ATTACHMENT 4

INTERIM STAFF EVALUATION OPEN ITEM AND CONFIRMATORY ITEM RESPONSES

On February 10, 2014, the NRC issued the Interim Staff Evaluation (ISE) for Palisades Nuclear Plant (PNP)[3]. In that document, eight (8) open items and thirty (30) confirmatory items were identified.

A NRC onsite audit was conducted at PNP during the week of June 15, 2015, during which all of the confirmatory and open items were closed, with the exception of the four items discussed in Attachment 3, as documented in the audit report.[4]

Listed below are the Entergy Nuclear Operations, Inc. (ENO) responses to the ISE open and confirmatory items. These responses were provided to the NRC before and during the onsite audit.

Open Item 3.1.1.2.A

Evaluate the impact of potential soil liquefaction on deployment of portable FLEX equipment.

ENO Response

The impact of potential soil liquefaction on deployment of portable FLEX equipment was evaluated. Soil test borings were performed on site, and soil liquefaction susceptibility was identified. PNP analysis PLP-RPT-14-00030, "Report of Geotechnical Exploration FLEX Equipment Storage Building," determined that the soil outside the protected area (PA) was indeed susceptible to liquefaction after a seismic event. Liquefiable soil may cause differential settlements of soil along the deployment path, resulting in roads that could not be traversed. Since there was minimal area inside the PA for a building that could withstand all beyond-design-basis external events (BDBEEs), the FLEX equipment is located in two independent structures that when combined can withstand the required BDBEE, such that at least one set of portable FLEX equipment is available and accessible for any and all BDBEEs.

The storage location selected inside the PA (FLEX Storage Building – A) is a pre-engineered metal building designed to withstand seismic and seiche BDBEEs, and is located such that travel paths are not impeded by liquefaction. The storage location outside the PA (FLEX Storage Building – B) is a hardened reinforced concrete building designed to withstand all BDBEEs. However, its location is such that haul paths for its stored FLEX equipment may be affected by soil liquefaction.

If during a seismic event in which soil liquefaction outside the PA were to occur, that impeded FLEX equipment travel paths from FLEX Storage Building - B, then equipment will be deployed from FLEX Storage Building - A.

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[3] NRC letter, "Palisades Nuclear Plant - Interim Staff Evaluation Regarding Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC No. MF0768)," dated February 10, 2014 (ADAMS Accession No. ML13365A264).

[4] NRC letter, "Palisades Nuclear Plant – Report for the Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Pool Instrumentation Related to Orders EA-12-049 and EA-12-051 (TAC Nos. MF0768 and MF0769)," dated October 13, 2015 (ADAMS Accession No. ML15272A324).

Open Item 3.1.1.2.B

Evaluate the potential need for a power source to move or deploy the equipment (e.g., to open the door from a storage location).

ENO Response

FLEX Storage Building - A utilizes a power-operated rollup door with manual override capability in the event of a loss of power. FLEX Storage Building - B utilizes a manually-operated rollup door. Therefore, there is no need for a power source to move or deploy the FLEX equipment from the storage locations.

Open Item 3.1.1.3.A

Evaluate impacts from large internal flooding sources that are not seismically robust and the potential impact on the mitigating strategies.

ENO Response

The impacts from large internal flooding sources that are not seismically robust and the potential impact on the mitigating strategies were evaluated.

The circulating water system supplies water to the main condenser by gravity flow from the two cooling tower's basins. The basin water level elevation is approximately 20 feet above the condenser inlet. Each tower basin supplies one-half of the condenser through a 90-inch pipe which connects to a 96-inch condenser inlet piping at the intake structure. Two cooling tower pumps receive heated circulating water from the condenser and return the circulating water to the cooling tower distribution headers through two 96-inch pipes.

Water for the fire suppression system is supplied by three full capacity fire pumps. Each fire pump is capable of providing water to the largest system demand plus fire hose streams in the area of demand. One fire pump is electrically driven, and the other two are diesel engine driven.

As discussed in the PNP Final Safety Analysis Report (FSAR), Section 5.4.2, Integrated Plant Safety Assessment Systematic Evaluation Program (SEP) Topic VI-7.D considered the effects of flooding on safety-related equipment required for safe shutdown or accident mitigation due to postulated failures in non-class 1 systems. The NRC review of this topic considered the potential for flooding from both inside and outside the equipment compartments. Postulated failures in the circulating water system and the fire protection system represented the bounding cases. The NRC concluded that the auxiliary feedwater (AFW) pumps and the diesel generators were inadequately protected (note that the diesel generators are assumed unavailable and are therefore, not credited in an extended loss of alternating current (ac) power (ELAP) event). The evaluation of flooding in the AFW pump room concluded that motor-driven AFW pump (P-8A) and turbine-driven AFW pump P-8B were vulnerable to flooding from internal sources. The subsequent addition of a third AFW pump (P-8C) in the west engineered safeguards room provided redundancy and satisfactorily resolved this issue. However, during an ELAP event, this third pump, which is motor-driven, would not be available to support FLEX strategies. Flooding of the AFW pump room is discussed further below.

The remaining types of equipment in the FSAR Section 5.4.2 discussion were determined to be adequately protected. This includes flooding of the engineered safeguards motor control centers and battery rooms due to a fire main break, which is adequately mitigated by passive design features. Other areas susceptible to internal flooding due to failure of non-seismic Category I piping were also evaluated to be acceptable.

Within the AFW pump room, non-Seismic Category I piping was either evaluated to be seismically robust or modified to be seismically robust. For example, evaluation PLP-RPT-13-00050 of the condensate reject and makeup pipeline HB-26-16" in the room indicates that this piping is seismically robust. Report PLP-RPT-13-00050 also documents that the fire protection piping in the room was evaluated as being seismically robust. Additionally, EC 48188 installed physical modifications that provided supports to hotwell makeup/reject line HB-26-6" which allowed this line to be considered seismically robust.

Also, in calculation EA-C-PAL-95-1526-01, "Internal Flooding Evaluation for Plant Areas Outside of Containment," the flood potential due to a circulating water system piping/expansion joint failure in the turbine building is discussed. There is potential communication between the condensate pump pit and the auxiliary feedwater (AFW) pump room. The AFW pump room drain line connects to the turbine sump located in the condensate pump pit. AFW pump room flooding is prevented by a ball check valve which is maintained to assure continued operability. There is also a watertight door directly connecting the two rooms. The watertight door is controlled as a barrier by the PNP Operating License under Technical Specification 3.0.9, "unavailability of barriers". For these reasons the AFW pump room is not considered part of this area for flood analysis."

The Palisades Nuclear Plant FLEX Final Integrated Plan states that the speed of the turbine driven AFW (TDAFW) pump is controlled by an air operated, regulator valve. This valve is located outside the AFW pump room and can be operated manually, if required, by a dedicated operator. Therefore access to the AFW pump room is not required to control TDAFW pump speed.

The rupture of the safety injection refueling water (SIRW) tank was evaluated separately. It was concluded that rupture of this tank will have no effect on other safety-related equipment, as stated in FSAR 5.4.2, "Flooding and Wetting from Plant Sources."

Flooding as a result of postulated breaks in the plant's steam heating system is discussed in FSAR Section 5.6.7.1(3), "High-Energy Line Breaks Outside Containment," which concludes that the integrity of safety equipment would not be threatened by plant heating steam-line breaks.

The condensate storage tank (CST) and the primary system makeup water tank are located outside, so failure of these tanks would not cause flooding of any safety related equipment. The FLEX mitigation strategies are developed with consideration of the internal flooding evaluations. Items not addressed by existing internal flooding evaluations were reviewed under the FLEX project, and modifications were implemented as required to ensure seismic robustness. Therefore, based on the evaluations and modifications described above, there are no significant impacts to the mitigating strategies from large internal flooding sources that are not seismically robust.

Open Item 3.1.1.3.B

Evaluate the potential for ground water to impact the mitigating strategies.

ENO Response

As indicated in NUREG-0820, Integrated Plant Safety Assessment, Systematic Evaluation Program, Palisades Plant, Consumers Power Company, Docket No. 50-255, Final Report, October 1982, SEP Topic III-3.B, "Structural and Other Consequences (e.g., Flooding of Safely-Related Equipment in Basements) of Failure of Underdrain Systems," is not applicable to the PNP site because the site does not have a system whose function is to lower the groundwater table (Appendix C, page C-1). Therefore, AC power for groundwater mitigation during an ELAP event at PNP is not required.

Open Item 3.1.5.1.A

Evaluate the potential for high temperature hazards to impact the functionality of FLEX equipment in the FLEX storage facility.

ENO Response

Two structures, one inside the PA and one outside the PA, are utilized to house all portable FLEX equipment. The storage location inside the PA (FLEX Storage Building - A) is a pre-engineered metal building that utilizes a power-operated rollup door with manual override capability in the event of a loss of power. The storage building outside the PA (FLEX Storage Building – B) is a reinforced concrete building that utilizes a manually-operated door.

FLEX Storage Building – A is designed to withstand cold, ice, snow, and heat, however, it is not provided with heating or cooling capabilities. The equipment is maintained and conditioned through plant maintenance procedures, through the use of block-heaters or jacket water heaters during cold weather conditions, and by opening doors during hot weather conditions.

FLEX Storage Building – B is adequately equipped to withstand extreme cold, ice, snow, and extreme heat conditions. The equipment is maintained and conditioned through plant procedures and through the use of block-heaters or jacket water heaters for extreme cold. For extreme heat conditions, the building is equipped with fixed ventilation louvers and a constant running 5,800 cfm fan to provide exhaust of any fuel oil vapors. A thermostat controlled 8,100 cfm ventilation fan is also provided with a maximum setpoint of 85°F to provide additional ventilation during high interior temperatures. Additionally, similar to the FLEX Storage Building-A, roll up doors can be opened to provide additional ventilation and air circulation if required. The available 13,900 cfm of ventilation combined with the 1'-1" reinforced concrete construction (walls and roof) and the ability to open doors provide assurance that the temperature in FLEX Storage Building-B can be maintained within required limits.

Additional operating and storage temperature information for the FLEX equipment is provided in Attachment 3, under Audit Item OI 3.1.5.3.A.

The potential for high temperature hazards to impact the functionality of FLEX equipment in the FLEX storage facility was evaluated, and the FLEX equipment is capable of withstanding BDBEE extreme temperatures.

Open Item 3.1.5.3.A

Evaluate the potential for high temperature hazards to impact the deployment of FLEX equipment.

ENO Response

FLEX equipment is designed for high temperature operation, and will remain functional while deployed under high temperature conditions. The site design maximum ambient temperature is 95°F and is bounded by the maximum ambient temperatures for the equipment. Specific operating and storage temperature information for the FLEX equipment is provided in Attachment 3, under Audit Item OI 3.1.5.3.A.

Open Item 3.2.1.8.A

Verify resolution of the generic concern associated with the modeling of the timing and uniformity of the mixing of a liquid boric acid solution injected into the PCS under natural circulation conditions potentially involving two-phase flow.

ENO Response

Single phase natural circulation flow is maintained without pumped makeup until 10 hours into the event. The PNP ELAP analysis[5] confirms that a 30 gpm flow from a makeup pump will maintain single phase natural circulation. The timing assumed in the analysis was pumped injection flow beginning at eight hours. Loop flows remain relatively constant at approximately 300 to 350 lbm/sec; no voiding occurs within the top of the steam generator U-tubes and primary coolant system (PCS) mass inventory is slowly increasing.

The ELAP analysis concluded that the core will remain indefinitely sub-critical during an ELAP (for PCS temperatures of 355°F after xenon concentration has decayed away). Initial borated inventory addition occurs due to SIT injection as a result of the plant cooldown. The remaining boron injection requirement is determined using the PCS makeup pump parameters, minimum boron concentration of the injection source, and shutdown margin requirement. The Combustion Engineering Nuclear Transient Simulator (CENTS) code was

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[5] CN-SEE-II-13-5, "Palisades Reactor Coolant System (RCS) Inventory and Shutdown Margin Analyses to Support the Diverse and Flexible Coping Strategies (FLEX)," Revision 1.

used for all cases, with a St. Lucie Unit 1 base deck, modified for PNP core parameters (St. Lucie Unit 1 is very similar in PCS volume configuration to PNP). The analysis indicates sufficient shutdown margin from safety injection tank (SIT) injection alone for at least the first 13 hours, followed by PCS boration using a makeup pump for seven hours at 30 gpm to reach the required concentration to indefinitely maintain the core sub-critical at 355°F.

The ELAP analysis uses a uniform boron mixing model which requires 60 minutes to assume complete mixing. The time sensitive action for reactivity control is to begin pumped PCS injection at hour 13 and inject for seven hours to allow PCS boration and mixing to be completed by 24 hours. The PNP strategy begins PCS injection at hour eight, which ensures that single-phase natural circulation will be maintained, and also ensures sufficient time for complete mixing of injected borated water throughout the PCS.

<u>Open Item 3.2.1.9.B</u>

Provide additional justification for the alternate approach to NEI 12-06 involving the use of installed charging pumps.

<u>ENO Response</u>

Installed charging pumps P-55B and P-55C are used as the primary and alternate means of primary coolant system (PCS) makeup, which is an alternate approach to NEI 12-06 for meeting the Order. NEI 12-06, Section 3.2.2 (13) states: "Regardless of installed coping capability, all plants will include the ability to use portable pumps to provide RPV/RCS/SG makeup as a means to provide a diverse capability beyond installed equipment…"

Although an alternate approach to NEI 12-06, this strategy is deemed to meet the NEI 12-06 diversity requirements because each pump is powered from a separate safety related load center, each with a primary and alternate strategy for receiving power from the FLEX generator. Additionally, the load centers can be cross-tied and either charging pump can be powered by either connection point to provide a reliable primary and alternate connection point (separate safety-related trains) for each charging pump.

In order to repower the installed charging pumps, the FLEX generator will be deployed and connected after eight hours. The primary connection point for the FLEX generator is load center 19. EC47345 installed a new breaker in a spare cubicle on load center LCC-19 to receive power from the FLEX generator. Power at LCC-19 will be back-fed through transformers EX-19 and EX-11 to supply power to load center LCC-11. LCC-11 will supply power to installed charging pump P-55C.

The alternate connection point for the FLEX generator is load center 20. Power from load center LCC-20 is capable of back-feeding through transformers EX-20 and EX-12 to supply power to load center LCC-12. EC47348 installed a new breaker in a spare cubicle on LCC-20 to receive power from the FLEX generator. LCC-12 will feed power to installed charging pump P-55B. LCC-11 and LCC-12 can be cross-connected so that either charging pump can be powered by either the primary or the alternate connection point. Therefore, each charging pump has a primary and alternate strategy for receiving power from the FLEX generator.

The safety related load centers LCC-19 and LCC-20 provide Class 1E service as defined by IEEE 308-1971, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations." Both load centers are located in the electrical equipment room within the auxiliary building. Load centers 19 and 20 are in conformance with established criteria for redundancy and physical separation of Class 1E systems. Transformer 11 feeds LCC-11 and transformer 19 feeds LCC-19. Transformer 12 feeds LCC-12 and transformer 20 feeds LCC-20. By connecting the FLEX generator to LCC-19 or LCC-20, power can be back-fed through transformer 19 or 20, to transformers 11 or 12, and then to LCCs 11 or 12.
The safety related load centers LCC-11 and LCC-12 provide Class 1E service as defined by IEEE 308-1971. They are both located in the cable spreading room within the auxiliary building. As the primary strategy to power a charging pump in a FLEX event, LCC-11 will supply charging pump P-55C. As the alternate strategy to power a charging pump in a FLEX event, LCC-12 will power charging pump P-55B.

Transformers 11, 12, 19 and 20 and LCCs 11, 12, 19 and 20 are Safety Class 1E and Seismic Category I.

PNP has two independent flow paths to inject water to the PCS. Each flow path utilizes a different system for discharging water to the PCS. The normal flow path is through the chemical volume control system (CVCS) regenerative heat exchanger to the PCS, and another path directs flow to the high pressure safety injection (HPSI) header and then to the PCS. The HPSI system branch connection is an independent piping path off the common header and separate from the CVCS connection. Each flow path can be physically isolated from one another (via pump discharge valves and header isolation valves) should either flow path be compromised. Each piping flow path has been validated to be robust in accordance with NEI 12-06. Valves which are required to align either flow path are powered by the FLEX generator, and procedures for valve operation are addressed in the FLEX Support Guidelines (FSGs).

The robustness of the charging system is addressed in PNP report PLP-RPT-13-00051, "Boric Acid Storage Tank (BAST) Suction Piping and Component Evaluation for FLEX." PLP-RPT-13-00051 documents the qualifications and evaluations required to credit the suction piping and components for pumps P-55B and P-55C, which are required to supply borated makeup water to the PCS, as "robust" as defined in NEI 12-06.

This PNP FLEX strategy utilizes robust plant equipment that is located within a structure (i.e., auxiliary building) that is protected from all PNP design basis external events and reduces the number of operator actions required to place that equipment into operation.

Confirmatory Item 3.1.3.1.A

Confirm that the FLEX storage facility(s) will meet the plant's design-basis tornado wind speed of 300 mph or will be designed or evaluated equivalent to ASCE 7-10 using a tornado wind speed of 230 mph with separation and diversity between the storage locations. If the method of protection chosen is the later, confirm that separation and diversity is adequate.

ENO Response

The reinforced concrete storage building (FLEX Storage Building – B) is designed for the BDBEE wind event. The wind speed is based on Regulatory Guide (RG) 1.76[7], consistent with NUREG-0800, Standard Review Plan, Section 3.3.2, with missiles consistent with NUREG-0800, Section 3.5.1.4. This is the acceptance criteria outlined under the Systematic Evaluation Program cited in the PNP FSAR.

The building is designed to meet NEI 12-06, Section 7.3.1.1.b. The wind speed used is 230 mph and forces are calculated per ASCE 7-10. Tornado missiles are accounted for, not by diverse structures as stated in NEI 12-06, but by a structure specifically designed for missiles such that there is reasonable protection for N sets of equipment. Design basis missiles are used in the design in addition to a 1.2 psi pressure drop.

The pre-engineered metal storage building within the PA (FLEX Storage Building – A) is designed per local building code requirements (ASCE 7-05) and does not include tornado wind speeds.

Confirmatory Item 3.2.1.A

Confirm that the operator actions times in the first 20 minutes of the event are adequate and reasonably achievable when the associated ELAP procedures are developed and validated.

ENO Response

There is only one time-dependent operator action in the first 20 minutes of the event and it has been validated to be achievable. The operator action is to isolate primary coolant pump (PCP) controlled bleedoff (CBO) within the first 20 minutes. This action is directed in EOP-1.0, "Standard Post-Trip Actions," Section 5.0, "Operator Actions," Step 3, "Response Not Obtained," and in EOP-3.0, "Station Blackout Recovery," Step 5. The required action is performed in the control room and the operating crews are trained to perform this action.

Confirmatory Item 3.2.1.B

Confirm the robustness of the charging pump control circuit or provide FLEX procedure guidance to manually operate the charging pumps by breaker operation.

ENO Response

The charging pumps control circuitry is fed from safety related 125 VDC buses. The 125 VDC supply is connected to safety related 480 VAC load centers, and then on to the main control room, allowing the motors to be remotely operated. The 125 VDC and 480 VAC power supplies necessary to remotely operate the charging pumps from the main control room are all considered robust, as they are safety-related sources. Therefore, the control circuitry

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[7] NRC Regulatory Guide (RG) 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," Revision 1.

necessary to operate the charging pumps from the control room is also considered robust as defined by NEI 12-06.

The charging pumps power circuitry is also considered robust. Load centers LCC-19 and LCC-20 provide Class 1E service as defined by IEEE 308-1971, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations." They are both safety related, and are both located in the electrical equipment room within the auxiliary building. Load centers 19 and 20 are in conformance with established criteria for redundancy and physical separation of Class 1E systems. Transformer 11 feeds LCC-11 and transformer 19 feeds LCC-19. Transformer 12 feeds LCC-12 and transformer 20 feeds LCC-20. By connecting the FLEX diesel generator to LCC-19 or LCC-20, power can be back-fed through transformers 19 or 20, to transformers 11 and 12, and then to LCC-11 and LCC-12.

Load centers LCC-11 and LCC-12 provide Class 1E service as defined by IEEE 308-1971. They are both safety related. They are both located in the cable spreading room in the auxiliary building. As the primary strategy to power a charging pump in a FLEX event, LCC-11 will power charging pump P-55C. As the alternate strategy to power a charging pump in a FLEX event, LCC-12 will power charging pump P-55B.

Transformers 11, 12, 19 and 20, and LCCs 11, 12, 19 and 20 are Safety Class 1E and Seismic Category I.

As indicated in PLP-RPT-13-00051, existing plant documentation, namely Unresolved Safety Issue (USI) A-46 Seismic Qualification Utility Group (SQUG) reports, credit charging pumps P-55B and P-55C as seismically rugged. Therefore, the electrical components required to operate these pumps are rugged as well.

Confirmatory Item 3.2.1.C

Confirm the seismic robustness of the BAST piping to support use of the BAST water as a supply source for the charging pumps.

ENO Response

Report PLP-RPT-13-00051 and EC 49798 evaluated the robustness of the piping from the boric acid storage tank (BAST) to the charging pump suctions. PLP-RPT-13-00051 concluded that the piping from the BAST to the charging pump suctions meets the requirements for robustness as defined by NEI 12-6. Consequently, the piping is seismically robust and can be credited for use during a BDBEE.

Confirmatory Item 3.2.1.D

Confirm the availability and adequacy of a borated water supply to support the PCS makeup strategy.

ENO Response

The boric acid storage tanks (T-53A and T-53B) contain sufficient boric acid to provide borated makeup to the PCS for greater than 24 hours after event initiation. 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 supplied by a FLEX pump. With a usable volume of 457.4 gallons, one batching tank volume every 90 minutes will meet the necessary inventory to account for any primary coolant system leakage. The required minimum boric acid batch concentration is 1720 ppm. In addition to the turbulent mixing from the injection of lake water into 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 is from Lake Michigan and could be as low as 32°F. At this temperature, the solubility of boric acid is 2.61 weight percent or 4565 ppm. The boric acid concentration of 1720 ppm is well below 4565 ppm to ensure the boric acid stays in solution when mixed with cold water.

FLEX hoses will be run from the FLEX distribution manifold to T-77 prior to the depletion of T-53A and T-53B. The FLEX distribution manifold is supplied by the FLEX pump which takes suction from the intake structure (Lake Michigan). The FLEX pump and manifold must be deployed and operating at t=8 hours to supply makeup to steam generators. This provides sufficient time to run hoses to the batching tank and prepare batch additions of borated water prior to depletion of T-53A and T-53B greater than 24 hours after the event.

Confirmatory Item 3.2.1.E

Confirm the continued functionality of the Atmospheric Dump Valves in the context of a tornado missile hazard during an ELAP in order to support a symmetric cooldown. Alternatively, address the effects of asymmetric natural circulation cooldown.

ENO Response

The atmospheric dump valves (ADVs), actuators, air supply piping, inlet piping and bulk of discharge piping are all located within the CPCo Design Class 1 auxiliary building and as such are protected against all applicable external events, including tornado-generated missiles. These components meet the definition of "robust" with respect to NEI 12-06, Revision 0. There are two ADVs on each steam generator (total of four), each with an independent exhaust stack that exits the auxiliary building roof at an elevation of 639 feet above sea level (plant grade level is 590 feet above sea level). Each exhaust stack is 8-inch schedule 40 pipe (0.322 inches thick).

The current PNP licensing basis does not require tornado missile protection of the ADV exhaust stacks. At the time of the PNP Systematic Evaluation Program, the NRC concluded that the PNP met the current criteria for protection from tornado missiles. This conclusion was based in part on the limited susceptibility of the ADV exhaust stacks to tornado missiles as follows:

> "[The] dump valve stacks extend approximately six to eight feet above the auxiliary building roof. The section of the auxiliary building roof where the exhaust stacks are located is below that of the surrounding structures, and is well protected by the north and east and is partially sheltered by the containment on the south side. To the west, the turbine building, although not completely missile proof, rises approximately 25 feet above and extends approximately 175 feet to the south of this section of the roof. The only direction from which the stacks are not at least partially sheltered would be from above."

In addition to the protection afforded by the turbine building to the west, the four ADV stacks are also sheltered by the main steam relief valve exhaust stacks located immediately adjacent and to the east of the ADV stacks. Based on the low probability of a tornado missile impacting the ADV exhaust due to protection from surrounding structures, and their location with respect to plant grade level, the ADV exhaust stacks are considered to be adequately protected from tornado missiles to ensure a symmetric plant cooldown. Though the ADV exhaust stacks are not provided with explicit protection from tornado missiles, it is determined that based on the location of the stacks with respect to surrounding structures, the exhaust stacks are reasonably protected from tornado missiles to be considered as "robust" per NEI 12-06 and will serve their function following a BDBEE to perform a symmetric plant cooldown. It is also noted that Section 3.2.1.4 of NEI 12-06 states that "main steam system valves (such as main steam isolation valves, turbine stop valves, atmospheric dumps, etc.), necessary to maintain decay heat removal functions operate as designed."

<u>Confirmatory Item 3.2.1.F</u>

Confirm the ability of any non-safety related equipment to function as credited in the mitigation strategies in accordance with the external event criteria described in NEI-12-06.

<u>ENO Response</u>

All installed equipment credited in mitigation strategies, including non-safety related equipment, has been evaluated and documented to be in conformance to the external event criteria described in NEI 12-06 in EC 46465. The non-safety related equipment that was evaluated is as follows:

ATTACHMENT 4

INTERIM STAFF EVALUATION OPEN ITEM AND CONFIRMATORY ITEM RESPONSES

Structure, System or Component Safety Class	Structure, System or Component Safety Class
Turbine Building	Non-safety related (NSR)
T-81 Piping and Components	Combination of safety related (SR) and NSR components
T-2 Piping and Components	Combination of SR and NSR components
Nitrogen Backup Station # 2 and Associated Tubing (TDAFW steam supply valve CV-0522B))	Combination of SR and NSR components
Nitrogen Backup Station # 1 and Associated Tubing (AFW supply valves CV-0727 and CV-0749)	Combination of SR and NSR components
TDAFW Pump Discharge and Recirculation Piping and Components	Combination of SR and NSR components
Main Feedwater Piping and Components	NSR
Nitrogen Backup Station #9 and Associated Tubing (Atmospheric Dump Valves)	NSR
T-77 Boric Acid Batch Tank	NSR
T-77 Piping and Components	NSR
T-53A/B Piping and Components	Combination of SR and NSR components
P-56A Boric Acid Pump	NSR
P-56B Boric Acid Pump	NSR
P-55A/B/C Charging Pump	NSR
P-55A/B/C Piping and Components	Combination of SR and NSR components
Lighting Panel EL-04A/05A	QP/NSR
EP-1901 FLEX Electrical Panel	NSR
EP-2001 FLEX Electrical Panel	NSR
CV-2191 Controlled Bleed Off Relief Stop Valve	QP
LIA-0365 – Safety Injection Tank T-82A Level Alarm	QP
LIA-0368 - Safety Injection Tank T-82B Level Alarm	QP
LIA-0372 - Safety Injection Tank T-82C Level Alarm	QP
LIA-0374 - Safety Injection Tank T-82D Level Alarm	QP
PI-0782 – Auxiliary Feedwater Pumps P-8A & B Suction	QP
TI-1812 – Containment Building Reactor Cavity Temperature Indicator	QP
TI-1813 – Containment Building Steam Generator Space Temperature Indicator	QP
TI-1814 - Containment Building Steam Generator Space Temperature Indicator	QP
TI-1815 - Containment Building Steam Generator Space Temperature Indicator	QP
EVI-27/D1 – Station Battery ED-01 UV Relay / Voltage	QP
EVI-27/D2 - Battery D02 DC Volt Indicator / Undervoltage Relay	QP

Confirmatory Item 3.2.1.1.A

Confirm that the use of Combustion Engineering Nuclear Transient Simulator (CENTS) in the ELAP analysis is limited to the flow conditions prior to reflux boiling initiation. This confirmation should include a description of the CENTS-calculated flow quality at the top of the SG U-tube for the condition when two-phase natural circulation ends and reflux boiling initiates.

ENO Response

The use of CENTS in the site-specific PNP ELAP analysis (CN-SEE-II-13-5, Revision 1) is limited to the flow conditions prior to reflux boiling initiation. The use of CENTS is within the allowable range of the Pressurized Water Reactor Owners Group (PWROG) white paper, which was accepted by the NRC.[8] The PNP primary strategy is to maintain single phase natural circulation, for which the use of CENTS has previously been accepted by the NRC. The ELAP analysis indicates single phase natural circulation flow is maintained without pumped makeup until 10 hours into the event. The analysis confirms a 30 gpm flow from a FLEX makeup pump will maintain single phase natural circulation. Flow was assumed to begin at 8 hours.

Confirmatory Item 3.2.1.2.A

Confirm the Primary Coolant Pump (PCP) seal leakage rate assumed in the ELAP analysis is justified. Specifically, if the PCP seal leakage rate used in the plant-specific analysis is less than the upper bound expectation for the seal leakage rate (15 gpm/seal) discussed in the PWROG position paper addressing the PCP seal leakage for Combustion Engineering plants (ADAMS Accession No. ML13235A151, non-publicly available), justification should be provided.

ENO Response

The PCP seal leakage rate assumed in the ELAP analysis is 15 gpm per PCP seal. The PNP FLEX strategy is consistent with the current analysis (CN SEE-II-13-5, Revision 1) with respect to the timing and flow rate at which PCS makeup is required to maintain single phase natural circulation and for achieving adequate shutdown margin through PCS boration. The ELAP analysis assumption of 15 gpm/pump aligns with the assumptions of the generic analysis WCAP-17601, "Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs," Revision 1.

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[8] NRC letter to Pressurized Water Reactor Owners Group, October 7, 2013 (ADAMS Accession No. ML13276A555).

Confirmatory Item 3.2.1.2.B

Confirm whether seal failure will occur or not when subcooling of the coolant in the PCS cold-legs is greater than 50 degrees Fahrenheit (°F). This evaluation should specify the seal leakage flow assumed for the ELAP from time zero to the timeframe when subcooling in the PCS cold-legs decreases to 50°F, and provide justification for the assumed leakage rate.

ENO Response

In accordance with PNP Emergency Operation Procedure (EOP) 3.0, plant operators maintain PCS subcooling within the band of 25°F to 50°F post trip. It is important to note that PCS subcooling by the EOPs is based on a reference to the core exit thermocouples (CETs), or, hot leg temperatures. In accordance with the Emergency Procedure Guideline, CEN-152 Engineering Limit Bases Document, EOP limits on subcooling are not germane to PCP seal preservation but instead are based on 1) the need to verify adequate core cooling, and, 2) used as a basis to determine when voiding occurs in the PCS, and, 3) used to validate pressurizer level provides usable indication of acceptable PCS inventory. In the case of natural circulation, which would be the PCS cooling means during an ELAP, the maintenance of PCS subcooling by EOP-3.0 would be to maintain PCS temperature subcooled as indicated by the CETs, which would be equivalent to hot leg temperatures. The parameter of interest for preservation of subcooling for RCP seals would be the cold leg temperatures. The PCP seal failure model of WCAP 16175-P-A[9] analyzes potential seal failure modes due to hydraulic instability (pop-open), thermal binding, and extrusion of seal elastomers. In the analysis of the model, maintaining seal stage inlet sub-cooling above 50°F is important to preclusion of failure due to hydraulic instability.

The discussion on page B-9 of WCAP 16175-P-A provides information relative to the PCS response for two reference CE plants under station blackout conditions when analyzed through CENTS. This discussion indicates that given no operator action, the SBO event will maintain the PCS with a greater than 50°F subcooling for periods on the order of hours. The high subcooling is a result of residual hot water in the pressurizer and the approximate 20°F hot leg – cold leg temperature difference that exists during the early natural circulation time period. This same temperature difference was witnessed in the SONGS natural circulation testing. This discussion goes on to say that since it takes hours for the lowest seal to reach pop-open subcooling levels and since CBO closure removes pressure drops across all seals, save the last one, CBO isolation even late in the scenario would also prevent pop-open failure. Figure B1.2.8 of WCAP 16175-P-A shows the hot and cold leg PCS subcooling values from this analysis and indicates that cold leg (PCP seal) subcooling is not challenged until several hours into the event. Furthermore, ENO recently performed a simulated ELAP scenario using the plant simulator and the data shown in Figure B1.2.8 was found to be representative of hot and cold leg temperature subcooling values at PNP.

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

Confirmatory Item 3.2.1.2.C

If the Integrated Plan is changed to credit isolation of controlled bleed-off (CBO), confirm the assumption that the integrity of the PCP seals can be maintained, and the seal leakage rate is less than 1 gpm per PCP during an ELAP before CBO is isolated. This evaluation should provide the maximum temperature and pressure, and minimum subcooling of the coolant in the PCS cold legs during the ELAP before CBO isolation. If CBO isolation is being assumed, justify the sequence of events (SOE) and time constraints so established.

ENO Response

The PNP operating practice to isolate the CBO line is predicated on an operating strategy designed to prevent the three PCP seal failure mechanisms (elastomer binding, elastomer extrusion, and seal face hydraulic instability – "pop-open") described in WCAP 16175-P-A from occurring, thereby providing maximum protection against seal failure and hence seal leakage. The site will perform a rapid cooldown two hours into the ELAP event, reducing PCS and cold leg temperatures well below the service temperature limits of concern for the PCP seal elastomers (PCP elastomer seal temperatures will not exceed service condition temperature limits during the entire event as temperatures never elevate to this level from event inception). By isolating the CBO line 20 minutes into the event, the potential for seal hydraulic instability (pop-open failure mode) is removed. Prior to isolating the CBO line, all PCP seal stages are sufficiently subcooled (in excess of 50°F) so that failure due to the "pop open" hydraulic instability failure mode is precluded. Initial seal leakage rate is assumed to be 15 gpm per PCP.

PCS pressure is 2010 psia at event initiation, which has a saturation temperature of 636.5°F. The maximum PCS cold leg temperature would be about 557°F by operation of the main steam safety valves. At T+20 minutes, complete CBO isolation is performed. No operator induced cooldown is credited until T+2 hours.

Actions for CBO isolation are contained in EOP-3.0, "Station Blackout Recovery," and EOP-1.0, "Standard Post Trip Actions." The PCP controlled bleedoff CBO isolation valves (CV-2083 and CV-2099) and the CBO relief stop valve (CV-2191) must be closed to complete CBO isolation. All three valves are operated from the control room.

Confirmatory Item 3.2.1.3.A

Confirm the applicability of ANS 5.1-1979 + 2 sigma decay heat curve.

ENO Response

As documented in Reference 7, the ELAP analysis performed for PNP in References 1 and 5 below implemented the ANS 5.1-1979 decay heat curve with two sigma uncertainty, and included the effects of neutron capture and long term actinides (Reference 2, Section 4.4, developed in Reference 3). Reference 2 is applicable because St. Lucie Unit 1 and PNP are sister plants. Reference 3 was originally created for Palo Verde Nuclear Generating Station but it is applicable to all plants, including PNP, that remain within the limits established with respect to power level, fuel enrichment, fuel burnup, operating cycle length, fuel characteristics, and the use of hybrid fuel. Reference 3 states that the decay heat curve is applicable up to the following limits:

1. Power level up to 4070 MWt
2. Fuel enrichments up to and including 5.0 weight percent
3. Fuel burnups up to 73,000 MWD/MTU
4. Up to a 24 month operating cycle with a 90% overall capacity factor
5. Not applicable to hybrid fuel
6. Fuel characteristics are based on the entire fuel cycle

The initial power level for the PNP analysis is 2530 MWt (Reference 4, Table 3.0-1) and the current power level is 2565.4 MWt, Reference 6). Although the current power level is higher than that used in References 1, 4, and 5, it has been found that initial core power level plays a negligible role in the transient response. Fuel enrichment at PNP is less than 5.0 weight percent and there is no hybrid fuel in the PNP core. The operating cycle for PNP is 18 months and fuel burnup does not surpass 73,000 MWD/MTU. The curve used in Reference 1 for the PNP analyses is applicable and conservative.

<u>References</u>

1. Westinghouse Document WCAP-17601-P, Rev. 1, "Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs."

2. Westinghouse Document CN-OA-08-34, Rev. 0, "St. Lucie Unit 1 CENTS Data Base Compilation for EPU."

3. Westinghouse Document 25/26/27-AS95-C-015, Rev. 03, "PVNGS Decay Heat Curve Including Long Term Actinides."

4. Westinghouse Document 001-ST96-C-006, Rev. 0, "Palisades SBLOCA ECCS Performing Design Basis Analysis."

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

6. Palisades Nuclear Plant Renewed Facility Operating License Amendment No. 251.

7. Westinghouse letter LTR-SCC-14-008, Rev. 0, "Recommended Response to Entergy PWR Nuclear Plants OIP Audit Questions," dated April 14, 2014.

Confirmatory Item 3.2.1.5.A

Confirm the containment temperature, pressure, and moisture profiles during the ELAP event, and justify the adequacy of the computer codes/methodologies, and assumptions used in the analysis.

ENO Response

Calculation EA-EC46465-02, "PLP MAAP4 Containment Analysis for BDBEE," Revision 0, analyzed the containment response (temperature and pressure) during a BDBEE with the plant in two operational modes. This calculation used the Modular Accident Analysis Program (MAAP) computer code to perform the containment analysis. In a letter dated October 3, 2013, the NRC endorsed the use of MAAP in performing containment analyses for PWRs for satisfying the intent of NRC Order EA-12-049 (FLEX). EA-EC46465-02 uses MAAP to perform a containment analysis, and does not use the code for establishing a timeline for coping actions with respect to the primary system. Therefore, the application of MAAP used in this analysis is acceptable based on endorsement by the NRC.[10]

The two cases chosen to bound most plant configurations are Mode 1 at full power and Mode 5 at mid-loop inventory.

The containment analysis determines containment temperature and pressure for the duration of 120 hours. The results of this analysis show that containment temperature and pressure remain below their respective design limits of 283°F and 55 psig. Prior to 120 hours after the event, onsite and offsite equipment will be available to mitigate containment conditions.

The containment temperature and pressure do not exceed the design limits and consequently the critical parameter instrumentation meet the qualification requirements necessary for the conditions expected during a FLEX event. EC 46465 contains an analysis of the qualification requirements for the critical parameter instruments.

For Modes 1-4, the containment temperature and pressure do not exceed the design limits. For Modes 5 and 6, the analysis determined that by opening a 3.75-inch equivalent diameter penetration in containment to relieve temperature and pressure, the containment design limits are not exceeded. Consequently the critical parameter instrumentation meet the qualification requirements necessary for the conditions expected during a FLEX event. EC 46465 contains an analysis of the qualification requirements for the critical parameter instruments. In addition, the key containment parameters (temperature and pressure) are such that 120 hours is not a time constraint for mitigating actions to be performed.

[10] NRC letter to Nuclear Energy Institute, dated October 3, 2013 (ADAMS Accession Number ML13275A318)

Confirmatory Item 3.2.1.5.B

Confirm whether further instrumentation is needed based upon ongoing ELAP evaluations.

ENO Response

No further instrumentation was needed based on the ELAP evaluations. A final evaluation of critical instrumentation was completed and is addressed in EC 46465. The final list of parameters available for monitoring during a BDBEE include those required by NEI 12-06, and those recommended by PWROG (PA-PSC-0965[11]) (with the exception of AFW discharge pressure which is addressed in EC 46465) and WCAP-17601.

The containment temperature and pressure do not exceed the design limits and consequently the critical parameter instrumentation meet the qualification requirements necessary for the conditions expected during FLEX. EC 46465 contains analysis of the qualification requirements for the critical parameter instruments. In addition, the key containment parameters (temperature and pressure) are such that 120 hours is not a time constraint for mitigating actions to be performed.

Instrumentation that comes installed on and is used to monitor the portable FLEX electrical power equipment includes voltmeter, ampere meter, frequency meter, engine battery voltage, engine coolant temperature, engine oil pressure, and panel lights.

Confirmatory Item 3.2.1.6.A

Complete validation of the SOE timeline.

ENO Response

Validation of the sequence of events (SOE) was completed. Evaluations were performed to assess the timing and resources required to deploy the FLEX portable equipment and perform actions required by the SOE timeline. These evaluations included assessments of proposed strategies and conceptual designs. In addition, analyses were performed which included tabletop assessments and walkthroughs with operators to simulate transporting, staging, and connecting the FLEX equipment or performing other required actions such as load shed. These evaluations and analyses indicate that on-site operational resources can perform the required actions with sufficient margin to ensure proper mitigation of the event.

Confirmatory Item 3.2.1.6.B

In the audit process, the licensee has indicated that an assessment has been performed identifying potential changes to the SOE. Confirm that a final SOE has been developed incorporating any identified changes.

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[11] Pressurized Water Reactor Owners Group (PWROG) Core Cooling Position Paper, Revision 0, PA-PSC-0965, November 2012.

ENO Response

Updated information regarding the sequence of events (SOE) is provided in Section 2.17 of the Final Integrated Plan (see Attachment 5). This information was updated as required following time constraint action validation that was performed in accordance with NEI validation process guidance.

The validation included evaluations that were performed to assess the timing and resources required to deploy the FLEX portable equipment and perform actions required by the sequence of events timeline. These evaluations included assessments of proposed strategies and conceptual designs. In addition, analyses were performed which included tabletop assessments and walkthroughs with operators to simulate transporting, staging, and connecting the FLEX equipment or performing other required actions such as load shed. These evaluations and analyses indicate that on-site operational resources can perform the required actions with sufficient margin to ensure proper mitigation of the event.

Confirmatory Item 3.2.1.9.A

Confirm that the ability to line up portable pumps is consistent with the times assumed in the final version of the Integrated Plan.

ENO Response

The ability to line up portable pumps is consistent with the times discussed in the Final Integrated Plan.

Only one FLEX portable pump is required to meet the needs of the PNP FLEX strategy. The time constraint for connection of the FLEX pump is determined by calculating the capacity of the credited steam generator make-up sources for Phase 1. Calculation EA-EC46465-14, T-2 Inventory Makeup Capability of AFW with T-81 Gravity Feed," Revision 0, determined the initial levels in the condensate storage tank (T-2) and primary system makeup storage tank (T-81) required to provide eight hours of makeup to the steam generators. Makeup water to the steam generators for Phase 1 will come from T-2 and T-81, which are cross-tied during the early stages of the event to provide a suction source to the TDAFW pump feeding the steam generators. The credited volume of the combined T-2 and T-81 tanks is calculated to last greater than eight hours. Therefore the limiting time constraint for deployment of the portable pump is eight hours for steam generator makeup when a suction source for TDAFW is no longer available.

The FLEX pump will provide flow to the steam generators directly via connections to the main feedwater water piping or the AFW (alternate) piping. The one diesel driven FLEX pump will provide flow to both steam generators, the spent fuel pool (SFP) for SFP makeup/cooling, and the boric acid batching tank (T-77) for long term PCS inventory replenishment. Evaluations have been performed to assess the timing and resources required to deploy the FLEX portable pump. These evaluations, contained in EC 46465, included assessments of proposed strategies and conceptual designs. These evaluations indicate that on-site operational resources can begin deployment of the FLEX pump at approximately t=4 hours and complete deployment by t=7 hours. This will provide an one-hour margin to ensure success. Tabletop assessments and walkthroughs with operators to simulate transporting, staging, and connecting the FLEX pump were performed during the verification and validation efforts.

The required minimum capacity of the FLEX portable pump is 410 gpm at 235 psi discharge pressure (EC 46465). This minimum capacity was determined by hydraulic calculation using the most demanding FLEX Phase 2 flow requirements which is simultaneous makeup to steam generators and the SFP. The hydraulic analysis also determined that maximum required pump suction lift is 18 feet including pressure drop through the FLEX pump suction hose.

Confirmatory Item 3.2.2.A

Resolve the discrepancy between the licensee-determined flow rate of 100 gallons per minute (gpm) SFP spray and the 250 gpm performance attribute of NEI 12-06, Table D-3.

ENO Response

Two monitor nozzles are employed to supply the SFP spray cooling function. The two monitor nozzles will be located at opposite ends of the SFP and will provide 125 gpm each or 250 gpm total.

Confirmatory Item 3.2.3.A

Confirm the plan assumptions for containment cooling, after completion of the containment response analysis.

ENO Response

The assumptions concerning containment cooling were confirmed after completion of the containment response analysis.

The containment analysis was completed using the Modular Accident Analysis Program (MAAP). Results of this analysis show containment design parameters will not be exceeded for the at-power scenario (i.e., event initiating in Mode 1).

The containment air coolers are not credited for the PNP FLEX coping strategy. The site specific containment analysis (EA-EC46465-02, "PLP MAAP4 Containment Analysis for BDBEE," Revision 0) showed that the containment air coolers are not required for over 120 hours for the at-power scenario. During the plant recovery phase (i.e., Phase 3), the containment air coolers may be utilized, although they are not credited for the FLEX coping strategy. During the recovery phase, the containment air coolers may be provided cooling water via the Phase 3 low pressure/high flow pump. This is accomplished through use of a service water system tie-in location which provides cooling water for necessary plant heat loads including containment air coolers that are used for containment heat removal.

For the most conservative shutdown scenario (i.e., Mode 5 reduced inventory), the results of the analysis show that a vent path is required to prevent exceeding the design limits of containment. One of the two containment purge exhaust headers is used to vent containment. Procedural controls have been established using the supplemental guidance provided in the NEI position paper entitled "Shutdown / Refueling Modes."[12]

In addition, FIG-11, "Service Water – NSRC (Phase 3)," Revision 0, states that containment atmosphere is not expected to exceed the 140°F limit at which instruments inside containment would be negatively impacted for up to six days after the ELAP event, and provides direction for restoration of service water and the containment air coolers to ensure that the containment design temperature limit for instrument function is not exceeded.

Confirmatory Item 3.2.4.1.A

Confirm whether supplemental cooling is required for components or systems used in the mitigating strategies plan.

ENO Response

The TDAFW pump and the charging pumps are installed plant components that are used in the FLEX strategy. The TDAFW system is cooled by taking a portion of the pump discharge and supplying it to the bearing oil cooler to keep the TDAFW pump cool during operation. Additionally, the TDAFW pump room was evaluated (EC 46465) for room heat up during TDAFW operation. The GOTHIC analysis of the TDAFW pump room indicated that the room temperatures would not exceed the high temperature criteria (160°F) for at least five days.

Based on System Operating Procedure SOP-2A, "Chemical and Volume Control System," the charging pump can be operated for up to 72 hours without cooling to the charging pump oil coolers. The charging pumps will not be in continuous use but will be used intermittently during the course of the BDBEE.

Confirmatory Item 3.2.4.1.B

Confirm the connection point for the UHS FLEX Pump to the Service Water System.

ENO Response

As described in EC 46465, a deployable header (flanged elbow) was manufactured as part of the FLEX equipment to connect the Phase 3 National Safer Response Center (NSRC) pump to the service water system. This header will replace a section of pipe on the discharge of service water pump P-7C just before the inlet strainer F-2C, and will be attached directly to the strainer inlet. The discharge hoses from the pump can then be routed into the intake structure and connected to the header.

[12] NEI position paper, "Shutdown / Refueling Modes," September 18, 2013 (ADAMS Accession Number ML13273A514)

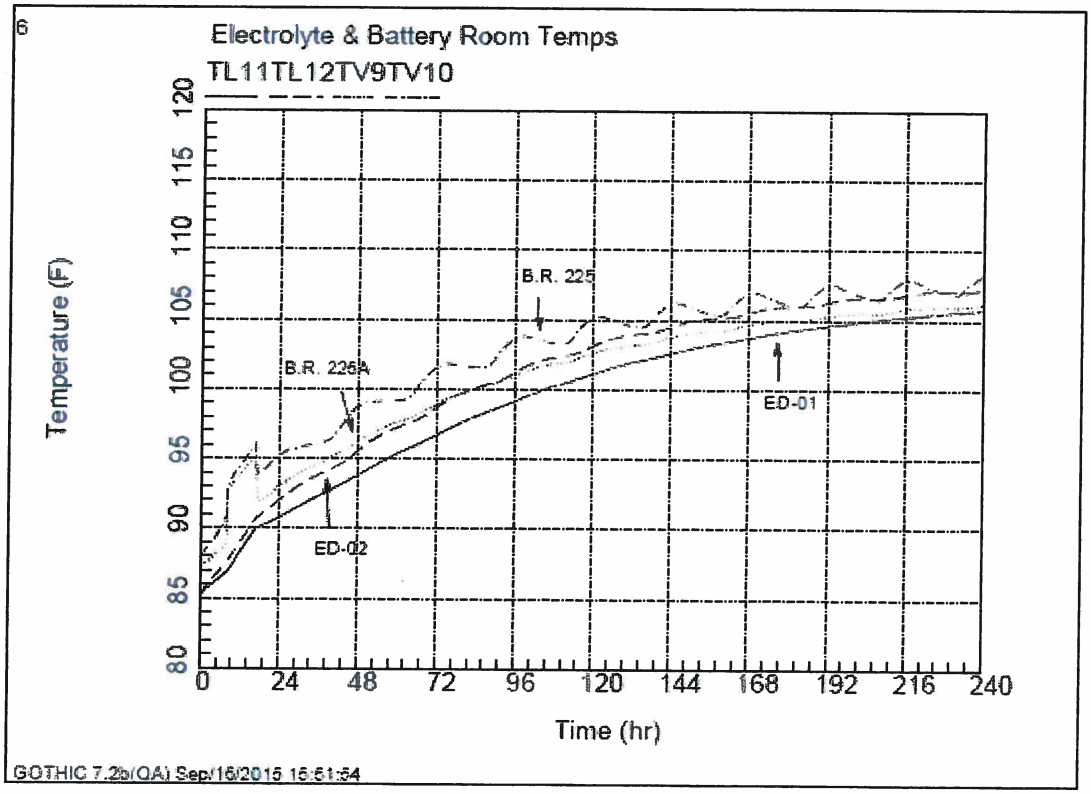
The NSRC low pressure/high flow pump will provide the motive force to reestablish service water flow through installed service water system piping.

Confirmatory Item 3.2.4.2.A

Confirm the adequacy of the ventilation provided in the battery room to protect the batteries from the effects of extreme high and low temperatures.

ENO Response

Calculation EA-EC46465-04, "BDBEE Temperature Calculation for CSR, EER, and Battery Rooms," Revision 1, determined the temperature in the battery rooms under extreme high temperatures and loss of ventilation. The battery vendor manual specifies a maximum temperature limit of 120°F to prevent mechanical and/or performance degradation of the battery. The calculation credits opening the battery room and cable spreading room Door 44 after ten hours to provide natural circulation of air, and concludes that the temperature in both battery rooms will remain below 120°F for at least 240 hours. These results are shown in the figure below. Based on the results of this analysis, the temperatures in the battery rooms are not expected to reach the maximum temperature limit of 120°F.



Calculation EA-EC46465-04 also determines the electrolyte temperature for the batteries for an extreme low temperature event. From PNP Technical Specification 3.8.6, the battery electrolyte temperature must remain above 70°F to remain operable. The calculation determined that the electrolyte temperature for the batteries in both rooms remains above 70°F for the analysis duration of eight hours. Eight hours after the event, the FLEX generator will be connected to the battery chargers. Once the battery chargers are placed in service, they will carry the DC load. Therefore, the batteries will remain operable during the extreme low temperature event without any operator action providing supplemental heat to the rooms.

Confirmatory Item 3.2.4.2.B

Confirm the adequacy of battery room ventilation to prevent hydrogen accumulation while recharging the batteries in Phase 2 or Phase 3.

ENO Response

Calculation EA-DBD-1.07-001, "Battery Room Ventilation Requirements for Hydrogen Control," Revision 1, provides the basis for battery room hydrogen control. The calculation states that when the batteries are being equalized (charged) and ventilation is lost, the time to reach two percent hydrogen in the rooms is 1.8 hours. Therefore, to prevent hydrogen accumulation above two percent, a portable ventilation/exhaust to the battery rooms will be deployed by 1.5 hours after battery charging begins, or 9.5 hours after the event. The installed battery room ventilation system is not credited because it is not seismically qualified and is not protected from wind-generated missiles. A lightweight (< 30 pounds), portable exhauster/blower specifically designed for confined space and hazardous location ventilation is stationed immediately outside the battery rooms. The exhauster, which is powered from a 120 volt AC receptacle on the FLEX generator, is specified with a minimum capacity of 150 scfm required for battery room hydrogen ventilation (far greater than necessary to keep the hydrogen concentration well below explosive limits). 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 exhaust blowers are explosion-proof.

Confirmatory Item 3.2.4.3.A

Confirm whether heat tracing is required for borated water systems.

ENO Response

Heating tracing is not required for the borated water systems. Based on EC 46465, precipitation of boric acid will not occur in the boric acid storage tanks (BASTs) T-53A and T-53B until 330 hours after loss of heating. In the insulated chemical and volume control system piping, where the highly concentrated boric acid is present, 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 the onset of precipitation may occur will not result in significant precipitation such that the charging lines would 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. The required operation of the charging pumps to prevent precipitation of boric acid in the lines is bounded by the PCS makeup rate to account for system leakage such that the inventory in T-53A and T-53B is not negatively impacted by this operation.

Regarding loss of BAST level indication due to precipitation, low level switches on the tanks ensure that level is maintained at 118 inches during normal operations when the reactor is critical. This level corresponds to 94.5 percent, providing the operators with an initial BAST inventory prior to the event. Level will be computed/monitored (once PCS makeup is commenced) based on the length of time that the charging pump is running during the event. With normal level in the tank and knowledge of flow rate (40 gpm), the level in the tank can easily be tracked. Operating procedures provide guidance to operators for BAST level tracking during a BDBEE. Therefore, no additional mitigation measures to maintain heat tracing are necessary for BAST level indication.

Confirmatory Item 3.2.4.4.A

Confirm that communication enhancements credited in the NRC's communication assessment (ADAMS Accession No. ML13129A219) are completed as planned.

ENO Response

Communication enhancements have been completed. For example, additional hand-held radios, satellite phones, and spare batteries have been purchased and staged to ensure that that the criteria established in NEI 12-01, "Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities," are met. Procedures have been revised to incorporate this new communications equipment. Sizing of existing uninterruptible power supply (UPS) batteries in emergency planning facilities was reviewed to ensure that adequate power capacity exists, and UPS batteries were replaced as necessary. Seismic-related issues concerning anchorage, special interactions, and housekeeping were reviewed and corrected as required.

Confirmatory Item 3.2.4.6.A

Confirm that habitability limits will be maintained and/or operator protective measures will be employed in all phases of an ELAP to ensure operators will be capable of FLEX strategy execution under adverse temperature conditions.

ENO Response

Operators are trained on working in high temperature areas in the plant. Entry into and work in high temperature environments are governed by site industrial safety procedures with controls for work in heat stress situations. Procedures provide guidance for operating staff to evaluate the area and room temperatures and take actions as necessary. In addition, current general site training includes a module on the recognition of dehydration along with methods to cope. Bottled water is stored on site, and PNP procedures use passive cooling technologies for response personnel.

Calculation EA-EC46465-03, "Control Room Heatup for Extended Loss of AC Power," Revision 0, was developed to determine the temperature in the main control room during an ELAP event. Results of this calculation show 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, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors." Long-term habitability can be assured by monitoring of control room conditions, heat stress countermeasures, and rotation of personnel to the extent feasible. In addition, the FLEX Support Guidelines (FSG) provide guidance for control room staff to evaluate control room temperature and take actions as necessary.

Additionally, continuous exposure to adverse temperature conditions (extreme heat or cold environment) is not expected as many manual actions are intermittent and/or infrequent, allowing the operator to seek shelter/relief if necessary.

Confirmatory Item 3.2.4.7.A

Confirm that the evaluation of the CST and T-81 shows that the tank qualification is consistent with the strategy and the provisions of NEI 12-06.

ENO Response

Site documentation demonstrates that both tanks are robust for seismic and tornado wind.

The analysis conducted to assess the susceptibility and protection requirements of the CST for wind missiles is performed within EC 48187, "T-2 CST Analysis and Missile Barrier." EC 48187 contains a four-phase analysis using a finite element methodology that demonstrated that the CST tank shell (as well as tank T-81) is vulnerable to perforation from a 6-inch diameter pipe missile. EC 48187 designed a modification consisting of adding a 3/8 inch thick steel shell around each tank along the full height, essentially creating a wrapper around each tank.

Following the implementation of the design modification described in EC 48187, the CST and T-81 are robust against all applicable RG 1.76, Revision 1, tornado missile hazards, with the single exception being the tank T-81 foundation mounting bolting for an automobile missile hazard. A means of providing an engineered solution to the tank bolting was unsuccessful because of adverse impacts to proposed missile protection structures, to existing structures in the immediate vicinity, and to site travel and access ways, and because of spatial limitations. An alternate approach was used that qualitatively evaluated the probability of an automobile missile strike. The use of probability has been acceptable to the NRC on a case-by-case basis. The use of probability in conjunction with other mitigating actions, in this case, was viewed as reasonable, and through informed evaluation was deemed justifiable and acceptable.

EC 48187 documents the approach described above. The approach includes procedural actions to remove automobile-like hazards from the zone of influence based on severe weather trigger, to permanently restrain any current known potential car-like missiles, and to use alternate water sources in the event T-81 is structurally threatened. This is an alternate approach to the guidance of NEI 12-06, and is documented as such in the fifth six-month FLEX status report submitted on August 28, 2015.

Confirmatory Item 3.2.4.7.B

Confirm that the FLEX Support Guidelines provide clear criteria for transferring to the next preferred source of water when refilling the CST.

ENO Response

The strategy of makeup to the steam generators was changed after the issuance of the Overall Integrated Plan (OIP). The CST refill, which was previously described as the primary strategy, was not used. Instead, as described in EC 46465, inventory for feeding the steam generators in Phase 2 is provided directly to the main feedwater (MFW) system piping or the auxiliary feed water (AFW) system piping via hose connections, thereby bypassing the CST. The source of water for Phase 2 steam generator makeup will remain the same (i.e., from Lake Michigan using a portable FLEX pump staged on the west side of the intake structure). Flexible discharge hoses will be routed to connections on the MFW system piping or the AFW system piping prior to depletion of combined CST and T-81 inventory. A portable, diesel-driven FLEX pump will be deployed from the FLEX storage facility to provide a minimum of 136.5 gpm of makeup water at a steam generator pressure of 200 psi. Note that one FLEX pump is sized to support all strategies. The primary connection point for direct steam generator makeup during Phase 2 is on the MFW system piping in the turbine building. EC 47338 installed a new connection between feedwater recirculation valves MV-FW907 and MV-FW908 on feedwater heater E-6B.

If the MFW connection is unavailable following the event, the alternate connection point for direct steam generator makeup is on the AFW system piping inside the West Safeguards room of the Auxiliary Building. EC 47340 installed a new connection in the discharge piping of AFW pump P-8C.

For Phase 1, the CST and T-81 tanks will be used until inventory is depleted (at approximately eight hours), after which use of the FLEX pump with a suction from the intake structure will commence. EOP-3.0, "Station Blackout Recovery," Attachments 2 and 3, provide guidance to establish alternate low pressure feedwater when the steam-driven AFW pump (P-8B) is no longer available.

As part of the defense-in-depth guidance to enhance the alternate approach for missile protection against the automobile-like hazard, FSG-6, "Alternate CST (T-2) Makeup," provides guidance to provide lake water makeup to T-2 using the diesel-driven fire water pumps (DDFWP) P-9B or P-41 with one of the following flowpaths:

1. EOP Supplement 31, "Supply AFW Pumps From Alternate Sources," aligns fire water (if available) directly to the suction of P-8B. Excess flow is provided which backfills T-2 at the same time suction is provided to P-8B. This is the easiest method available for operators.
2. FIG-6 describes the use of fire protection system (FPS) water (if available) from either the FPS test header or a nearby hydrant via a hose connected to vents on the

blowdown system to T-2. While not robust, this method could be available and therefore, addresses defense-in-depth.

3. FIG-6 describes the use of FPS water (if available) from either the FPS test header or a nearby hydrant via a hose connected to the T-2 vent on top of the tank.
4. Either methods 2 or 3 above could also use the FLEX pump as a water source in lieu of the DDFWPs.
5. If 1, 2, 3, or 4 are not available, the FLEX strategy would be implemented for use of the FLEX pump makeup directly to the steam generators through diverse connections provided in FSG-3, "Low Pressure Feedwater," and FIG-2, "FLEX Pump Staging and Operation. "

The above methods would be prioritized in the field by operations personnel at the time of the BDBEE based on equipment availability and ease of use.

Confirmatory Item 3.2.4.10.A

Confirm that the load shed calculation verifies adequate battery capacity with sufficient margin throughout Phase 1 to assure the battery does not get depleted prior to charging, and the results of the analysis are properly integrated into the overall strategy.

ENO Response

The load shed calculation verifies adequate battery capacity with sufficient margin throughout Phase 1 to assure the battery does not get depleted prior to charging, and the results of the analysis are properly integrated into the overall strategy. Calculation EA-ELEC-LDTAB-021, "Station Batteries ED-01 & ED-02 FLEX Coping Capability," evaluates the dc load profile for extended load shedding activities. The calculation is based on an initial load shed previously analyzed/evaluated for SBO conditions and addressed in procedures EOP-3.0, "Station Blackout Recovery," EOP Supplement 7, "Battery #1 Load Stripping," and Supplement 8, "Battery #2 Load Stripping." The SBO load shed allows for battery durations of greater than four hours. In calculation EA-ELEC-LDTAB-021, additional loads are identified for deep load shedding that extend the battery duration to at least eight hours during a BDBEE. By extending the battery duration to at least eight hours, sufficient time is provided for the deployment and staging of the FLEX generator, which will be connected to the battery chargers prior to t=8 hours. Deployment of the FLEX diesel generator will start by approximately t=2 hours and complete by approximately t=6 hours, thereby providing sufficient margin for ensuring continuation of power to critical instruments and mitigation systems. Further analysis was performed which included tabletop assessments and walkthroughs with operators to simulate transporting, staging, and connecting the FLEX equipment, or performing other required actions such as load shedding. The additional loads for deep load shedding were incorporated into appropriate procedures and validated in accordance with the validation process following development of the FSGs. Calculation EA-ELEC-LDTAB-021 was posted to the ePortal.

Confirmatory Item 3.2.4.10.A

Confirm that plans for the deployment of portable equipment used to implement the response conform to the criteria of NEI 12-06, Section 12.2, with regards to considerations 2 through 10.

ENO Response

By letter dated September 11, 2014[13], the Nuclear Energy Institute (NEI) provided a white paper titled "National SAFER Response Centers," which provides the programmatic aspects and implementation plans for the SAFER program. The NRC staff reviewed the SAFER program description provided in the NEI white paper and additional information via audit, and observed proof-of-concept exercises and equipment testing. The NRC concluded that SAFER has procured equipment, implemented appropriate processes to maintain the equipment, and developed plans to deliver the equipment needed to support site responses to BDBEEs, consistent with NEI 12-06 guidance. In particular, the NRC review concluded that the SAFER plans and procedures conform to the guidance described in NEI 12-06, Section 12.2, "Minimum Capabilities of Off-Site Sources."[14]

[13] NEI letter, "National SAFER Response Center Operational Status," dated September 11, 2014 (ADAMS Accession No. ML14259A222).

[14] NRC letter, "Staff Assessment of National SAFER Response Centers Established in Response to Order EA-12-049," dated September 26, 2014 (ADAMS Accession No. ML14265A107).