore, completing the equipment line-up for initiating SFP make-up at 11 hours is conservative.

Given the time available before makeup is necessary, there are no activities required to support SFP cooling during Phase 1. NEI 12-06, Table D-3 requires a vented pathway for steam and condensate from the SFP. This requirement is met by opening the double leaf doors on the roof of the Fuel Handling Building. The double leaf door will be opened prior to SFP boiling based on the heat load in the pool at the time of the event (as early as 3.28 hours).

2.4.2 <u>Phase 2 Strategy</u>

The transition to Phase 2 strategies will be made as the inventory in the SFP slowly declines due to boiling. It has been determined that the SFP makeup with an intact pool is not required until 21.3 hours for a normal decay heat load, and 11 hours for a maximum decay heat load. SFP cooling through makeup and spray will be provided by using the portable diesel driven FLEX pump.

The Phase 2 strategy for SFP cooling is to deploy a FLEX pump to provide makeup to the pool with water from Lake Michigan. Table D-1 of NEI 12-06 requires the ability to makeup to the SFP via hoses on the refuel deck, makeup to the SFP via a connection to SFP cooling piping, and also the capability to spray water into the SFP via portable oscillating monitor nozzles. These requirements are met with two connections requiring entry to the refuel floor (spray and direct pool makeup), and one that does not require entry by using installed piping. All SFP strategies will use the same portable diesel driven FLEX pump that is deployed west of the Intake Structure for the previous identified strategies for Reactor Core Cooling and take suction from the Intake Canal (Lake Michigan).

The strategy for SFP makeup through SFP piping is through an existing 2½" hose connection located in the SFP Heat Exchanger Room and isolated by valve MV-SFP140. Makeup flow is through flexible hoses routed from the FLEX pump to the hose distribution manifold, through the Turbine Building, Auxiliary Building, and into the SFP Heat Exchanger Room. Attachment 9.2.8 of Reference 3.1.27 shows the connection points and routing for hoses. Once the hose connection has been made, valve MV-SFP137, which is normally locked closed, will be opened to establish a flow path to the SFP through permanent SFP Cooling System pipes HC-4-3" and HC-4-12". See Figure 4 for flow diagram of makeup strategy.

The other two strategies (direct hose makeup and spray capability) for SFP cooling require entry to the refuel floor to route flexible hoses and to position the portable monitor nozzles for spray capability. Flexible hoses will be routed from the FLEX Pump to the refueling floor where the hoses are either connected to the monitor nozzle or discharged directly into the SFP.

With normal SFP heat loads a makeup flow of 33 gpm must be established before 21.3 hours after the start of the event to maintain 15 feet of water above the top of racks. The use of 15 feet is conservative and exceeds the minimum water level over the racks of 10 feet (FSAR Section 9.11.3.5.1) to ensure adequate shielding for plant personnel. Following a full core offload which results in the maximum decay heat load, the SFP begins to boil 3.28 hours after the event. In order to maintain 15 feet of water above the top of the racks, a makeup flow rate of 65 gpm must be established by 11 hours after the event.

2.4.3 Phase 3 Strategy

The Phase 3 coping capabilities for SFP cooling can continue to utilize the Phase 2 strategies.

At 72 hours after the event, off-site equipment from the NSRC is available. A deployable hose connection header is used to allow the connection of hoses from the NSRC supplied low pressure/high flow pump to the Service Water System (SWS) piping as previously discussed. Additionally, the two (2) NSRC 4160 VAC generators provide the capability to repower a complete Class 1E 2400 VAC bus. This allows the capability to restore a complete train of SFP Cooling System (pump and heat exchanger) to operation for long term plant recovery.

2.4.4 Structures, Systems, and Components

2.4.4.1 Primary Connection

Makeup Strategy Method 1 (Hose)

There are no permanent system piping connections associated with the Method 1 strategy; all equipment is portable and does not require any physical connections to permanent plant equipment.

Makeup Strategy Method 2 (SFP Cooling System Piping)

This method of SFP makeup utilizes an existing 2 ½" hose connection located in the SFP Heat Exchanger Room and isolated by valve MV-SFP140 and does not require access to the SFP floor. Makeup flow is through flexible hoses routed from the portable diesel driven FLEX pump to the hose distribution manifold, through the Turbine Building, Auxiliary Building, and into the SFP Heat Exchanger Room. Attachment 9.2.8 of Reference 3.1.27 shows the connection points and hose paths. Once the hose connection has been made, valve MV-SFP137, which is normally locked closed, will be opened to establish a flow path to the SFP through installed pipes HC-4-3" and HC-4-12". The Turbine Building has been assessed for structural integrity and debris as previously discussed in Section 2.3.4.1 and will provide needed protection and access for the hose routing noted. The SFP Heat Exchanger Room is located within the Seismic Category 1/Design Class 1 Auxiliary Building. The segments of SFP system piping relied upon are designated as Design Class 1 per FSAR Table 5.2-3. Based on this, hose routing is assured and the applicable SSCs are fully protected and qualified for all applicable external events.

Makeup Strategy Method 3 (Spray)

There are no permanent system piping connections associated with the Method 3 strategy; all equipment is portable and does not require any physical connections to permanent plant equipment.

2.4.4.2 <u>Alternate Connection</u>

There are no alternate connections for the three methods described in Section 2.4.4.1 for supplying makeup to the SFP. Diversity for SFP makeup is achieved by providing multiple methods (permanent SFP piping connection, SFP hose makeup and SFP spray makeup) to provide makeup capability to the SFP and meets the requirements of NEI 12-06.

2.4.4.3 Spent Fuel Pool

The fuel handling area, including the Spent Fuel Pool, is a Consumers Power Company (CPCo) Design Class 1 structure and the SFP Cooling System is a CPCo Design Class 1 system.

2.4.4.4 Spent Fuel Pool Level Instrumentation (LI-2141 and LI-2142)

As discussed in Section 2.4.8, each instrument channel is located within the confines of Category 1 structures and has been designed to remain available (augmented quality, environmentally and seismically qualified) following a BDBEE. The equipment is fully protected and qualified for all applicable external events.

2.4.4.5 Ventilation

SFP bulk boiling will create adverse temperature, humidity, and condensation conditions in the SFP/Refuel Floor Area. NEI 12-06 requires a ventilation vent pathway to exhaust the humid atmosphere from the SFP/Refuel Floor Area with outside air. This requirement is met by opening the double leaf doors on the roof of the Fuel Handling Building which is normally locked. Procedures have been revised for operations to have readily available access to the keys for this door such that it can be opened without undue delay following a BDBEE. The double leaf door will be opened prior to SFP boiling based on the heat load in the pool at the time of the event (as early as 3.28 hours).

2.4.5 Key SFP Parameters

The key parameter for the SFP make-up strategy is the SFP water level. The SFP water level is monitored by the instrumentation that was installed in response to Order EA-12-051, *Reliable Spent Fuel Pool level Instrumentation* (EC 46466, Reference 3.1.49). See Section 2.4.8 for additional details.

2.4.6 Thermal-Hydraulic Analyses

Under non-outage conditions, the maximum SFP heat load is 4.47 MW. Loss of SFP cooling with this heat load and an initial SFP temperature of 140°F results in a time to boil of 5.63 hours. Palisades will use a safety margin of 15 feet above the top of the spent fuel, which will be reached after 21.3 hours; therefore, completing the equipment line-up for initiating SFP make-up at 18 hours is conservative.

The worst case SFP heat load during an outage is 9.02 MW. Loss of SFP cooling with this heat load and an initial SFP temperature of 140°F results in a time to boil of 3.28 hours. The amount of time for boil-off to reach 15 feet above the top of the spent fuel is approximately 11.07 hours.

The initial coping strategy for Spent Fuel Pool cooling is to monitor Spent Fuel Pool level using instrumentation installed as required by NRC Order EA-12-051. A flow of 65 gpm will replenish the water being boiled for the limiting case. Deployment of any of the SFP makeup strategies within 11 hours (for the limiting case) with a flow rate that exceeds the boil-off rate (65 gpm for the limiting case) will provide for adequate makeup to restore the SFP level and maintain a level of water at least 15 feet above the top of the spent fuel.

Calculation EA-EC46465-06 of Reference 3.1.27, Hydraulic Analysis of FLEX Coping Strategies, provides the hydraulic analysis of the FLEX Phase 2 strategies. Cases 3 and 4 are used to analyze the flow paths of the three methods of cooling/makeup to the SFP. The FLEX pump credited for use in all of the strategies for Palisades is the Hale IP1000DJ and was found to be more than sufficient to meet the flow requirements necessary for SFP makeup/cooling.

2.4.7 Flex Pump and Water Supplies

2.4.7.1 Portable Diesel Driven FLEX Pump (P-1002 and P-1003)

The portable diesel driven FLEX Pump credited for use in all of the strategies for Palisades is the Hale IP1000DJ. Section 2.3.10.1 addresses the capability of the pump to meet all FLEX strategy flow requirements.

2.4.7.2 Phase 2 SFP Monitor Spray Nozzles

Two oscillating monitor nozzles are required to provide a total spray of 250 gpm to the SFP as is required by NEI 12-06. The spray nozzles will be placed at opposite corners of the pool to provide adequate coverage over the pool and will be deployed by fire brigade trained Nuclear Plant Operators (NPOs). A 5" discharge hose will be routed from the Phase 2 manifold to a wye fitting that will split the flow into two 2.5" hose runs up the stairs in the Auxiliary Building up to the SFP Room where the nozzles are staged. To ensure the water supply pressure does not exceed the pressure rating of the monitor nozzles, each 2.5" hose run must have an inline orifice plate installed. The orifice plates are installed on 2.5" NH female couplings. See Attachment 9.3.2 of EC-46465 (Reference 3.1.27) for more details.

2.4.7.3 Lake Michigan

As discussed in Section 2.3.10.8, Lake Michigan provides an indefinite supply of untreated water for SFP makeup.

2.4.8 Electrical Analysis

The Spent Fuel Pool level will be monitored by new instrumentation installed to comply with NRC Order EA-12-051. The instrumentation consists of two independent guided wave radar channels of level display. Normal power for the instrumentation is provided from the non-safety related 120 VAC distribution system. The normal 120 VAC power supplies are de-energized during an ELAP and not recovered. Each instrument channel is also provided with an installed battery pack that provides for a minimum of 7 days of operation. Each channel is also equipped with an external port that can accept a 9-36 VDC supply. This port has been functionally tested with a marine lead acid type battery and the FSGs direct the installation of this type of battery before expiration of the on board battery pack.

2.5 Containment Integrity

Containment cooling is lost for an extended period of time during an ELAP with the unit in Modes 1-4. With no cooling in the Containment building, temperature and pressure in Containment will rise, but remain below design limits for at least 10 days.

Since design limits are not exceeded, key parameters instrumentation will remain available.

A Containment response analysis (calculation EA-EC46465-02, Palisades MAAP Containment Analysis for BDBEE, of Reference 3.1.27) was performed for the BDBEE with the plant in two operational modes. The two cases chosen to bound most plant configurations are; Mode 1 at full power, and Mode 5 at mid-loop inventory. This analysis uses the Modular Accident Analysis Program (MAAP) computer code to assess the Containment response but does not use the code for establishing a timeline for coping actions with respect to the primary system. This approach for use of MAAP during a BDBEE is consistent with that endorsed by the NRC (Reference 3.1.54).

2.5.1 Phase 1

Containment pressure and temperature are expected to increase during an ELAP due to loss of Containment cooling and mass and energy transfer from the PCS to Containment. The Palisades Containment design pressure is 69.7 psia, and the design temperature is 283°F. The Containment Liner has been analyzed for temperatures up to 410°F for a design basis accident.

A Containment evaluation has been performed consistent with the boundary conditions described in Section 2 of NEI 12-06. Based on the performance of installed PCP seals, pressure and temperature of Containment are not expected to rise significantly. Analysis done in support of the IER 11-4 response (Reference 3.1.28) demonstrated that as long as cooling water was restored to the SGs prior to fuel damage there would not be any structural concerns with Containment for this event. Therefore, there are no specific Phase 1 actions required at this time. However, the FSGs will include steps to monitor Containment conditions.

The results of the MAAP analysis confirm that the Containment function is not challenged early in the event for the at-power scenario. Therefore, no Phase 1 actions are required to maintain Containment integrity. Results of the Mode 5 scenario are discussed below in Section 2.5.2.

2.5.2 Phase 2

Consistent with Reference 3.1.34, the Mode 1 analysis assumes an initial letdown rate of 75 gpm for the first ten minutes of the transient, and conservatively assumes an initial PCP seal leakage rate of 15 gpm per seal (PCP seal leakage decreases as the PCS is depressurized). The Containment analysis assumed a PCP seal leakage rate of 15 gpm because this maximizes the energy transfer into Containment and is therefore conservative. The analysis for Mode 1 follows the 75°F per hour cooldown case documented in Westinghouse PCS analysis CN-SEE-II-13-5 (Reference 3.1.28). The Containment analysis determines Containment temperature and pressure for the analysis duration of 120 hours. Results of this analysis show that Containment temperature and pressure remain below their respective design limits for the analysis duration of 120 hours. The rate of temperature and pressure increase in Containment at 120 hours is such that the design limits will not be challenged within the first ten days after an event. Prior to 120 hours after the event, onsite and off-site equipment will be available to mitigate Containment conditions.

As described in Reference 3.1.27, the Mode 5 analysis assumes that the plant has been shut down for 48 hours prior to the event, the PCS is at 200°F, 14.7 psia, and is at a reduced inventory (i.e., mid-loop). PCS makeup is assumed available to prevent the core from being uncovered. As the PCS heats up and begins to boil, decay heat removal occurs by steam transfer into Containment. Without any mitigating actions in this scenario, Containment design limits of temperature and pressure were exceeded 14.6 hours after the event. The analysis also determined that by opening a 3.75-inch equivalent diameter penetration in Containment, the Containment temperature and pressure design limits are not exceeded for the analysis duration of 120 hours. The analysis assumed that the action to open a Containment vent path would be taken after a 5 psig rise in Containment pressure following the event. Either one of two 8" Containment purge headers (JBB-1-8" and JBB-2-8") can be used to provide Containment venting. Two AOV's in either line (CV-1805 and CV-1806 on JBB-2-8"; CV-1807 and CV-1808 on JBB-1-8") must be held open to permit flow. The air then discharges into a filter housing on the 607' elevation of the CCW Room. A door on the CCW filter will be opened to allow the Containment atmosphere to exhaust to the CCW Room. A double door on the 625' elevation of the CCW Room is also opened allowing the room to exhaust directly to the atmosphere completing the vent path. Nitrogen is supplied from Nitrogen Backup Station 9 on the 625' Auxiliary Bay Roof to the AOV's. In addition, the portable electric driven FLEX air compressor provides flexibility and can be used to supply the actuators of the valves if staged and available. The purge valves are initially opened with the nitrogen supply and then mechanically gagged in the open position to facilitate the venting of Containment.

2.5.3 Phase 3

As described previously in Section 2.3.3, the NSRC will supply a low pressure/high flow pump and two 4160 VAC generators for long term plant recovery. The low pressure/high flow pump allows for the restoration of service water flow to equipment such as the CCW system and LPSI pump. The 4160 VAC generators allow for the restoration of one complete Class 1E distribution bus (1D or 1C) which provide power to a LPSI pump, a CCW pump, SDC flowpath valves and three Containment Air Coolers (CACs). Containment temperatures will remain below acceptable limits (~140°F) for critical instrumentation inside Containment for at least 6 days. The NSRC generator will be utilized to start and stop CACs as required to maintain temperatures within limits to preserve critical instrumentation. As required, the NSRC low pressure/high flow pump and NSRC 4160 VAC generators can be used to transition the plant to a long term recovery mode utilizing Shutdown Cooling, thereby maintaining Containment temperatures and pressures below design limits.

2.5.4 Structures, Systems, Components

2.5.4.1 Service Water System (SWS)

Refer to Section 2.3.4.21 for discussion on robustness of the SWS piping.

2.5.4.2 Containment Purge Headers and Valves

The Containment purge headers required for the Modes 5 and 6 Containment venting strategy are seismically qualified Design Class 1 structures. The piping is located within the Auxiliary Building and protected from all applicable external events. The purge valves are rugged components similar in design to the TDAFW control valves and CBO isolation AOVs of the Palisades FLEX strategy. The valves like the piping are located within the Auxiliary Building and fully protected from all applicable external events.

2.5.4.3 Nitrogen Station 9

Refer to Section 2.3.4.7 for details on the Nitrogen Station 9.

2.5.4.4 LPSI System

Refer to Section 2.3.4.23 for details on the LPSI System.

2.5.4.5 CCW System

Refer to Section 2.3.4.25 for details on the CCW System.

2.5.4.6 Containment Building

The Containment Building is a Design Class 1, Seismic Category 1 structure that is qualified for all applicable external events.

2.5.4.7 Containment Air Coolers

The Containment Air Coolers, ducting and associated Service Water Valves are safety-related, Design Class 1, Seismic Category 1 structures. All equipment is located within the Design Class 1, Seismic Category 1 Containment Building. All equipment is fully protected and qualified for all applicable external events.

2.5.4.8 Containment Instrumentation

Refer to Section 2.3.6 for details on Containment instrumentation.

2.5.4.9 Class 1E 2400 VAC Distribution System (Bus 1C or 1D and Downstream Distribution)

Primary and alternate connections for the NSRC 4160 VAC generators are made at Bus 1D (152-213) or 1C (152-107). Buses 1C and 1D (switchgear, breakers, connecting cabling and conduit) are safety related, Class 1E structures located inside the Auxiliary Building. All SSCs are fully protected and qualified for all applicable external events.

2.5.5 Key Containment Parameters

Instrumentation providing the following key parameters is fully qualified and protected for all applicable external events (see Section 2.3.6):

- Containment Pressure: Containment pressure indication is available (via instruments LPIR-0382/0383) in the Main Control Room (MCR) throughout the event.

- Containment Temperature: Containment temperature indication is available (via instruments TI-1812, TI-1813, TI-1814, TI-1815) in the MCR throughout the event.

2.5.6 Thermal-Hydraulic Analyses

A Containment evaluation was performed based on the boundary conditions described in Section 2 of NEI 12-06. Based on the results of this evaluation, no actions are required to ensure maintenance of Containment integrity through Phases 1 and 2 for an event which occurs when the SGs are available (PCS in Modes 1-4). The evaluation indicated that a FLEX event which occurs when the PCS is in Modes 5 at reduced inventory may challenge Containment pressure unless a vent path is established. Without any mitigating actions in this scenario, Containment design limits of temperature and pressure were exceeded 14.6 hours after the event. The analysis (calculation EA-EC46465-02, Palisades MAAP Containment Analysis for BDBEE, of Reference 3.1.27) also determined that by opening a 3.75-inch equivalent diameter penetration in Containment to relieve temperature and pressure, the Containment temperature and pressure design limits are not exceeded for the analysis duration of 120 hours. The analysis assumed that the action to open a Containment vent path would be taken after a 5 psig rise in Containment pressure following the event. Either one of two 8" Containment purge headers (JBB-1-8" and JBB-2-8") can be used to provide Containment venting. For use, two AOV's in either line (CV-1805 and CV-1806 on JBB-2-8"; CV-1807 and CV-1808 on JBB-1-8") must be held open to permit flow. The air then discharges into a filter housing on the 607' elevation of the CCW Room, which will have a door opened to allow the venting flow to exit via the CCW Room which has a double door that opens to atmosphere on the 625' elevation of the CCW Room. Nitrogen is supplied from Nitrogen Backup Station #9 on the 625' Auxiliary Bay Roof to the AOV's to open them initially, and a mechanical gag is installed to maintain the valves open as long as necessary.

2.5.7 Flex Pump and Water Supplies

The NSRC is supplying a low pressure/high flow FLEX pump which will be connected to the Service Water System to support operation of Shutdown Cooling. Water supply will be provided by the Intake Canal/Lake Michigan. A deployable hose connection header will be used to allow the temporary connection of hoses from NSRC supplied equipment into the Service Water System. Operation of Shutdown Cooling would curtail further increase in Containment temperature. If necessary, NSRC equipment could be used for operation of the Containment Air Coolers (CAC). The portable electric driven FLEX air compressor provides additional capability beyond Nitrogen Station 9 to provide motive force to open and close either set of Containment purge valves.

2.5.8 Electrical Analysis

To provide long term support of Containment, Palisades will use the medium voltage FLEX generators from the NSRC to repower the installed Containment air coolers. Additionally, since the NSRC generators can be used to power one complete Class 1E 2400 VAC train, SDC can be placed in service to further reduce primary coolant system temperature and pressure, minimizing released energy into the Containment due to leakage. Palisades will use an onsite step down transformer to drop the output of the NSRC 4160 VAC generator to the Class 1E bus voltage of 2400 VAC.

2.6 Characterization of External Hazards

2.6.1 Seismic

Per the FSAR (Reference 3.1.35) seismic input, the seismic criteria for Palisades includes two (2) design basis earthquake spectra: Operating Basis Earthquake (OBE) and Safe Shutdown Earthquake (SSE).

A conservative SSE having peak horizontal ground acceleration at the surface of 0.05 g is the recommended value. However, to be conservative a hypothetical SSE of 0.2 g has been selected for designs and analyses, per FSAR Section 2.4.4. Thus, the Palisades site screens in for the seismic hazard.

Systems, structures, and components (SSCs) that are required to support FLEX are qualified to be seismically "robust" as defined in NEI 12-06. Conservative peak SSE accelerations are taken from response spectra in C-175(Q), and M-195(Q) (References 3.1.36 and 3.1.37). Procedure EN-CS-S-010-L (Reference 3.1.38) is used as guidance in determining the best approach for verifying seismic adequacy. Additional seismic qualifications of existing non-seismic SSCs as "robust" are performed per the SQUG Generic Implementation Plan

(GIP), EPRI 1019199 (Reference 3.1.39) and/or EPRI NP-6041-SL (Reference 3.1.40) as required.

The Palisades FSAR does not explicitly address soil liquefaction. Flood and seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 (Reference 3.1.9) have been performed to evaluate soil liquefaction. The results indicated that potential exists for liquefaction of soils outside the Protected Area (PA) during a seismic event. As a result of this evaluation the Palisades FLEX Storage Building scope was revised to locate a facility inside the PA and construct one hardened facility outside the PA.

The Expedited Seismic Evaluation Program (ESEP) Report was submitted to the NRC on 12/18/14 (Reference 3.1.50). Any impacted equipment will be addressed as identified in that report under the ESEP.

2.6.2 External Flooding

The flood assessment for the Palisades site provided in the FSAR (Reference 3.1.35) considered flooding due to high levels in Lake Michigan, high rainfall, wind-generated waves concurrent with flooding, and seiches. High tides, hurricane surges, and tsunamis were determined to not affect the site due to the inland location.

FLEX equipment is required to be accessible, deployable and functioning upon an external flood per NEI 12-06. Palisades is susceptible to seiche and precipitation hazards. FSAR Section 5.4.1.1 states that the current probable maximum flood (PMF) due to maximum expected precipitation is no higher than 6" above grade due to overland run-off to Lake Michigan. General plant grade elevation is 589'-0" along Lake Michigan. Flooding due to precipitation is considered slow moving, with warning time of a few days and unknown duration.

The flood expected from a seiche would reach an elevation of 594.1' per FSAR Section 2.2.2.1. A seiche is defined as a standing wave in a partially enclosed body of water (i.e. lake) and is characterized as an unpredictable event with no warning but is expected to recede in 30 minutes. FLEX Phase 2 portable equipment deployment will be initiated after the seiche has receded, and FLEX equipment is stored and will be staged above the PMF. Report PLP-RPT-12-00142

(Reference 3.1.41), which is the flooding walkdown report prepared for Near Term Task Force (NTTF) Recommendation 2.3, has been reviewed to ensure FLEX connections and equipment below the PMF are located in water-tight areas. All plant equipment that will be used for FLEX is protected against a flood to a level of 594.4 ft per FSAR Section 2.2. Any impacts to the external flooding level identified by the flooding re-evaluation required per 10 CFR 50.54(f) will be addressed through future regulatory requirements.

In addition, Palisades has developed procedures and strategies for delivery of off-site FLEX equipment during Phase 3, which considers regional impacts from flooding.

2.6.3 Severe Storms with High Wind

SSCs credited for FLEX are evaluated for the design basis tornado for Palisades. The tornado design parameters are an extreme design event that bounds those parameters defined in the FSAR for operating basis straight line wind speeds. Palisades design basis wind from tornado on existing Class 1 SSCs results in an external pressure resulting from a tornado funnel having a tangential wind speed of 300 mph and a differential pressure of 3 psig per FSAR, Section 5.3.2.1. The tornado missile criterion varies for different Class 1 SSCs within the plant. The NRC reviewed these missiles against NUREG-0800 (FSAR, Section 5.5.1.3.2). The Containment Structure, Auxiliary Building, Turbine Building, Intake Structure, Auxiliary Building Radwaste Addition, Auxiliary Building TSC/EER/HVAC Addition, Diesel Fuel Oil Storage Tank Housing, and Condensate Storage Tank tornado missile design parameters are defined in the FSAR. All other SSCs for which there is no existing design basis have been evaluated per NRC Regulatory Guide 1.76, Rev. 1, based on NUREG-0800, Chapter 3, Sections 3.3.2 and 3.5.1.4, Revision 3.

In summary, based on the available locale data and Figure 7-2 of NEI 12-06, Palisades is susceptible to severe storms with high winds.

2.6.4 Ice, Snow and Extreme Cold

Per the FLEX guidance all sites should consider the temperature ranges and weather conditions for their site in storing and deploying their FLEX equipment. That is, the equipment procured should be suitable for use in the anticipated range of conditions with normal design practices.

The guidance provided in NEI 12-06 (Reference 3.1.3), Section 8.2.1 state that plants above the 35th parallel must consider extreme cold and snowfall. Per the FSAR (Reference 3.1.35), Figure 1-1, Sheet 1, Palisades is contained within a box with corner coordinates 42°18' N, -086°18' W and 42°20' N, -086°19' W. Based on these coordinates, Palisades is a Level 5 region as defined by Figure 8-2 of NEI 12-06. Thus, the Palisades site screens in for the extreme ice storm hazard. In addition, based on these coordinates the Palisades site is above the 35th parallel, and the Palisades site screens in for the extreme cold hazard.

Deployable FLEX equipment is designed for extreme cold operation and will be maintained and conditioned through plant maintenance procedures through the use of block-heaters or water jacket heaters for extreme cold to ensure it will function when deployed. Procedural guidance assures that once deployed, FLEX components are sufficiently protected to prevent inoperability due to freezing. Per FSAR Section 9.8.2.1 and Table 9-13, the site design minimum and maximum ambient temperatures are -10°F and 95°F, respectively.

Heavy ice storms associated with freezing rain or sleet occur in the area. A uniformly distributed live load of 40 lbs/ft^2 is common to all structures at Palisades to account for snow and ice. A uniformly distributed live load of 50 lbs/ft^2 is designed for the Auxiliary Building Technical Support Center (TSC)/ Electrical Equipment Room (EER)/Heating, Ventilation and Air Conditioning (HVAC) addition.

2.6.5 High Temperatures

Due to Palisades' proximity to Lake Michigan, the site experiences cooler temperatures than most locations in their region, the 10-year maximum temperature is 95°F per FSAR Section 2.5 (Reference 3.1.35). However, the guidance in NEI 12-06 (Reference 3.1.3) Section 9.2 states that all sites within the continental United States will address the high temperature scenarios. Thus, the Palisades site screens in for the extreme heat hazard.

NEI 12-06 guidance requires consideration of extreme high temperatures up to 110-120 °F. Per FSAR Sections 2.5.1 and 5.9.1.4, because of the proximity of the cool lake the extreme 10-year maximum temperature is 95 °F. Deployable FLEX equipment is designed for high temperature operation and stored/maintained at a temperature that will ensure it will function when deployed.

2.7 Planned Protection of Flex Equipment

Two structures, one inside the Protected Area (PA) and one outside the PA, are utilized to house all portable FLEX equipment. The necessity for two locations as stated arose after the soil outside the PA was found to be liquefiable in a seismic event. Liquefiable soil would likely cause differential settlements of soil along the deployment path, resulting in roads that may not be able to be traversed. At the same time, there is minimal area inside the PA to house a building that could withstand all BDBEE hazards. The solution to this problem is to house FLEX equipment in two structures that will each withstand a portion of the required BDBEE such that at least one set of portable FLEX equipment will be available and accessible for any and all BDBEE.

The storage location inside the PA, FLEX Storage Building "A", is a pre-engineered metal building designed to withstand all BDBEE with exception of the high wind hazard. The FLEX Storage Building "A" is designed to withstand cold, ice, snow, and heat, however, it will not be provided with heating or cooling capabilities. The equipment will be maintained and conditioned through plant maintenance procedures through the use of block-heaters or water jacket heaters during cold weather conditions and opening doors during hot weather conditions. The FLEX Storage Building "A" is designed to withstand all BDBEE with exception of the high wind hazard. The FLEX Storage Building "A" (and corresponding FLEX equipment within) is located within the PA north of the North Radwaste and Construction Building. This allows for the FLEX equipment to be deployed along travel paths that are not susceptible to liquefaction since the area within the PA is built upon engineered and over-consolidated soils. The building, and interaction with equipment within, are evaluated for the seismic event per NEI 12-06, Section 5.3.1.1.b. In addition, it has been demonstrated in EC46465 that the forces on the building from the plant's design basis earthquake (SSE) are bounded by the forces from the wind loading. Therefore, there is reasonable assurance that the building can withstand a SSE such that equipment within will remain deployable. The building is located atop a graded pad and concrete slab such that the stored equipment is above the maximum flood height of 594.1' and is also located such that it is protected from seismic interaction from adjacent structures. This allows for a full set of equipment to be available in the case of a seismic event and/or flood.

The storage location outside the PA, FLEX Storage Building "B", is a hardened reinforced concrete building designed to withstand all BDBEE, including tornado generated missiles, as well as seismic BDBEE for protection of the Phase 3 equipment (step down transformer and the temporary cable to connect to Bus 1D or 1C) which will be stored in the building. The building is designed for the seismic event per NEI 12-06, Section 5.3.1.1.b, and it has also been demonstrated in EC46465 that there is margin provided in the building to withstand the forces from the plant's design basis safe shutdown earthquake (SSE). Therefore there is reasonable assurance that the building can withstand a SSE such that equipment within will remain deployable.

The FLEX Storage Building "B" is designed to protect FLEX equipment against all applicable external events as specified in NEI 12-06, including tornado driven missiles as defined in NRC Regulatory Guide 1.76. The portable Phase 2 equipment in this building will not be relied upon (credited) in a seismic event due to the concern of liquefaction along the haul path from the building to the equipment staging areas. The Phase 3 equipment stored in the FLEX Storage Building "B" is considered accessible in the case of a seismic event as it is not required until 72 hours (or later) following the BDBEE, which would allow adequate time to resolve accessibility issues due to a seismic BDBEE. The FLEX Storage Building "B" is adequately equipped to withstand extreme cold, ice, snow, and extreme heat conditions. However, it will not be provided with heating or cooling capabilities. The equipment will be maintained and conditioned through plant maintenance procedures through the use of block-heaters or water jacket heaters for extreme cold. This building is also designed to withstand extreme temperatures by using a natural ventilation system. In addition, ventilation fans and small heaters are provided in this building. This ventilation combined with opening large garage doors will cope with the extreme heat. The FLEX Storage Building "B" houses one entire set of portable FLEX equipment, including a debris removal machine to clear a path from the building location to the site in the case of a high wind BDB event.

The method of storage of FLEX equipment is an alternate approach to the guidance of NEI 12-06. Since the equipment is considered only partially protected (event specific in some cases), an alternate approach is also pertinent for the allowed out of service times for the stored FLEX equipment. NEI 12-06, Revision 0 allows for a 90-day out-of-service time. The 90-day FLEX outage time for 1 of 2 functionally redundant components is based on a typical plant 12-week maintenance schedule. The 12-week out-of-service time allows an appropriate amount of time for scoping work, procuring parts and planning the activity without adversely impacting other planned maintenance activities. In the specific case of 1 of 2 functionally redundant components for which the remaining component is not fully protected from all BDBEE, a 45-day time limit was established. The 45-day limit represents the typical 6 week maintenance schedule. Requiring a time limit less than 45 days would adversely impact risk informed (EOOS), planned, man loaded activities. This could easily result in increased risk to the plant if they were required to alter the locked in work schedule to accomplish FLEX equipment maintenance by dropping already planned work. Additionally, the choice to accomplish the FLEX work outside the planned schedule through the use of overtime is also a potential risk increase given the requirements to manage overtime as part of fatigue management.

With the FLEX equipment representing components that are generally not risk significant a 45-day limit is appropriate for these circumstances when viewed with consideration of other plant equipment. In summary, Palisades will utilize a 45-day allowed out of service time requirement in lieu of the 90-day allowed out of service time of NEI 12-06, Revision 0.

2.8 Planned Deployment of Flex Equipment

2.8.1 Haul Paths and Accessibility

Deployment of FLEX equipment is described in the subsequent sections below for each strategy and all modes. The broad-spectrum deployment strategies are unchanged for the different operating modes. The deployment strategies from the FLEX Storage Buildings to each staging area are identified, as well as the debris removal concerns, security barriers, and lighting needs as they apply to each deployment path.

Palisades will use deployment paths, which refer to the route from a storage location to the staging location (for the pumps and generators), and routing paths, which refer to the route from a staging location to the point of connection to existing plant equipment (for hoses and cables).

Deployment paths are shown in Figure 1 and Figure 2 of this document for all strategies. Routing paths are shown in Attachment 3 of Reference 3.1.27.

To ensure the strategies can be implemented in all modes, areas adjacent to the equipment storage facilities and staging areas, as well as the deployment and routing paths, are kept normally accessible.

To support debris removal, a large FLEX front end loader is provided and equipped with a hitch to tow the FLEX generator and Phase 3 transformer. This machine is standardized (same model and manufacturer) for the Entergy fleet. There is reasonable assurance that a front end loader can facilitate removal/clearing of expected debris fields along the deployment path consistent with sand, trees, shrubs and damaged passenger vehicles. A debris assessment report is provided in EC 46467 (Reference 3.1.42) with more detail.

Two storage areas have been identified as discussed above. FLEX Storage Building "A" is located inside the PA (Storage Location #1 of Figure 1) on the north end of the plant in the vicinity of the North Radwaste Building. This is the primary storage location for all events except a high wind event. FLEX Storage Building "B" is located east of the plant site near the abandoned security checkpoint (Storage Location #2 of Figure 2). This is the primary storage location for the high wind event. The pathway from FLEX Storage Building "B" requires navigation through multiple security barriers and requires assistance from Security personnel. The control of security gates after a FLEX event will be through the Security Program.

The primary deployment pathway for all applicable hazards except a high wind event is entirely within the PA from FLEX Storage Building "A" to the staging areas. This primary pathway has no security barriers other than chain link fence delay gates which can be manually opened, cut open with bolt cutters, or run through with debris clearing or deployment vehicles.

The alternate pathway requires access through multiple security barriers and can be used with assistance from Security personnel.

During winter conditions, snow/ice removal is routinely performed by a local contractor and maintains deployment paths clear and free of snow and ice to assure deployment capabilities.

Based on the size, types and quantities of debris that can be expected along the deployment routes, it was concluded that the debris can be cleared using either a large 4 wheel drive truck equipped with a plow on the front or one large 4-wheeled front end loader.

The Palisades strategy stores a heavy duty pickup truck (with plow) in FLEX Storage Building "A". This heavy duty pickup truck also supports towing of the FLEX equipment. Based on an assessment of the haul path inside the PA, the debris field along the deployment travel path is considered to be minimal.

The truck is equipped with fifth wheel hitch to tow the larger generator as well as a tow hitch to move smaller equipment such as pumps and hose trailers.

A large Case 821F wheeled loader and additional heavy duty pickup truck is provided in Storage Building "B". This compliment provides capability for the wind event in excess of that provided for the other events associated with Building "A". Additionally, since Building "B" is completely hardened against all applicable external events, the equipment inside Building "B" is assured of being available for all applicable external events even though deployment following a seismic event may be challenged.

2.9 Deployment of Strategies

2.9.1 Reactor Core Cooling Strategy

Prior to depletion of the combined contents of the CST and T-81 tanks (approximately 8 hours), the portable diesel driven FLEX pump will be deployed from one of the FLEX storage buildings to provide makeup water at a Steam Generator pressure of 200 psi. Flexible hose will be dropped through removable grating (at locations currently utilized for B.5.b pump suction) into the intake canal to provide water to the pump suction from Lake Michigan. Lake Michigan provides an indefinite supply of untreated water. See Section 2.15.1 for the analysis on the effects on the heat transfer capabilities of the Steam Generators when using water from Lake Michigan.

The portable diesel driven FLEX pump will be staged west of the Intake Structure as shown in Figure 1. The primary staging location is the northwest corner of the Intake Structure and the alternate staging location is the southwest corner. The 6" suction hose and strainer will be lowered through a removed section of grating along the west wall of the intake structure. The removed section of grating for routing of the suction hose should be as close as possible to the pump to minimize suction hose lengths. Six (6) inch hose will be routed from the discharge of the FLEX pump to the hose distribution manifold located in the Turbine Building. Suggested hose manifold locations and associated hose routings are shown in Figure 9. The hose manifold is equipped with multiple 5" and 2-1/2" hose connections, including associated throttling/isolation valves. Hose connections on this manifold will provide the capability to meet all flow demands required for implementation of the FLEX Phase 2 strategy. Suggested hose routing sketches from the manifold to Phase 2 FLEX demands are also included in Attachments 9.2.7 and 9.2.8 of EC-46465 (Reference 3.1.27).

The hose route paths pass through the Turbine Building to utilize the connection point on the MFW system. Refer to Section 2.3.4 which documents the results of the evaluation of the Turbine Building and its ability to remain intact, accessible and protect FLEX equipment for the FLEX strategy.

The portable electric driven FLEX air compressor that supports long-term ADV operation is powered by the portable diesel driven FLEX generator and staged within the Auxiliary Building. An extension cable will be run from either the primary or secondary generator staging location to the compressor staging location (refer to Attachment 9.2.4 of Reference 3.1.27).

There are two portable diesel driven FLEX pumps provided for the strategy, one is stored in Building "A" and one is stored in Building "B". Likewise, two portable electric driven FLEX air compressors are provided for the strategy, one is stored in each storage building.

The primary and alternate deployment pathways for FLEX equipment from each storage location are shown in Figure 1.

2.9.2 Primary Coolant System (PCS) Strategy

The FLEX PCS strategy relies on utilization of installed Charging Pumps, powered by the FLEX generator. No connection points are necessary for the PCS inventory control strategy (Modes 1-4), though connection points are required for the Modes 5 and 6 shutdown strategy. The borated water source for suction to the installed Charging Pumps is from the installed BASTs. The borated water inventory in these tanks is sufficient to maintain PCS inventory control for at least 24 hours without makeup. Prior to depletion of these tanks, boric acid batching operation will begin using the installed Boric Acid Mixing Tank (T-77). Water for makeup to the Boric Acid Batch Mixing Tank (to support batching operations) is provided by the portable diesel driven FLEX pump beginning 24 hours following the event. No connection points are required for water makeup to T-77 which will be provided via flexible hose by the portable diesel driven FLEX pump with suction from Lake Michigan. As previously discussed, the portable diesel driven FLEX pump supplies all water needs for the Palisades FLEX strategy through the multi-port manifold.

The Phase 3 low pressure/high flow NSRC pump will be connected to the Service Water System by a deployable header installed on the inlet flange to Strainer F-2C inside the Intake Structure. Staging locations for the NSRC pump are identical to that of Palisades' portable diesel driven FLEX Pump. No modification or designed connection point is required for establishing the connection to the service water system. The flanged elbow that connects the Service Water pump discharge to the Service Water strainer inlet must be removed and the deployable aluminum header installed at the 16" inlet flange of the Service Water strainer. To facilitate removal of the existing service water elbow and installation of the deployable Phase 3 service water header, a portable crane/hoist and associated rigging will be required. The portable hoist/mobile engine crane will be hydraulic, manually operated, with a minimum capacity to support the 16" flanged SW elbow. The actions necessary to install the deployable header are contained in FLEX procedures and plant staff is trained to perform the activity.

2.9.3 Electrical Strategy

The primary electrical connection point will include a permanently installed connection that enables a quick plug up connection of the portable diesel driven FLEX generator to the 480 VAC Electrical Distribution System (EDS). See earlier discussion for primary and alternate connections at LCC 19 and 20, and Section 2.3.4.18 for discussion of equipment qualification for all applicable external events. The connection to LCC-19 will be via a new FLEX panel (EP-1901) installed in the North Penetration Area with one set of quick disconnect receptacles. Permanent cables complete the connection from EP-1901 to breaker 52-19FLEX in LCC-19. The alternate connection point for the FLEX Generator is Load Center 20. The connection to LCC-20 will be via a new FLEX panel (EP-2001) installed in the Electrical Equipment Room with one set of quick disconnect receptacles. Permanent cables complete the connection from EP-2001 to breaker 52-20FLEX in LCC-20.

There are two (2) portable diesel driven FLEX generators provided for the strategy, one is stored in FLEX Building "A" and one in FLEX Building "B".

The primary staging location for the FLEX Generator is northeast of the Containment Building. Cables will be routed from the staging location to quick disconnect box EP-1901 in the North Penetration Area as shown on Figure 10. The secondary staging location for the FLEX Generator is the courtyard north of the Turbine Building. Cables will be routed from the staging location to the Electrical Equipment Room and over to quick disconnect box EP-2001 as shown on Figure 11.

The Phase 3 NSRC generator will be connected to one train of Class 1E 2400 V switchgear (via a transformer), either Bus 1C or Bus 1D. The transformer will step the voltage from the NSRC generator (4160 VAC) down to the Bus 1C (1D) voltage (2400 VAC). The 4160VAC/2400VAC Step Down Transformer will be connected to Bus 1D or 1C using temporary cables connected directly to an existing breaker 152-213 (or 152-107 on Bus 1C) on the bus for all 3 phases. No modification or designed connection point is required for establishing the connection to the switchgear. The actions necessary to connect the cables are contained in FLEX procedures and plant staff is trained to perform the activity. Palisades stores the Phase 3 4160VAC/2400VAC Step Down Transformer in FLEX Building "B" which provides protection from all applicable external hazards.

See Figure 5 through Figure 8 for one-line electrical diagrams of primary and alternate electrical connection points.

2.9.4 Fueling of FLEX Equipment

An evaluation (Attachment 9.3.11 of Reference 3.1.27), which assessed the amount of diesel fuel required to operate the portable diesel driven FLEX generator and one portable diesel driven FLEX pump from hours 8 to 72 (i.e., running time of 64 hours) following a BDBEE was performed. Additionally, the evaluation identified an acceptable source of diesel fuel on site and determined the pumping requirements to ensure that this fuel is accessible during an ELAP.

As part of this evaluation, the Diesel Fuel Oil Storage Tank (T-10A) was identified as the source of fuel (refer to Section 2.3.4.19 for discussion on qualification of this tank).

The amount of diesel fuel consumed by the FLEX portable pump and the generator is approximately 3,300 gallons for a period of 64 hours. The minimum required storage volume for the T-10A is 30,554 gallons. Therefore the diesel fuel stored in T-10A is more than sufficient to provide the fuel required by the FLEX equipment and could power the equipment for approximately 24 days.

The strategy for refueling the portable diesel driven FLEX pump and portable diesel driven FLEX generator is to use a portable, DC-powered fuel pump to transfer diesel fuel from T-10A into a 500 gallon tank mounted trailer. This DC fuel pump will be powered from the heavy duty FLEX truck wiring harness. The trailer towed by the heavy duty FLEX truck will be used to deliver fuel to the FLEX pump and diesel generator, stopping by T-10A to refill the trailer as needed. A second DC fuel pump, powered from the FLEX truck, will be mounted on the trailer, and will be used to transfer fuel from the trailer to each piece of equipment.

The evaluation estimates that the first transfer of fuel from T-10A to each piece of FLEX equipment will require 118 minutes, or approximately 2 hours. Once the initial setup is complete, fuel can be re-delivered to both sets of equipment in intervals of 90 minutes. The limiting FLEX component with regard to refuel frequency is the FLEX pump, which is conservatively estimated to require a refuel every 5 hours.

Because both tanks can be refueled initially within 2 hours, and within 1.5 hour intervals in subsequent refuels, this refueling strategy ensures that the FLEX pump and diesel generator will operate with sufficient fuel well beyond 72 hours following a BDBEE.

Two sets of FLEX refueling equipment (trailer mounted tank, pumps, etc) are provided, with one set being stored in FLEX Storage Building "A" and the other in FLEX Storage Building "B". The Fuel Oil transfer tank is stored full of fuel (greater than 95% capacity). Each FLEX pump and generator is stored with fuel in their tanks. Fuel in each generator and pump is sampled/replaced on a preventive maintenance interval specified by Entergy Fleet PM Basis Templates specific to the equipment.

Diesel fuel in the EDG fuel oil storage tanks (including T-10A) is Low Sulfur (500 ppm sulfur) fuel oil or better, and is routinely sampled and tested commensurate with its use for the onsite EDGs to assure fuel oil quality is maintained to ASTM standards. This assures the fuel oil in T-10A is compatible with the EPA Tier 2 and Tier 3 engines (which will run on Low or Ultra Low Sulfur fuel) for the portable FLEX pumps and generators.

2.10 Off-site Resources

2.10.1 National SAFER Response Center

The industry established two National SAFER Response Centers (NSRCs) that house backup equipment to that used by the sites and additional equipment for long term recovery in support of utilities needs during BDB events. One facility is located in Phoenix, Arizona and the other is in Memphis, Tennessee. Entergy has established contracts with the Pooled Equipment Inventory Company (PEICo) that operates these facilities and the NSRCs are obligated to provide one complete set of the sites Phase 2 equipment as well as requested long term recovery equipment unique to the sites strategy. The Palisades on-site BDB equipment hose and cable end fittings are standardized with the equipment supplied from the NSRC. In the event of a BDB external event and subsequent ELAP/LUHS condition, equipment will be moved from the NSRC to a local assembly area established by the Strategic Alliance for FLEX Emergency Response (SAFER) team. NSRC equipment will begin arriving at Palisades designated site staging locations within the first 24 hours and all obligated equipment is received, staged and deployed no later than 72 hours after the event.

2.10.2 Equipment List

The equipment stored and maintained at the NSRC for transportation to the local assembly area to support the response to a BDBEE at Palisades is listed in Table 3. Table 3 identifies the equipment that is specifically credited in the FLEX strategies for Palisades.

2.11 Habitability and Operations

2.11.1 Equipment Operating Conditions

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

The key areas identified for all phases of execution of the FLEX strategy activities are inside Containment, the Main Control Room, the TDAFW Pump Room, Cable Spreading Room, Electrical Equipment Room, Battery Rooms and the SFP area. These areas have been evaluated to determine the temperature profiles following an ELAP/LUHS event.

Containment – Calculation EA-EC46465-02 of Reference 3.1.27 evaluated the Containment response following an ELAP. Based on the results of this analysis, the instrumentation relied upon during the FLEX strategy was evaluated to ensure functionality of the equipment following an ELAP. The instrumentation evaluated included SG Pressure and Level, Pressurizer Pressure and Level, Hot Leg and Cold Leg Temperature, Nuclear Instrumentation, Reactor Vessel Level Instrumentation (RVLMS), Core Exit Thermocouples, Softline Cables inside Containment, and Containment Pressure. The evaluation determined that if a method of cooling Containment is initiated within 6 days after the event, the instrumentation relied upon for the FLEX strategy will continue to function indefinitely. As discussed above in Section 2.5.3, equipment from the NSRC necessary to support Containment cooling (i.e., low pressure/high flow pump and 4160VAC generator) will be deployed and available within 72 hours after the event. Therefore, instrumentation relied upon for the FLEX strategy will be available following an ELAP for continued plant coping. Operator actions are not required inside of Containment following an ELAP so personnel habitability is not a concern.

Main Control Room - Calculation EA-EC46465-03 of Reference 3.1.27 determined that opening doors and providing a 4000 cfm ventilation flow 75 hours after the event will maintain the Control Room at a maximum temperature of 104°F, which is below the conservative limit for Control Room habitability of 110°F in NUMARC 87-00. The forced 4000 cfm ventilation flow requirement can be satisfied by use of NSRC provided ventilation fans.

TDAFW Pump Room - Palisades calculation EA-GOTHIC-AFW-01 (Reference 3.1.43) determines that with AFW Pump P-8B in service, the AFW pump room will not exceed the acceptance criteria of 160°F for at least 5 days. Access to the TDAFW Pump Room is not expected to be required during the event. The Palisades strategy only relies upon the TDAFW Pump for the first 8 hours of plant coping, at which point SG makeup is transitioned to the portable diesel driven FLEX pump. Therefore, operability of equipment in the TDAFW pump room is not challenged following an ELAP. If access to the TDAFW Pump Room is required, it would early (less than 8 hours) into the event when personnel habitability due to increased temperature would not be a concern.

Spent Fuel Pool Area - NEI 12-06, Table D-3 requires a vented pathway for steam and condensate from the SFP. This requirement is met by opening the double leaf doors on the roof of the Fuel Handling Building. The double leaf door will be opened prior to SFP boiling based on the heat load in the pool at the time of the event (as early as 3.28 hours for a full core offload). Operator actions that are required on the SFP floor (routing of hoses, positioning of spray nozzles) will be completed prior to SFP boiling such that personnel habitability in the SFP area will not be a concern.

Cable Spreading Room, Electrical Equipment Rooms, Battery Room, Switchgear Room 1D - Calculation EA-EC46465-04 of Reference 3.1.27 determined the temperature in these rooms following an ELAP. The calculation determined that with extreme high temperatures outside, operator actions to open doors may be required to maintain the temperature in these rooms less than 120°F and ensure long term functionality of equipment in these rooms. The operator actions to open doors in the Cable Spreading Room (CSR) and Electrical Equipment Rooms (EERs) are contained in the FSGs. Therefore, equipment in these rooms relied upon for the FLEX coping strategy will remain functional following an extreme high temperature event. Operator actions required in these rooms (routing cables, positioning exhaust fan, opening doors) will be completed early in the event when temperature has not significantly increased. The required actions are short duration activities and the temperature in the rooms at the time of the actions will not present concerns for personnel habitability.

This calculation also determines the electrolyte temperature for the batteries for an extreme low temperature event. The calculation determined that the electrolyte temperature for the batteries in both room remains above 70°F (Technical Specification operability limit) for the analysis duration of eight hours. Eight hours after the event, the FLEX generator will be connected to the Battery Chargers. Therefore, the batteries will remain functional during the extreme low temperature event without any operator action to provide supplemental heat to the rooms.

<u>Battery Room Hydrogen</u> - To prevent hydrogen accumulation, portable ventilation/exhaust to the Battery Rooms is required 1.5 hours after battery charging begins, or 9.5 hours after the event. A lightweight (< 30 lbs), electric driven portable FLEX exhauster/blower specifically designed for confined space and hazardous location ventilation is staged immediately adjacent to and outside of both Battery Rooms. The exhauster, which is powered from a 120V AC receptacle on the portable diesel driven FLEX generator, is specified with a minimum capacity of 150 scfm required for Battery Room hydrogen ventilation per EA-DBD-1.07-001 (Reference 3.1.44). Flexible duct that connects to the portable fan will be routed from the Cable Spreading Room outside of the Turbine Building such that the hydrogen can be exhausted to the atmosphere, preventing hydrogen accumulation in other areas of the plant. The Battery Rooms are located within the Seismic Category 1 Auxiliary Building. Since only one set of batteries associated with one Battery Room are required for the strategy, only one fan is required to support the strategy. As such, the unused fan may act as a backup to the fan in use. Both fans are fully protected from all applicable external events and storage of the equipment in this manner exceeds the guidance of NEI 12-06.

<u>Backup Nitrogen Station 9</u> – Two hours after the event, backup nitrogen supply to the Atmospheric Dump Valves must be aligned to allow cool down of the PCS. Eight hour after the event and prior to depletion of Backup Nitrogen Station 9 at 9.1 hours, the portable electric driven FLEX air compressor will be connected to a permanent connection on Station 9. Backup Nitrogen Station 9 is located in a small enclosure on the roof of the Auxiliary Building in close proximity to the Main Control Room. The access door to the enclosure opens to the atmosphere and there are no significant heat generating sources in

the room. The operator actions required in this area occur early into the event (two and eight hours) and are short duration actions to align valves and connect hoses. Given the time that actions are required, the lack of heat sources in the room, the short duration of the activity, and that the access door to the room opens to the atmosphere, personnel habitability for actions at Backup Nitrogen Station 9 is not a concern.

2.11.2 Heat Tracing

Heat tracing to FLEX connections is not required. All FLEX connections for hose or piping carrying water are inside buildings. For hoses that are routed outside and are susceptible to freezing during extreme low temperatures a method of recirculation is provided such that flow can be maintained in the exposed hose at all times thereby preventing freezing of the hose line. As discussed in Section 2.3.2, heat tracing is not required to prevent precipitation of boric acid.

2.12 Personnel Habitability

Personnel habitability was evaluated based on the calculations discussed above in Section 2.11 above and determined to be acceptable.

2.13 Lighting

The Main Control Room is served by emergency AC lighting, emergency DC lighting (powered by station batteries) and battery powered Emergency Lighting Units (ELUs) (Reference 3.1.25). During Phase 1 of a BDBEE, lighting in the MCR will be provided by the emergency DC lighting and ELUs. At eight hours after the event (start of Phase 2) the portable diesel driven FLEX generator is connected to provide power to the Battery Chargers for the continued operation of emergency DC lighting. Operators will have portable LED flashlights and lanterns available as necessary to provide lighting for operator actions outside the MCR. Area lighting is required for outside deployment during the night and it is met by the lights on the truck used to haul the generator as well as portable diesel driven FLEX light towers. Additional battery operated LED light towers are also stored in each FLEX Storage Building.

2.14 Communications

The Palisades communication plans are discussed in depth in letters to the NRC (References 3.1.23 and 3.1.24).

The Palisades communications systems and equipment are designed and installed to assure reliability of on-site and off-site communications in the event of a Design Basis Accident scenario. However, in the event of an ELAP, it is assumed limited communications systems functionality will be available.

A standard set of assumptions for an ELAP event is identified in NEI 12-01, Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities, May 2012.

<u>On site:</u>

Plant procedures include guidance for when normal communication means are not available. In addition, sufficient numbers of walkie-talkies will be available to provide communications between the various locations throughout the plant.

Radio communication equipment used in normal plant operations will also be used in an emergency to communicate with mobile units. The radio system consists of repeaters, antennas and portable radios, which provide communication between the TSC, dispatched in-plant teams and the Palisades Main Control Room. A radio repeater system provides communications via handheld radios to the operators during implementation of the BDBEE mitigation actions.

Uninterruptible Power Supplies (UPS) are provided to the credited communication components (i.e., credited equipment) for a minimum period of 24 hours following a BDBEE. Hand-held equipment (radios and satellite phones) will have adequate spare batteries to provide for 24 hours. After the initial 24-hour period, portable generators will provide power for the credited equipment. The credited equipment includes satellite phones and the Operations radio control station in the Main Control Room.

<u>Off-Site:</u>

Existing telephone communications are assumed to be inoperable following a BDBEE and therefore not credited. Communication links are established via satellite phones and use of the credited site radio channel(s). Satellite phones are the only reasonable means to communicate off-site when the telecommunications infrastructure surrounding the nuclear site is non-functional. They connect with other satellite phones as well as normal communications devices.

NEI 12-01, Section 4.1, outlines the minimum communication links to the federal, state, and local authorities. A total of 21 satellite phones are available for off-site communications. These phones are distributed between the Main Control Room (MCR), the Technical Support Center (TSC), the Operations Support Center (OSC), the Emergency Operations Facility (EOF), the Joint Information Center (JIC) and alternative emergency response facilities. Additionally, local Off-site Response Organizations (OROs) have satellite phone capability.

2.15 Water sources

2.15.1 Secondary Water Sources

Section 2.3.10.8 provides the credited water sources that are used to provide cooling water to the SGs. The CST and tank T-81 provides a minimum of 8 hours of inventory to the TDAFW pump at the initial onset of the event. Before the combined inventories of the two tanks is exhausted the portable diesel driven FLEX pump is placed in service drawing water directly from Lake Michigan. These tanks are fully protected and qualified for all applicable external events (see Section 2.3.4).

Lake Michigan provides an indefinite supply of untreated water and is assured to be available for all applicable external events. Calculation EA-EC46465-01 (Reference 3.1.48) was developed to determine the effects on the heat transfer capabilities of the Steam Generators when using this water for long-term makeup (i.e., Lake Michigan). This analysis assumed that demineralized water is available for Steam Generator injection for the first eight hours after the event. Steam Generator makeup will then transition to Lake Michigan water with the required AFW flow rates. Results of this calculation show a 4.4% loss of heat transfer capability in the Steam Generators 120 hours after the event. This minor loss in heat transfer capability is acceptable for operation up to 120 hours after the event due to the decrease in decay heat in the reactor that is required to be removed by the Steam Generators.

Approximately 72 hours after the event, a mobile water purification unit from the NSRC will be available. The analysis duration of 120 hours was chosen to provide margin beyond the 72 hours for deployment and operation of the water purification unit. The mobile purification unit will provide demineralized water to the FLEX pump for injection to the Steam Generators such that the only potential for Steam Generator fouling (i.e., loss of heat transfer capability) would occur during the period when lake water is injected directly into the Steam Generators without treatment.

Although not fully protected for all applicable external events, additional water sources may be available following an ELAP. The preferred additional water sources are discussed below, with other sources shown below in Table 4. If available, these water sources could be used for plant coping as necessary:

Safety Injection Refueling Water Tank (SIRWT) – The SIRWT contains 285,000 gallons of borated water at a concentration of 1720 ppm and is the normal suction source for the installed Charging Pumps. Inventory in the SIRWT could be used for PCS inventory control. Since the SIRWT is not fully protected from tornado missiles, it is not credited in the Palisades strategy.

Demineralized Water Storage Tank (T-939) – The Demineralized Water Storage Tank is located north of the Turbine Building and contains approximately 300,000 gallons of demineralized water. If available, the inventory in T-939 could be transferred into the CST to extend the duration that SG makeup can be accomplished via the installed TDAFW system. Since T-939 is not seismically qualified or protected from tornado missiles, it is not credited in the Palisades strategy.

Diesel Driven Fire Pumps (DDFPs) – Two DDFPs (P-9B and P-41) are located within the Intake Structure and take suction from Lake Michigan. Discharge of these pumps can be aligned to provide makeup to the TDAFW Pump P-8B for continued SG makeup via installed plant equipment. The actions to align valves for DDFP makeup to TDAFW is currently proceduralized and credited as the backup water supply following a tornado missile strike of the CST. The pumps are located inside the robust Intake Structure, but fire water piping has not been evaluated to be seismically robust, and the diesel fuel necessary to sustain continued operation of the DDFPs is not protected from all applicable external events. Therefore, the DDFPs are not credited in the Palisades strategy.

2.16 Shutdown and Refueling Analysis

Steam Generators Unavailable for Cooling (Modes 5 and 6)

Palisades has incorporated the guidance of NEI Position Paper titled "Shutdown / Refueling Modes," (Reference 3.1.17) addressing mitigating strategies in shutdown and refueling modes. This position paper has been endorsed by the NRC (Reference 3.1.18). Therefore, Entergy has incorporated the supplemental guidance provided in the NEI position paper to enhance the shutdown risk process and procedures. The approach for incorporation of the supplemental guidance is provided below.

Entergy fleet procedure EN-OU-108 has been revised consistent with the NEI position paper and includes guidance to consider the following:

- Maintaining FLEX equipment available, and
- FLEX equipment deployment such as pre-staging equipment to support maintaining or restoring the key safety functions in the event of a loss of shutdown cooling.

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

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

Hot Standby (Mode 3) and Hot Shutdown (Mode 4 SDC not in service) are all bounded by the FLEX strategy for power operation. For Mode 4 SDC in service, Cold Shutdown (Mode 5), and Refueling (Mode 6) the PCS and SG configurations may vary considerably. Five plant states were examined for an ELAP being declared with SDC aligned:

- Plant State A: PCS intact and full with SGs available.
    - Recovery by single phase natural circulation.
- Plant State B: PCS vented and capable of being made intact with SGs available.
    - Recovery by natural circulation or Once-Through-Cooling.
- Plant State C: PCS vented and not capable of being made intact with Reactor Vessel Upper Head installed

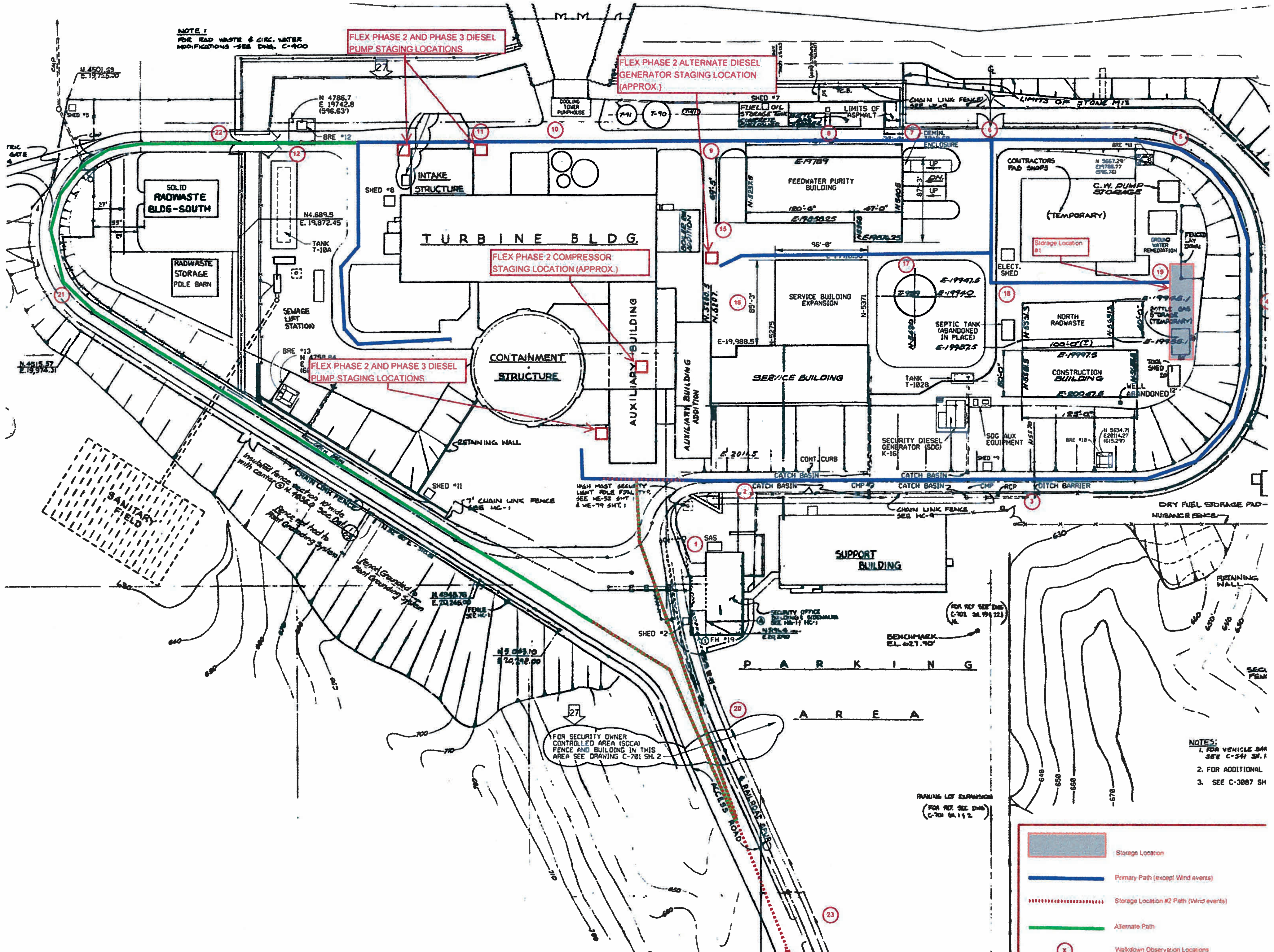
  - Recovery by Once-Through-Cooling.

- Plant State D: Reactor Vessel Head removed and PCS drained below Reactor Vessel flange
  - Recovery by Once-Through-Cooling and pool boiling.
- Plant State E: Reactor Vessel Head removed and Refueling Pool flooded.
  - Recovery by Once-Through-Cooling and pool boiling.

If the plant is in Mode 5 with the PCS vented or in Mode 6, the FLEX strategy for power operation is not available. In this case, AOPs/FSGs provide guidance to utilize the best available means to provide core cooling, including: gravity drain of borated water from the SIRWT or SITs to the PCS; repowering of an installed charging pump to inject borated water from any available source; and finally, non-borated water sources.

If all sources of borated water are unavailable for PCS makeup, then Lake Michigan provides an indefinite supply of makeup water that can be used until other resources become available. Newly installed physical connection points in the HPSI and LPSI systems provide the ability to make-up water to the PCS via the portable diesel driven FLEX pump. The HPSI and LPSI system piping connections may be utilized for implementation of FLEX coping strategies to ensure Reactor core cooling and heat removal when the Steam Generators are not available to remove decay heat (i.e., Modes 5 and 6) by maintaining PCS inventory control.

With SDC and the SGs unavailable to remove decay heat, the method of reactor core cooling discussed will cause water/steam to “spill” into Containment causing pressure and temperature to slowly increase in Containment. In order to maintain Containment within its design limits, it may be necessary to establish a vent path following an ELAP in Modes 5 or 6. This vent path via the Containment purge headers is discussed in Section 2.5.2.


FLEX PHASE 2 AND PHASE 3 DIESEL PUMP STAGING LOCATIONS
FLEX PHASE 2 ALTERNATE DIESEL GENERATOR STAGING LOCATION (APPROX.)
FLEX PHASE 2 COMPRESSOR STAGING LOCATION (APPROX.)
FLEX PHASE 2 AND PHASE 3 DIESEL PUMP STAGING LOCATIONS
Storage Location #1
TURBINE BLDG
CONTAINMENT STRUCTURE
AUXILIARY BUILDING
AUXILIARY BUILDING ADDITION
INTAKE STRUCTURE
SOLID RADWASTE BLDG-SOUTH
RADWASTE STORAGE POLE BARN
SEWAGE LIFT STATION
FEEDWATER PURITY BUILDING
SERVICE BUILDING EXPANSION
SERVICE BUILDING
SEPTIC TANK (ABANDONED IN PLACE)
NORTH RADWASTE
CONSTRUCTION BUILDING
CONTRACTORS FAB SHOPS
C.W. PUMP STORAGE
(TEMPORARY)
SECURITY DIESEL GENERATOR (SDG) K-16
SUPPORT BUILDING
SANITARY FIELD
RETAINING WALL
PARKING AREA
ACCESS ROAD
DRY FUEL STORAGE PAD
BENCHMARK EL 627.90'
FOR SECURITY OWNER CONTROLLED AREA (SOCA) FENCE AND BUILDING IN THIS AREA SEE DRAWING C-781 SH. 2
NOTES:
1. FOR VEHICLE BA... SEE C-541 SH. ...
2. FOR ADDITIONAL
3. SEE C-3087 SH
Storage Location
Primary Path (except Wind events)
Storage Location #2 Path (Wind events)
Alternate Path
Walkdown Observation Locations

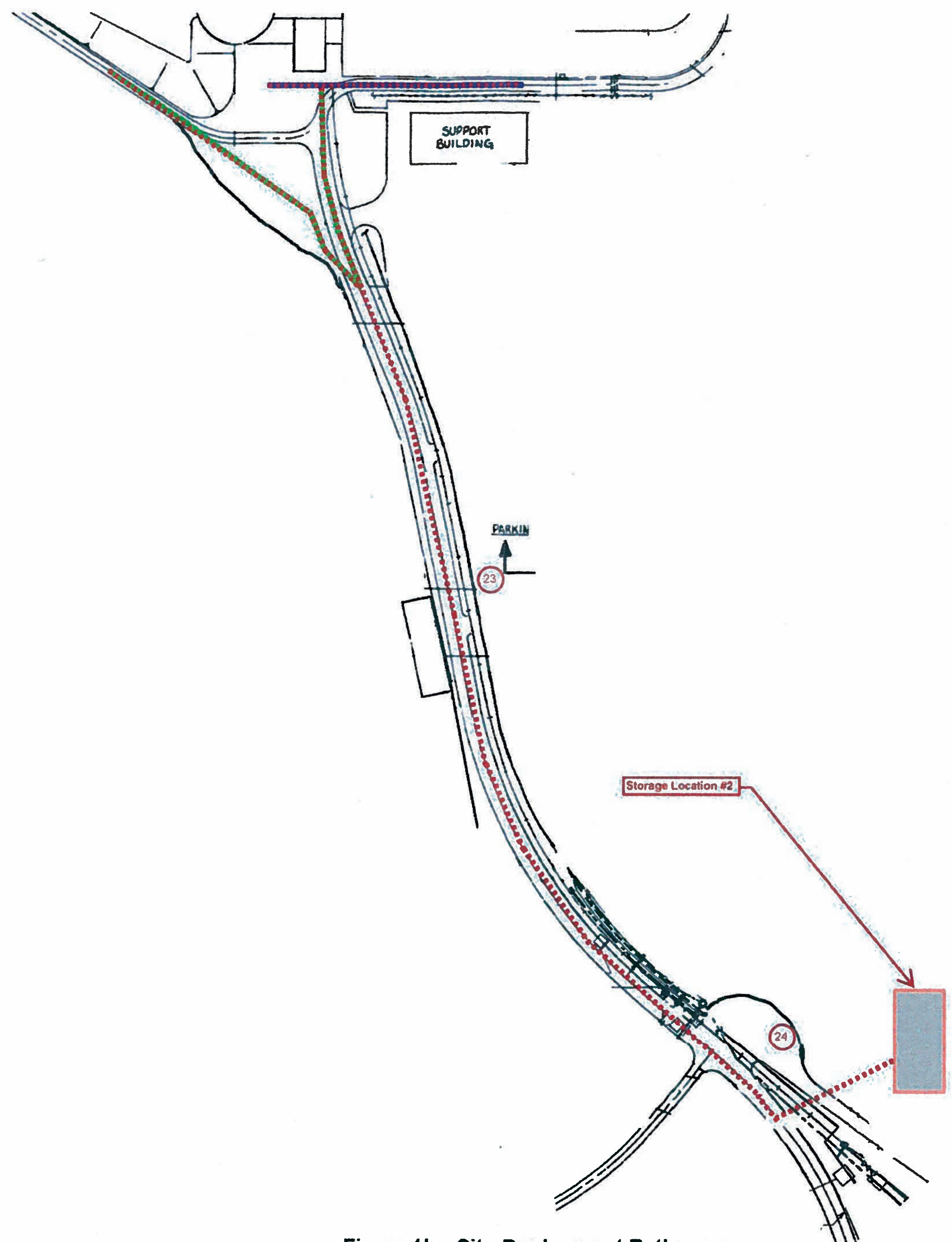
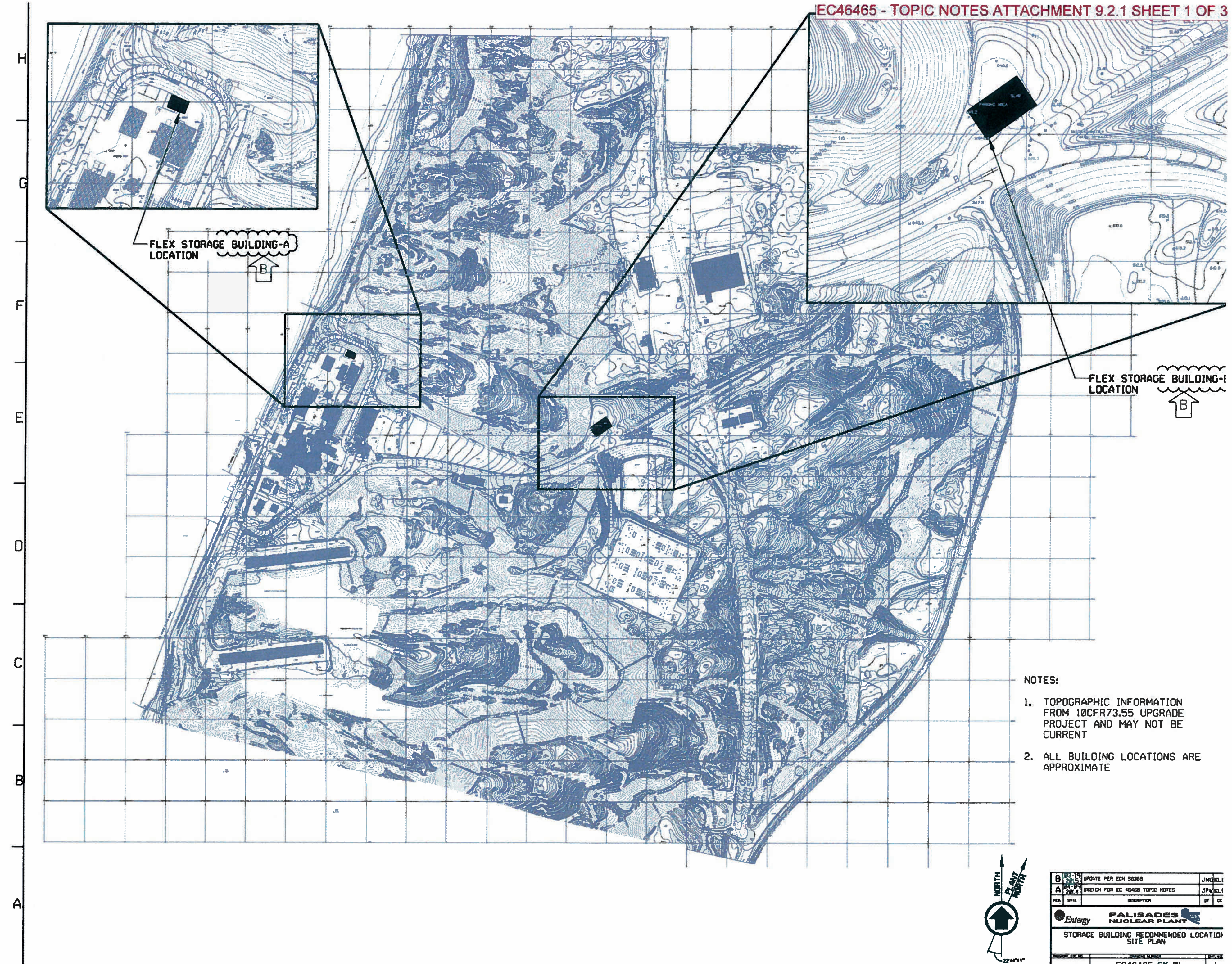


Figure 1b - Site Deployment Pathways



NOTES:

1. TOPOGRAPHIC INFORMATION FROM 10CFR73.55 UPGRADE PROJECT AND MAY NOT BE CURRENT

2. ALL BUILDING LOCATIONS ARE APPROXIMATE

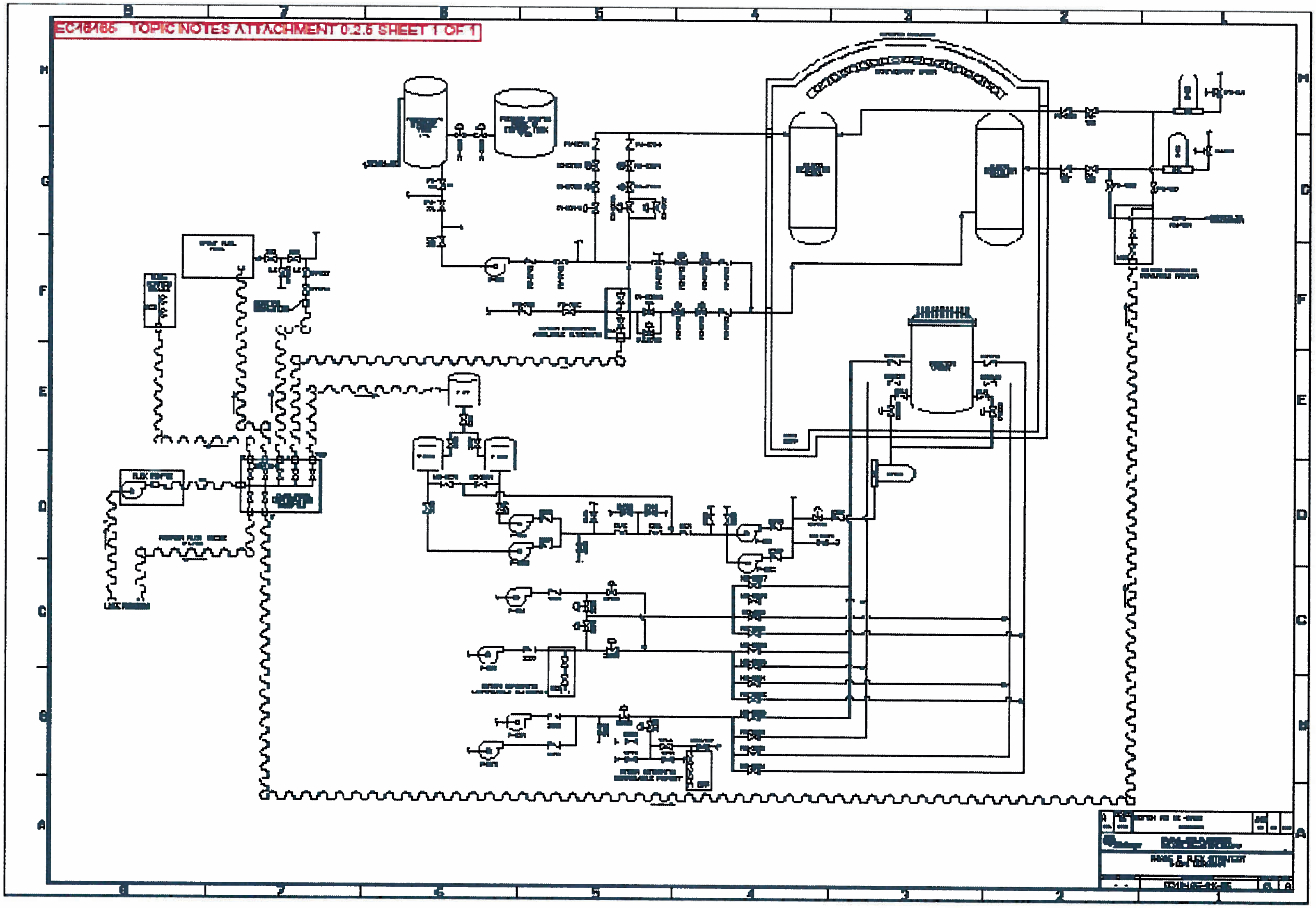
REV.	DATE	DESCRIPTION	BY	CK
B	03-19 2015	UPDATE PER ECN 56388	JMG	KLE
A	04-09 2014	SKETCH FOR EC 46465 TOPIC NOTES	JPW	KLE

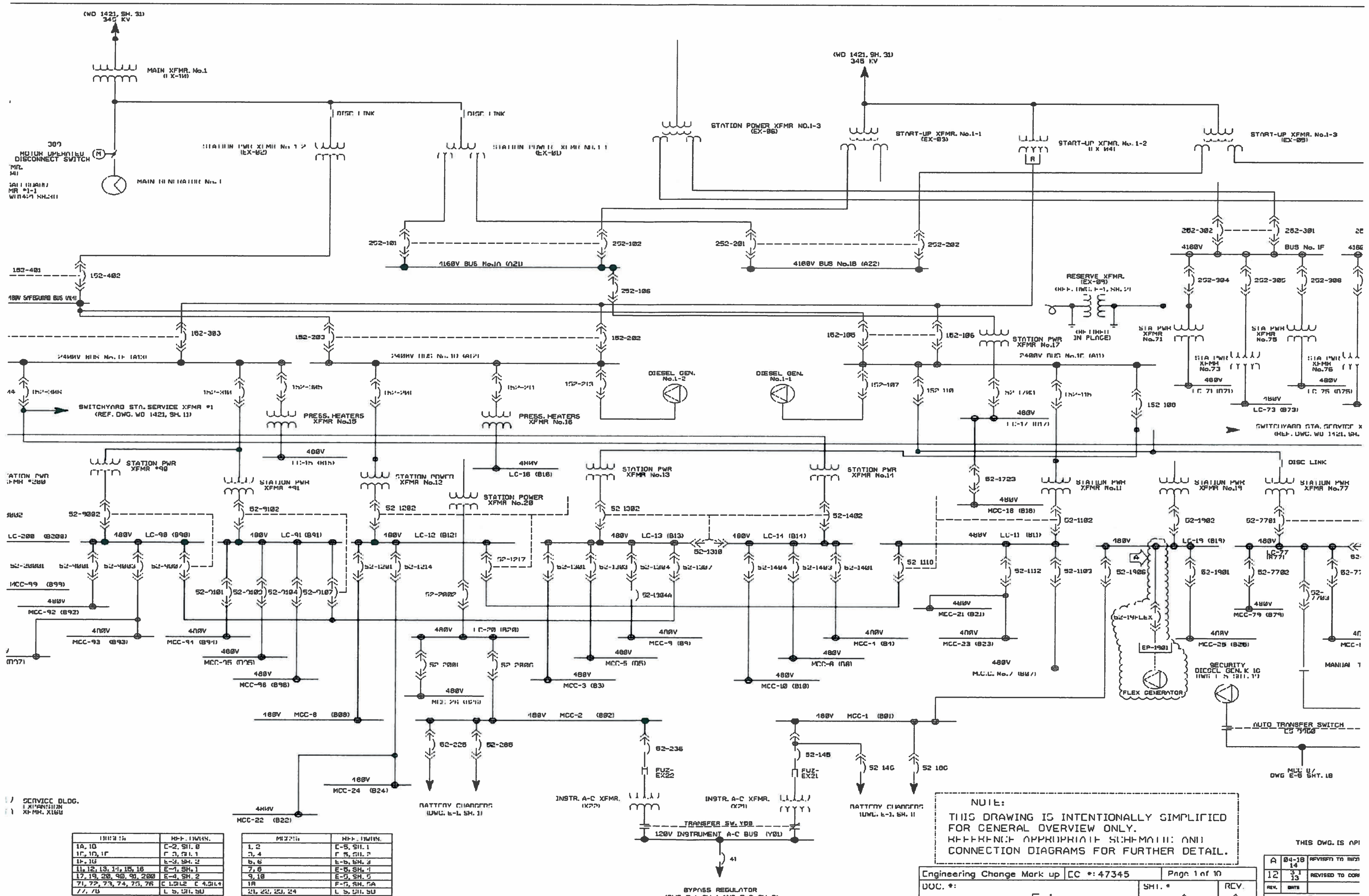
Entergy — PALISADES NUCLEAR PLANT

STORAGE BUILDING RECOMMENDED LOCATION SITE PLAN

PROPERTY DOC NO.	DRAWING NUMBER	SHT. NO.
	EC46465-SK-01	1

Figure 4: FLEX Strategy Flow Diagram





DOCS	REF. DWGS.
1A, 1B	E-2, SH. 0
1C, 1D, 1E	E-3, SH. 1
1F, 1G	E-3, SH. 2
11, 12, 13, 14, 15, 16	E-4, SH. 1
17, 19, 20, 90, 91, 200	E-4, SH. 2
71, 72, 73, 74, 75, 76	E 1.SH.2 E 4.SH.4
77, 78	E 5, SH. 5B

MCC'S	REF. DWGS.
1, 2	E-5, SH. 1
3, 4	E-5, SH. 2
5, 6	E-5, SH. 3
7, 8	E-5, SH. 4
9, 10	E-5, SH. 5
18	E-5, SH. 5A
21, 22, 23, 24	E 5, SH. 5B
25, 26	E-5, SH. 5C
27	E-5, SH. 12
79, 81, 82	E-5, SH. 5D
88	E 5, SH. 5E
92, 93	E-5, SH. 6
94, 95	E-5, SH. 7
96, 97	E-5, SH. 8
99, P9980	E-5, SH. 9
E8-87	E-5, SH. 18

NOTE:
THIS DRAWING IS INTENTIONALLY SIMPLIFIED FOR GENERAL OVERVIEW ONLY.
REFERENCE APPROPRIATE SCHEMATIC AND CONNECTION DIAGRAMS FOR FURTHER DETAIL.

Engineering Change Mark up	CC #: 47345	Page 1 of 10
DOC. #: E-1	SHT. #: A	REV. A
Safety Related: ☐ Before View ☐	Control Room Drawing ☐	
Supersedes Mark-up from CC #:	Issued per CCN #:	
K. DEGROOT Prepared By:	04/18/14 Date	R. RAHMAN Reviewer Name (Optional)

(FORMERLY WD950, SH. 17, REV. W)

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REV.	DATE	
A	04-18-14	REVISED TO INCO
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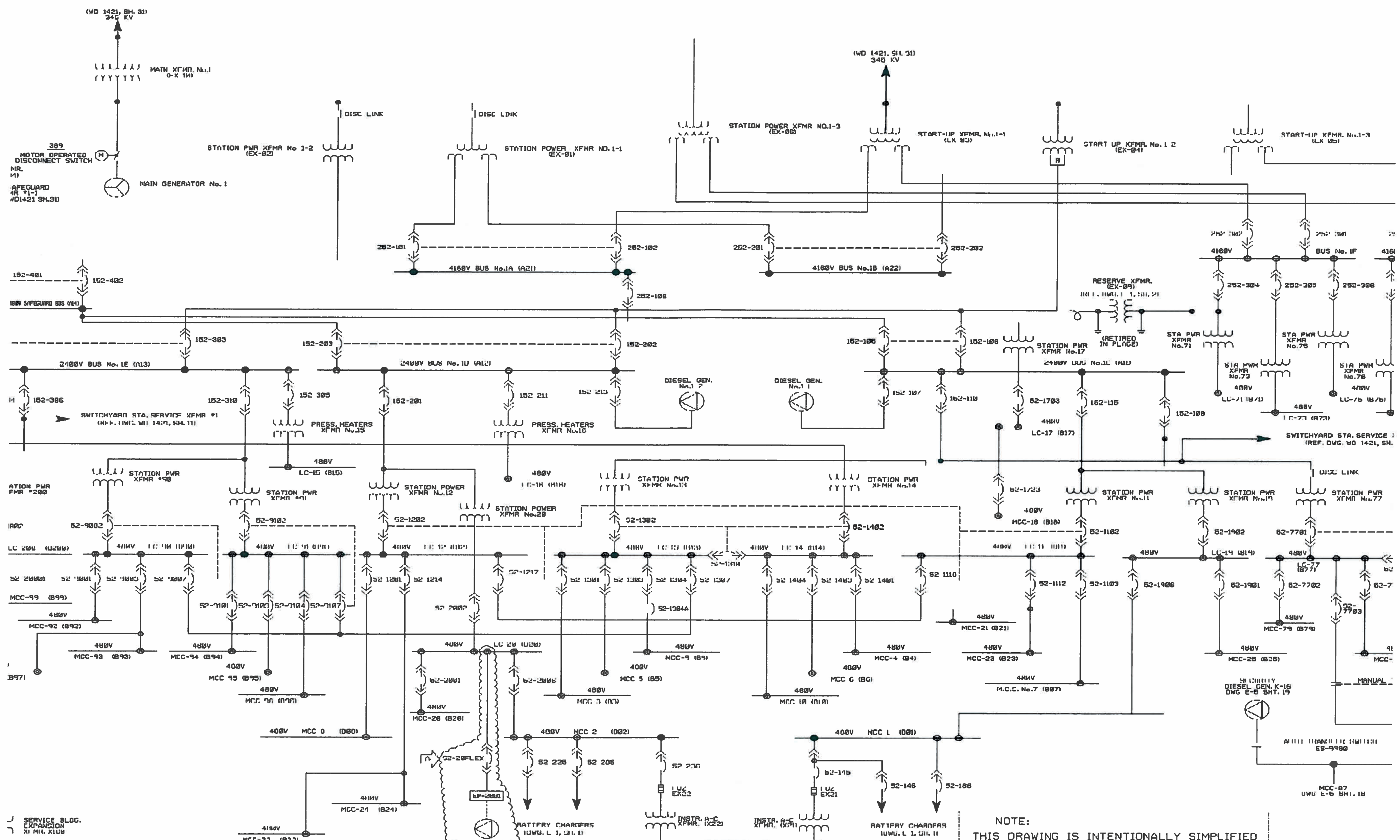

[illegible]	REF. DWG.
1A, 1B	E-2, SH. 8
1C, 1D, 1E	E-3, SH. 1
1F, 1G	E-3, SH. 2
11, 12, 13, 14, 15, 16	E-4, SH. 1
17, 19, 20, 90, 91, 200	E-4, SH. 2
71, 72, 73, 74, 75, 76	E-1.SH.2 E-1.SH.1
77, 78	E-5, SH. 5D

[illegible]	REF. DWG.
1, 2	E-5, SH. 1
3, 4	E-5, SH. 2
5, 6	E-5, SH. 3
7, 8	E-5, SH. 4
9, 10	E-5, SH. 5
18	E-5, SH. 5A
21, 22, 23, 24	E-5, SH. 5B
25, 26	E-5, SH. 5C
27	E-5, SH. 12
79, 81, 82	E-5, SH. 5D
88	E-5, SH. 5E
92, 93	E-5, SH. 6
94, 95	E-5, SH. 7
96, 97	E-5, SH. 8
99, P9900	E-5, SH. 9
EB-87	E-5, SH. 18

NOTE:
THIS DRAWING IS INTENTIONALLY SIMPLIFIED FOR GENERAL OVERVIEW ONLY.
REFERENCE APPROPRIATE SCHEMATIC AND CONNECTION DIAGRAMS FOR FURTHER DETAIL.

Engineering Change Mark up	EC #: 47348	Page 1 of 9
DOC. #: F-1	SH. #: A	REV. A
Safety Related: ☐	Before View ☐	Control Room Drawing ☐
Supersedes Mark up from EC #:		Issued per ECN #:
K. DEGROOT — Prepared By:	04/18/14 — Date	R. RAHMAN — Reviewer Name (Optional)

(FORMERLY WD1950, SH. 17, REV. W)

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Figure 7: Electrical One-line – Phase 3 Primary Connection

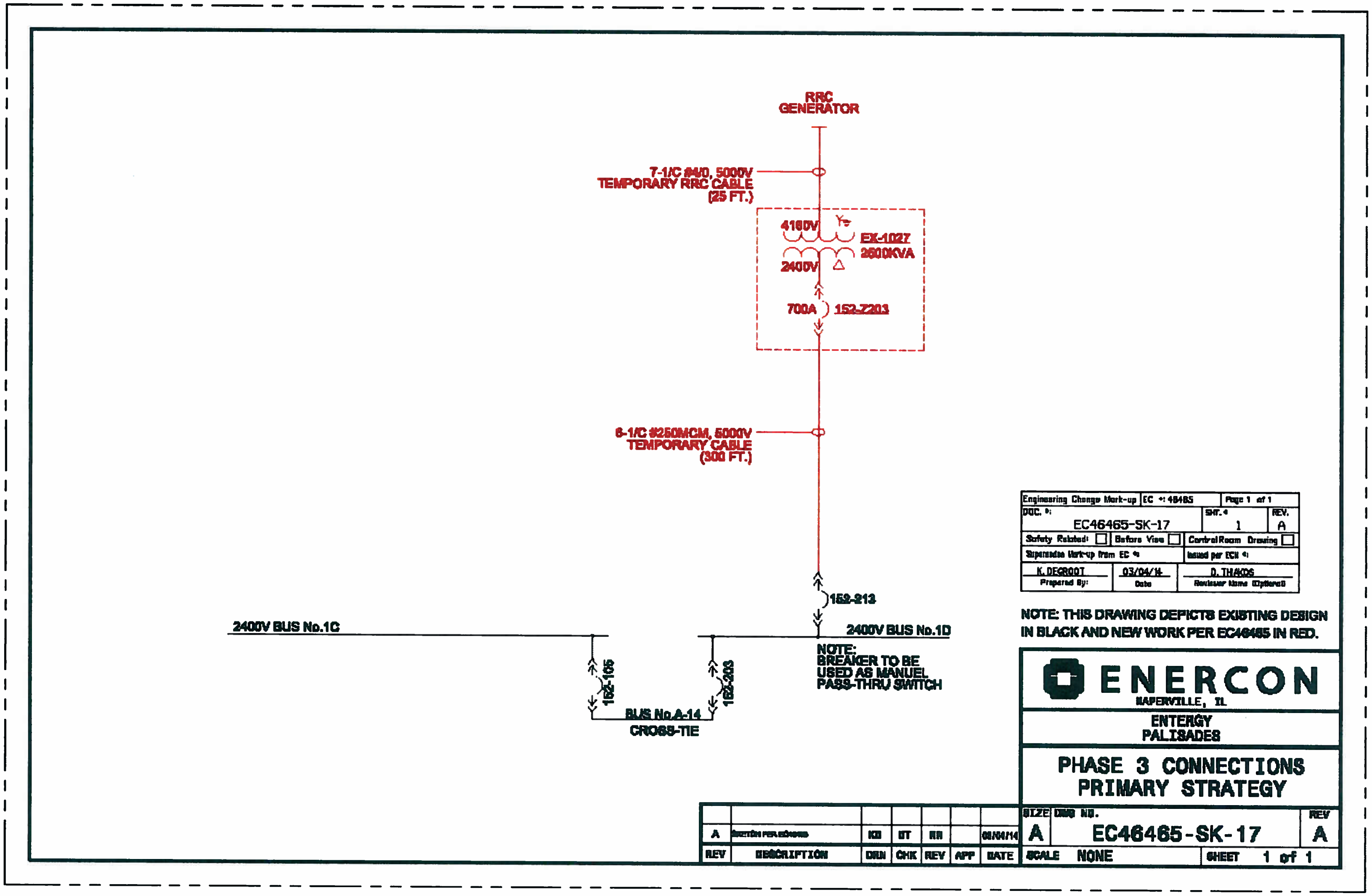
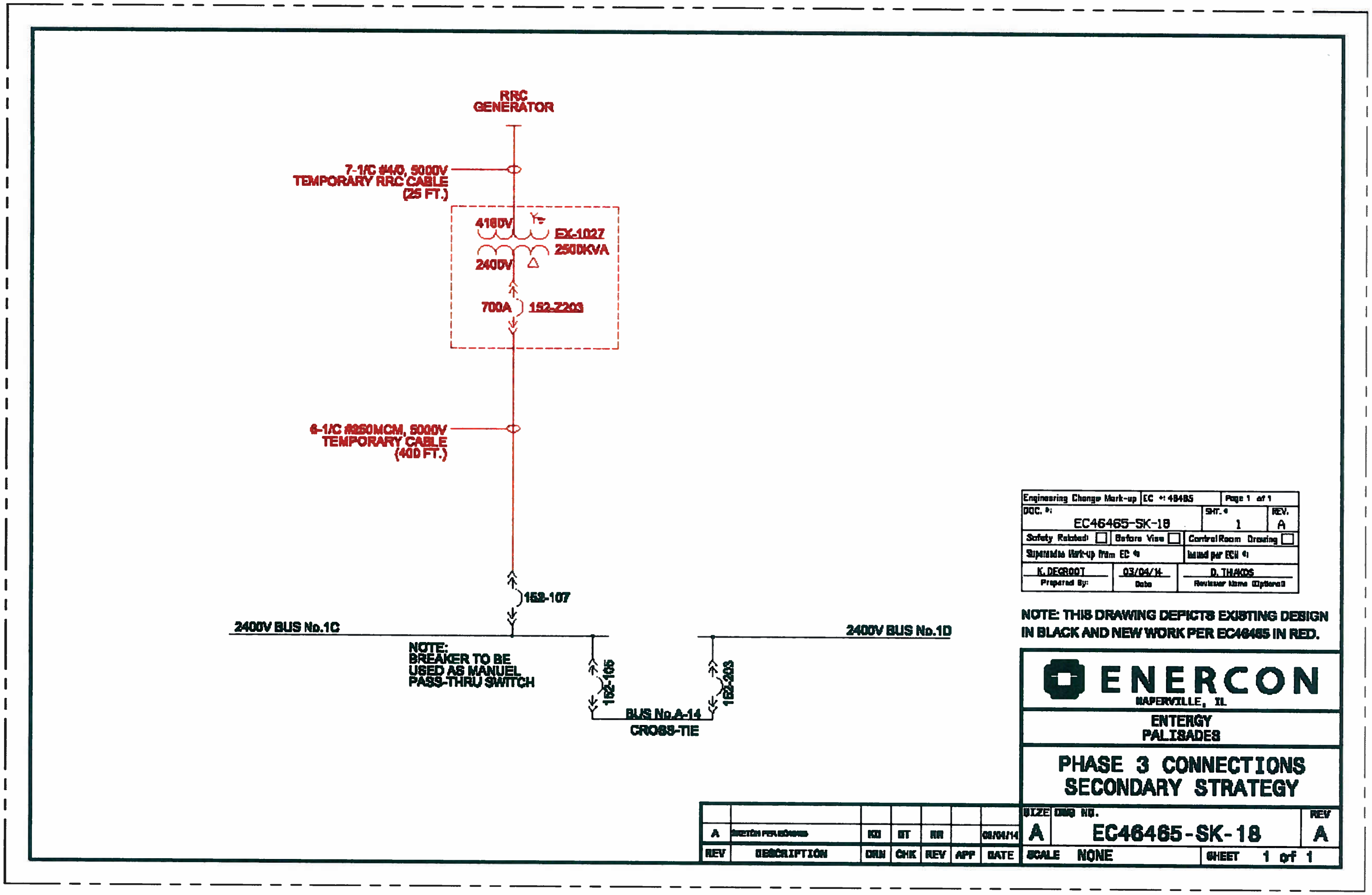
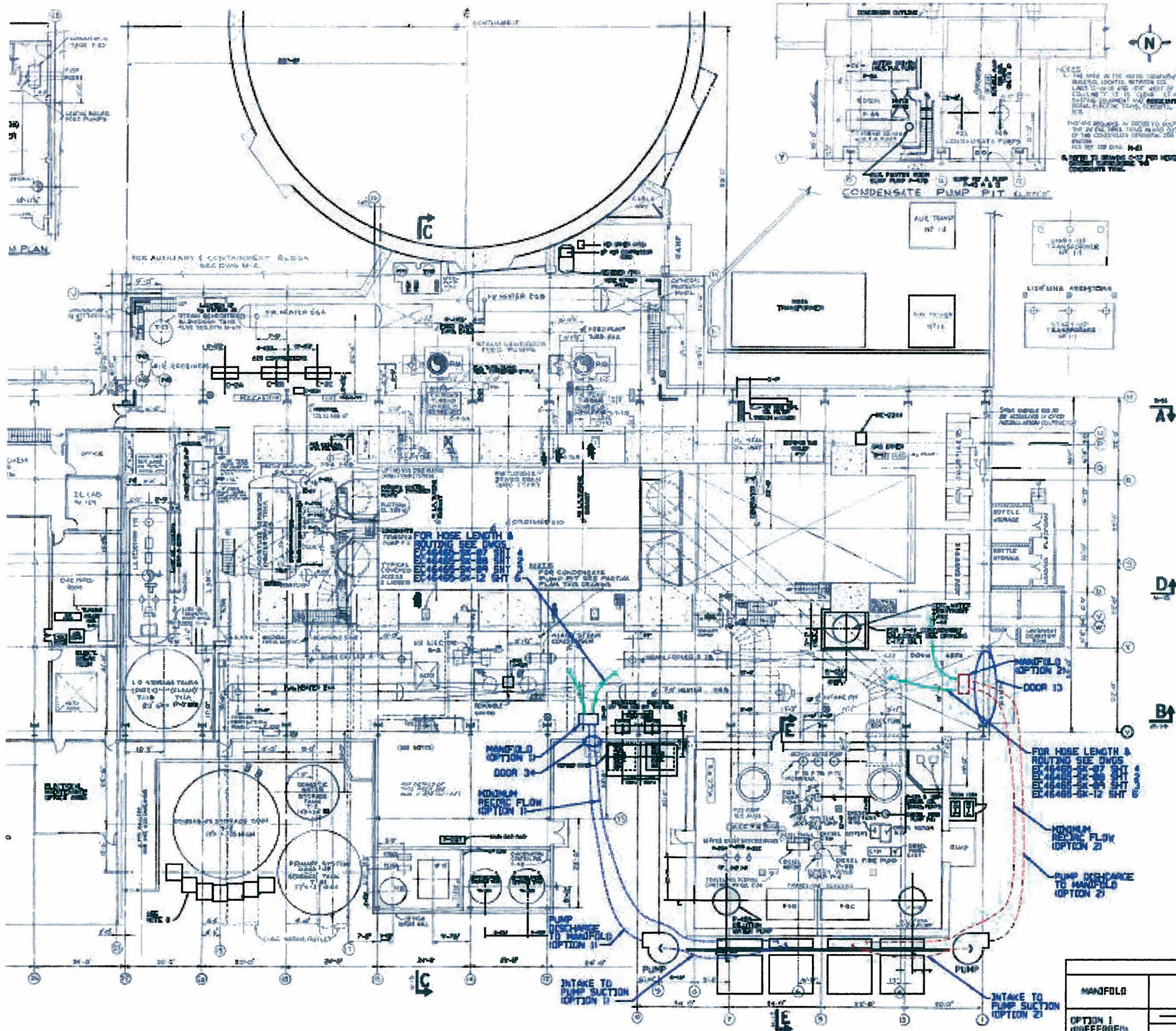


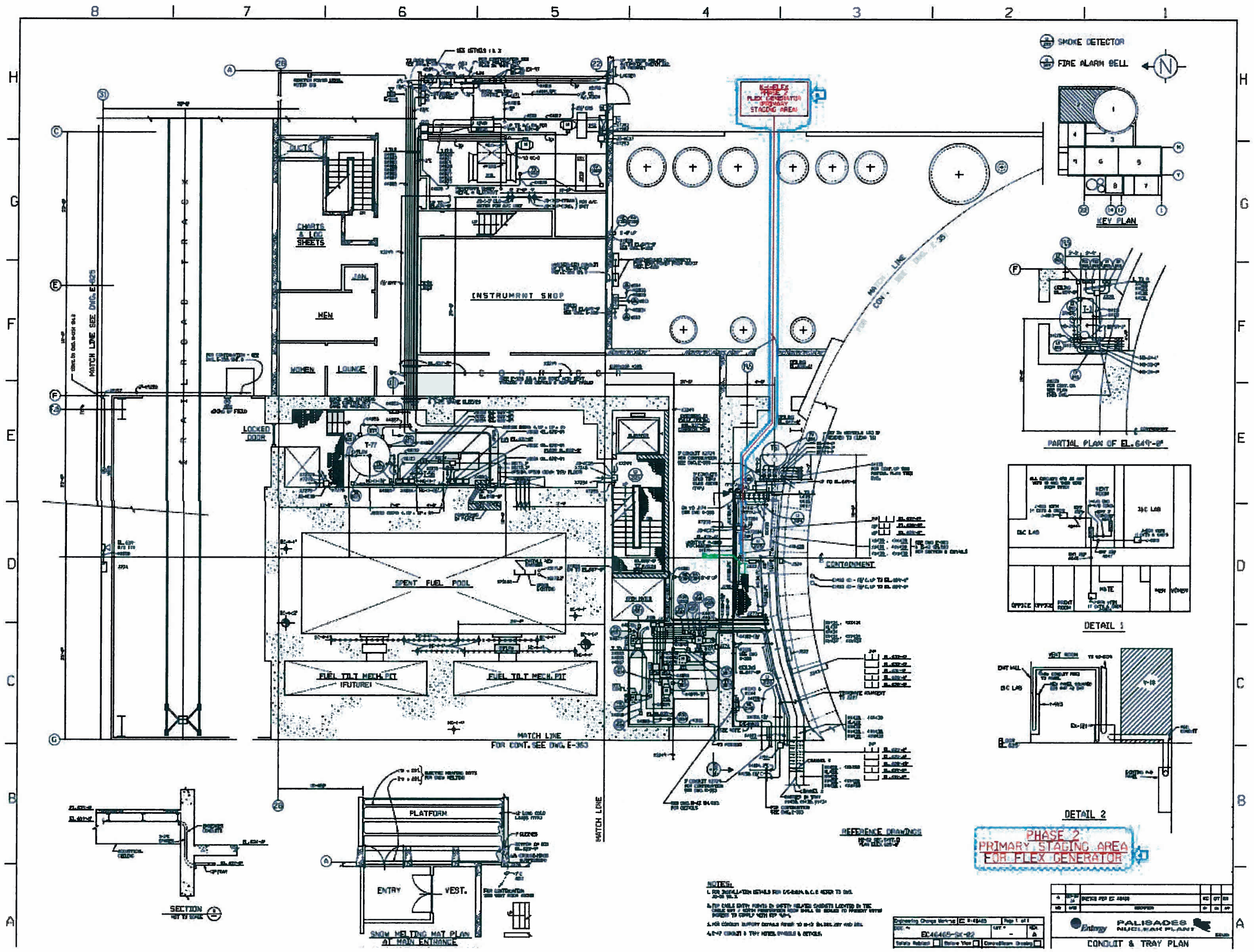
Figure 8: Electrical One-line – Phase 3 Alternate Connection

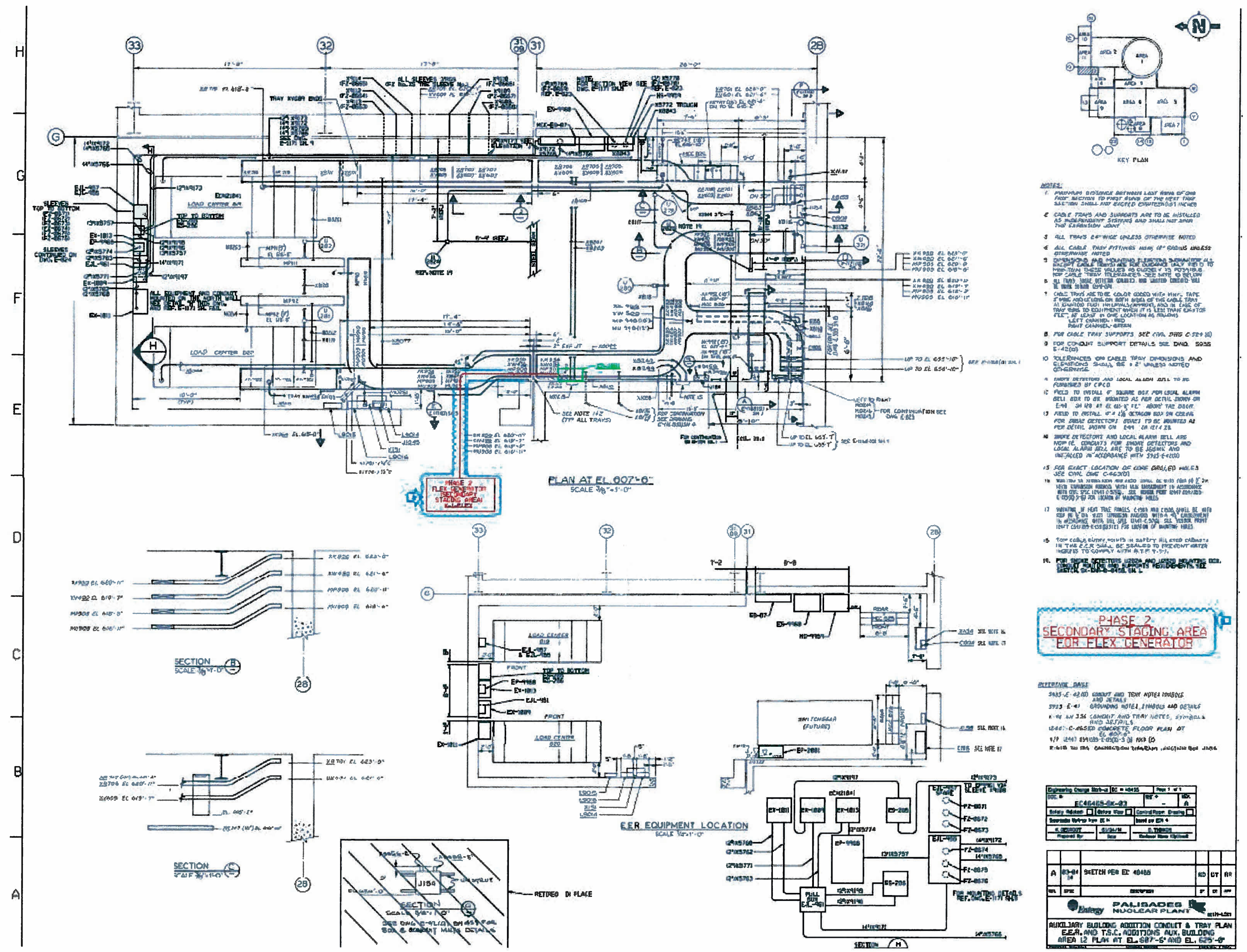




PUMP DISCHARGE TO MANIFOLD HOSE ROUT			
MANIFOLD	LEGEND	PUMP DISCHARGE TO MANIFOLD LENGTH (5" HOSE)	MIN[...] RECIR[...] (5'
OPTION 1 (PREFERRED)	——— (PREFERRED)	65'	
OPTION 2 (CONSERVATIVE)	– – – (PREFERRED)	85'	

Figure 10: Cable Routing (Primary Staging Location)




PLAN AT EL 607'-0"
PHASE 2
SECONDARY STAGING AREA
FOR FLEX GENERATOR
KEY PLAN
NOTES:
SECTION
EER EQUIPMENT LOCATION
LOAD CENTER
RETIRED IN PLACE
PALISADES
NUCLEAR PLANT
AUXILIARY BUILDING ADDITION CONDUIT & TRAY PLAN
E.E.R. AND T.S.C. ADDITIONS AUX. BUILDING
AREA 12 PLAN AT EL. 607'-6" AND EL. 625'-0"

2.17 Sequence of Events

Table 1 below presents a Sequence of Events (SOE) Timeline (Modes 1-4) for an ELAP/LUHS event at Palisades. Validation of each of the FLEX time constraint actions has been completed in accordance with the FLEX Validation Process document issued by NEI and includes consideration for staffing. A debris removal assessment has also been performed based on physical walk-downs of hall/routing paths to determine credible debris expected and reasonable time needed to clear the debris to support deployment of FLEX equipment from the storage buildings. Debris removal will be completed by 4 hours from the start of the event. By 6 hours into the event, the FLEX diesel generators and equipment trailers are deployed to their respective staging locations. Debris removal equipment is stored in each FLEX Storage Building as previously discussed in Section 2.8.1.

Table 1: Sequence of Events Timeline

Action Item	Elapsed Time[6] [hrs]	Action	New ELAP Time Constraint[7] Y/N	Time Constraint (hr)	Remarks / Applicability
0	0	Event Starts	N/A	N/A	Plant @100% power
1	2 min	Verify TDAFWP Operation and other automatic functions	N	N/A	TDAFW will automatically start when SG level reaches the low level setpoint. EOP/SBO procedures require operators to verify the auto start to ensure plant is operating as expected. While the TDAFWP area may be inaccessible, the pump will still be operable, and remote indication of flow can still be accomplished.
2	20 min	Isolate Controlled Bleedoff (CBO)	Y	20 min	To minimize PCP seal leakage, CBO isolation must occur within 20 minutes. Operator must verify that those CBO isolation valves that fail closed on loss of air (two of the three) are closed and take action to close the third, CV-2191, from the Main Control Room.
3	0.95	Declare ELAP	Y	1.0	This declaration initiates actions necessary for extended loss of AC power.
4	1.0	Initiate DC Load Shed	Y	1.0	Initiate shedding of DC loads in order to extend the life of the installed plant batteries. The DC load shedding

Action Item	Elapsed Time [6] [hrs]	Action	New ELAP Time Constraint [7] Y/N	Time Constraint (hr)	Remarks / Applicability
					extends the battery life to greater than 8 hours.
5	1.0	Open Cross-Connect valves CV-2008 and CV-2010	Y	1.0	Opening cross-connect valves CV-2008 and CV-2010 prior to one hour after the event ensures a minimum of 8 hours of SG makeup via TDAFW by supplementing the inventory in the CST with that of T-81.
6	1.0	Open Main Control Room door for ventilation	N	N/A	Can be accomplished at any time. This is not a time intensive step, and the heat load in the Main Control Room will be minimal based on the reduced amount of running equipment resulting from the ELAP.
7	1.0	Damage assessment	N	N/A	As required
8	1.0	Line up backup nitrogen bottles for operation of ADVs	Y	2.0	Operation of the ADVs will require opening of the nitrogen bottle isolation valves and cross tie valve CA-10619 to tie in the new Backup Nitrogen Station 9.
9	2.0	Commence Cooldown	Y	2.0	Cooldown initiated, to be completed in 3 hours (i.e.at 5 hour point). This cooldown will support depressurizing the PCS such that the SITs can inject.
10	2.0	Debris Removal (Access)	Y	6.0	Debris removal should begin approximately two hours following the event to ensure portable equipment deployment can be accomplished by hour 6.
11	2.0	Deploy and Connect FLEX Generator to establish PCS makeup via the installed Charging Pumps and to restore Battery Chargers	Y	8.0	PCS makeup is required by 8 hours to ensure single phase natural circulation. Initial suction will be from the Concentrated Boric Acid Tanks T-53A and T-53B. The FLEX Generator must also be established within 8 hours to restore the Battery Chargers.
12	2.0	Deploy and connect FLEX Pump to establish SG makeup	Y	8.0	SG makeup via the FLEX pump must begin prior to CST/T-81 depletion at hour eight. Suction for the portable pump will be directly from Lake Michigan.
13	3.0	Establish vent pathway for Refueling Building and stage SFP	Y	3.28	Must be established before SFP

Action Item	Elapsed Time [hrs][6]	Action	New ELAP Time Constraint[7] Y/N	Time Constraint (hr)	Remarks / Applicability
		monitor nozzles and hose in SFP Room			boiling begins to ensure the action can be taken while the building is steam free and still accessible. Deployable oscillating monitor nozzles should also be set up at the SFP prior to the area becoming uninhabitable. This should include hoses feeding the nozzles and another separate hose to feed the SFP directly. Note that the time constraint of 3.28 hours is following a full core offload. The SFP will not start boiling until 5.63 hours after loss of cooling for normal SFP heat loads.
14	6.0	Deploy FLEX Compressor	Y	9.1	Prior to nitrogen bottle depletion at approximately 9 hours, an air compressor should be aligned to the ADVs to allow for continued Steam Generator heat removal through the ADVs for the duration of the event.
15	8.0	Establish Spent Fuel Pool Makeup	Y	11.0	SFP makeup must be established 11 hours after the event to maintain 15 feet of water above the top of the racks. Note that the 11 hour time constraint is following a full core offload. SFP makeup will not be required until 21 hours after loss of cooling for normal SFP heat loads.
16	8.5	Establish battery ventilation	Y	9.5	Battery Room ventilation should be established less than 1.5 hours after charging has started to prevent hydrogen accumulation.
17	10.0	Commence refueling strategies	Y	13.0	The first diesel driven equipment should have started around hour 8.0. Refueling will require transferring diesel fuel from on-site diesel storage tanks to a diesel tank loaded on a truck. The fuel is then transported to the various diesel driven FLEX equipment. It is estimated that the first transfer of fuel will require 2 hours to complete. The FLEX pump is conservatively

Action Item	Elapsed Time [6] [hrs]	Action	New ELAP Time Constraint [7] Y/N	Time Constraint (hr)	Remarks / Applicability
					estimated to require a refuel every 5 hours.
18	24.0	Begin boron batching operations	Y	24.0	Action to begin at hour 24 to provide sufficient time for batching and mixing prior to depletion of T-53A/B.
19	72.0	Align mobile water purification system	N	N/A	Deploy system to provide purified water for all system make up.
20	72.0	Establish ultimate heat sink pump	N	N/A	Action initiated to deploy a pump to provide river water to the Service Water System to support long term shutdown cooling.
21	72.0	Establish the 2 MW FLEX generator and on-site step down transformer	N	N/A	Generator deployed to power large electrical equipment required for long term shutdown cooling.
22	72.0	Set up mobile boration unit.	N	N/A	Action initiated to provide a borated source after all on-site sources have been used.
23	72.0	Portable ventilation for the Main Main Control Room	Y	75.0	Supply ventilation flow of 4000 cfm to the Main Control Room.
24	72	Isolate the four Safety Injection Tanks (SITs) to preclude nitrogen injection		See remark	To prevent nitrogen injection into the PCS, the SIT outlet isolation valves must be closed. Must be accomplished prior to reducing pressure to less than 143.6 psia.
25	72	Establish shutdown cooling to cool the plant	N	N/A	Recovery action

6) Timing is provided for start of ELAP strategies. All actions will be completed prior to time constraint.

7) Instructions: Provide justification if No or N/A is selected in the remark column. If yes include technical basis discussion as requires by NEI 12-06 Section 3.2.1.72

2.18 Programmatic Elements

2.18.1 Overall Program Document

The Palisades Program Document provides a description of the Diverse and Flexible Coping Strategies (FLEX) Program for Palisades. The key program elements provided in the Program Document include:

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

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

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

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

2.18.2 Procedural Guidance

The inability to predict actual plant conditions that require the use of FLEX equipment makes it impossible to provide specific procedural guidance. As such, the FLEX Support Guidelines (FSGs) will provide guidance that can be employed for a variety of conditions. Clear criteria for entry into FSGs will ensure that FLEX strategies are used only as directed for BDBEE conditions, and are not used inappropriately in lieu of existing procedures. When FLEX equipment is needed to supplement EOPs or Abnormal Operating Procedures (AOPs) strategies, the EOP or AOP, Severe Accident Mitigation Guidelines (SAMGs), or Extreme Damage Mitigation Guidelines (EDGMs) will direct the entry into and exit from the appropriate FSG procedure.

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

Procedural Interfaces have been incorporated into Procedure EOP-3.0, Station Blackout Recovery (Reference 3.1.10), to the extent necessary to include appropriate reference to FSGs and provide command and control for the ELAP. Additionally, procedural interfaces have been incorporated into the following AOP to include appropriate reference to FSGs:

- AOP-38, Acts of Nature

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

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

2.18.3 Staffing

Using the methodology of NEI 12-01, *Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities*, an assessment of the capability of the Palisades on-shift staff and augmented Emergency Response Organization (ERO) to respond to a Beyond Design Basis External Event (BDBEE) was performed. The results of the assessment were submitted to the NRC on May 19, 2015.

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

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

A team of subject matter experts from Operations, Training, Radiation Protection, Chemistry, Security, Emergency Planning and FLEX Project Team personnel performed a tabletop exercise in February 2015 (Reference 3.1.51). The participants reviewed the assumptions and applied existing procedural guidance, including applicable draft and approved FLEX Support Guidelines (FSGs) for coping with a BDBEE using minimum on-shift staffing. Particular attention was given to the sequence and timing of each procedural step, its duration, and the on-shift individual performing the step to account for both the task and the estimated time to prepare for and perform the task.

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

2.18.4 Training

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

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

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

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

2.18.5 Equipment List

The equipment stored and maintained at the Palisades FLEX Storage Buildings necessary for the implementation of the FLEX strategies in response to a BDBEE at Palisades is listed in Table 2. Table 2 identifies the quantity, applicable strategy, and capacity/rating for the major FLEX equipment components only, as well as, various clarifying notes. Details regarding fittings, tools, hose lengths, consumable supplies, etc. are not inTable 2.

2.18.6 Equipment Maintenance and Testing

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

PMs have been developed for the FLEX Portable and Support Equipment.

The Entergy PM Basis Templates include activities such as:

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

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

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

The unavailability of equipment and applicable connections that directly perform a FLEX mitigation strategy for core, Containment, and

SFP will be managed such that risk to mitigating strategy capability is minimized.

Palisades' Operating Requirements Manual (ORM) has been revised to reflect compensatory actions if FLEX equipment is out of service or unavailable.

Maintenance/risk guidance conforms to the guidance of NEI 12-06 as follows:

- Portable FLEX equipment may be unavailable for 45 days provided that the site FLEX capability (N) is available. Note, this is an alternate approach to the guidance of NEI 12-06, Revision 0 due to the Palisades unique equipment storage plan (refer to Section 2.7 for additional details).
- If portable equipment becomes unavailable such that the site FLEX capability (N) is not maintained, initiate actions within 24 hours to restore the site FLEX capability (N) and implement compensatory measures (e.g., repair equipment, use of alternate suitable equipment or supplemental personnel) within 72 hours.

Work management procedures will reflect the allowed outage times as outlined above.

Table 2 – Palisades On-Site Portable Equipment Phase 2

Use and (potential / flexibility) diverse uses						Performance Criteria	Maintenance
Portable Equipment	Core	Containment	SFP	Instrumentation	Accessibility		Maintenance / PM requirements
FLEX Portable Diesel Pump (2)	X		X			410 gpm @ 235 psig	Will follow EPRI template requirements
400 kW PDG (2)	X			X		480 V, 500kVA, 400 kW	Will follow EPRI template requirements
FLEX Truck (2)					X	Class 3, 21,500 lb towing capacity, 4X4	Will follow EPRI template requirements
Debris Removal Loader (1)					X	4 wheel front end loader	Will follow EPRI template requirements
Exhaust Fan (2)					X	120 V, 1,000 cfm	Will follow EPRI template requirements
Portable Compressor (2)	X					130 psig, 21.08 scfm	Will follow EPRI template requirements
Portable Fuel Trailer (2)					X	500 gallon with a 20 gpm 12 V transfer pump	Will follow EPRI template requirements
Fuel Transfer Pump (2)					X	22 gpm @ 10 psi	Will follow EPRI template requirements

Table 3 - Portable Equipment Phase 3 (NSRC)

	Use and (potential / flexibility) diverse uses					Performance Criteria	Notes
Portable Equipment	**Core**	**Containment**	**SFP**	**Instrumentation**	**Accessibility**		
Medium Voltage Generators (2)	X	X	X	X		4160 V, 1000 kW	
Step Down Transformer	X	X	X	X		2.5 MW, 4160-2400 V	Will be stored on-site
Low Voltage Generator	X					480 V, 1100 kW	
High Pressure Injection Pump	X					60 gpm @ 2000 psi	
SG/RPV Makeup Pump	X					500 gpm @ 500 psi	
Low Pressure /High Flow Pump	X	X	X			5000 gpm @ 150 psi	
Mobile Boration Unit	X		X			1000 gallon tank	
Mobile Water Purification System	X		X			500 gpm	
Lighting Towers					X	440,000 Lumens	

Table 4 – Non-Credited Water Sources

Tank Name (number)	Capacity (gal)	Seismic	High Wind
Safety Injection Refueling Water Tank (T-58)	285,000	N	N
Primary Makeup Water Tank (T-90)	200,000	N	N
Utility Water Storage Tank (T-91)	75,000	N	N
Demineralized Water Storage Tank (T-939)	300,000	N	N

3. References

3.1 Mitigation Strategies (FLEX) References

3.1.1 SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," (ADAMS Accession No. ML 11186A950).

3.1.2 NRC Order EA-12-049, "Order to Modify Licenses With Regard to Requirements for Mitigation Strategies For Beyond-Design-Basis External Events," dated March 12, 2012, (ADAMS Accession No. ML 12056A045).

3.1.3 Nuclear Energy Institute (NEI) 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, Revision 0, dated August 2012 (ADAMS Accession No. ML12221A205)

3.1.4 NRC Interim Staff Guidance JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events", Revision 0, dated August 29, 2012 (ADAMS Accession No. ML 12229A174).

3.1.5 NRC Order Number, EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, dated March, 12, 2012 (ADAMS Accession No. ML12054A679)

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

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

3.1.8 LTR-PCSA-12-78, "Transmittal of PA-PSC-0965 Core Team PWROG Core Cooling Management Interim Position Paper," November 9, 2012

3.1.9 Request for Information Pursuant To Title 10 of The Code of Federal Regulations 50.54(F) Regarding Recommendations 2.1, 2.3, And 9.3, Of The Near-Term Task Force Review Of Insights From The Fukushima Dai-Ichi Accident, March 12, 2012

3.1.10 Palisades Nuclear Plant Emergency Operating Procedure EOP-3.0, Rev. 14, "Station Blackout Recovery Emergency Operating Procedure," November 15, 2006.

3.1.11 Palisades Nuclear Plant Emergency Operating Procedure Basis, EOP-3.0, "Station Blackout Recovery Basis", Revision 11

3.1.12 Palisades' response to INPO IER L1-11-4, "Near Term Actions to Address the Effects of an Extended Loss of All AC Power in Response to the Fukushima Daiichi Event," October 26, 2012.

3.1.13 LTR-SEE-II-13-23, Rev. 0, Palisades Auxiliary Feedwater Usage Parametric for FLEX

3.1.14 Nuclear Energy Institute (NEI) 12-01, Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities, Revision 0, dated May 3, 2012 (ADAMS Accession No. ML12125A410)

3.1.15 NUREG/CR-4461, Rev. 2, PNNL-15112, Rev. 1, Tornado Climatology of the Contiguous United States.

3.1.16 NRC Draft Regulatory Issue Summary 2014-XX, Tornado Missile Protection, dated February 20, 2014 (ADAMS Accession No. ML13094A421)

3.1.17 Nuclear Energy Institute, Position Paper: Shutdown/Refueling Modes, dated September 18, 2013 (ADAMS Accession No. ML13273A514)

3.1.18 NRC letter, dated September 30, 2013 (ADAMS Accession No. ML13267A382)

3.1.19 US Environmental Protection Agency, "Manual of Protection Action Guides and Protective Actions for Nuclear Incidents," EPA-400-R-92-001, May 1992.

3.1.20 USNRC, Regulatory Guide 1.13, Revision 2, "Spent Fuel Storage Facility Design Basis," March 2007.

3.1.21 ANSI/ANS 57.2 – 1983, "Requirements for Light Water Reactor Spent Fuel Storage Facilities," W1993.

3.1.22 IEEE 344:2004, IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations.

3.1.23 Entergy Letter to NRC (PNP 2012-090), *Response to the March 12, 2012, Information Request Pursuant to 10 CFR 50.54(f) Regarding Recommendation 9.3 for Completing Emergency Communication Assessments,* dated October 31, 2012

3.1.24 Entergy Letter to NRC (PNP 2013-012), *Response to NRC Follow-up Letter on Technical Issues for Resolution Regarding Licensee Communication Submittals Associated with Near-Term Task Force Recommendation 9.3 (TAC No. ME7951)*, dated February 21, 2013.

3.1.25 DBD-3.08, Design Basis Document, Emergency Lighting System, Revision 7

3.1.26 PLP-RPT-13-00050, Turbine Driven Auxiliary Feedwater (TDAFW) Upgrade and Evaluation for FLEX, Revision 0

3.1.27 Engineering Change EC-46465, Basis for FLEX Strategy

3.1.28 CN-SEE-II-13-5, Rev. 1, Palisades Reactor Coolant System (RCS) Inventory and Shutdown Margin Analysis to Support the Diverse and Flexible Coping Strategies (FLEX)

3.1.29 PLP-RPT-13-00051, Boric Acid Storage Tank (BAST) Suction Piping and Component Evaluation for FLEX, Revision 0

3.1.30 WCAP-16175-NP-A, Rev. 0, "Model for Failure of RCP Seals Given Loss of Seal Cooling in CE NSSS Plants" March 2007

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