Electrical Reviewer Final Integrated Plan Checklist for
Orders EA-12-049 and EA-12-051 Safety Evaluations

Summary of Staff Conclusions:

- The NRC staff concludes that the Phase 1 electrical equipment should be appropriately protected during the beyond-design-basis external event (BDBEE).
- The NRC staff concludes that, given the licensee's plans to shed loads, the vital battery should supply the needed loads until the Phase 2 equipment can be aligned for the analyzed extended loss of ac power (ELAP) event.
- The NRC staff concludes that the Phase 2 equipment should have adequate capacity to power the loads needed for the analyzed ELAP event.
- The NRC staff concludes that the Phase 3 equipment should have adequate capacity to power the loads needed for the analyzed ELAP event.
- The NRC staff concludes that the FLEX diesel generators (DGs), connection points, and distribution system should be adequately protected and have sufficient primary and alternate connection capability to support core cooling, SFP cooling, and containment during the evaluated ELAP event, consistent with Nuclear Energy Institute (NE)I 12-06.
- The NRC staff concludes that the licensee's plans should prevent unacceptable buildup of hydrogen in the vital battery rooms.
- The NRC staff concludes that the electrical equipment relied on to mitigate the analyzed ELAP event should remain functional.

Note: {information which should be placed on the electronic portal}
[condition when the information is needed]

<u>Reactor Core Cooling Strategies – SE Section 3.2.3.6 (Electrical Analysis)</u>

Staff Conclusion: Based on the staff's review of the licensee's analysis and procedures, and information from the battery vendor, the NRC staff finds that the ABC, Unit Nos. 1 and 2, direct current (dc) systems should have adequate capacity and capability to power the loads required to mitigate the consequences during Phase 1 of an ELAP as a result of a BDBEE provided that necessary load shedding is completed within the times assumed in the licensee's analysis.

Information needed to support conclusion:

<u>Phase 1 Equipment</u>

1. Vital batteries, dc distribution system, inverters, battery chargers – state their location and that they are protected from all external hazards). (North Anna Power Station, Units 1 and 2 (North Anna) Final Integrated Plan (FIP) Section 2.3.4.3, Millstone Power Station, Unit 2 (Millstone) FIP Section 2.3.4.3)

2. Discuss dc load shed
    a. State how long after declaring an ELAP that the dc load shed begins and what time will it be completed (e.g. operators would commence shed of dc loads within 45 minutes after the occurrence of an ELAP/ loss of normal access to the ultimate heat sink (LUHS) event. Load shedding is expected to

be completed within 30 minutes). (North Anna FIP Section 2.3.1, Millstone Unit 2 FIP Section 2.3.1)

   i. Reference procedures used in the dc load shed (e.g. ECA 0.0, FSGs, etc.) (Calvert Cliffs Nuclear Power Plant, Units 1 and 2 (Calvert Cliffs) FIP Section 3.5, Millstone, Unit 2 FIP Section 2.3.1, North Anna FIP Section 2.3.1) {procedure on e-portal}

3. Vital Battery Coping – state battery coping time (compare to time to align / connect FLEX DG to restore battery chargers) (North Anna FIP Section 2.3.1, Millstone, Unit 2 FIP Section 2.3.1) {coping analyses on e-portal}

   a. [If Vital Battery coping greater than 8 hours] State that evaluation follows guidance of NEI White Paper, "EA-12-049 Mitigating Strategies Resolution of Extended Batteries Duty Cycles Generic Concern," which is endorsed by the NRC in Agencywide Documents Access and Management System Accession No. ML13241A188. **(North Anna – 2.3.11, Millstone Unit 2 - 2.3.11)**

   b. {Vital Battery – manufacturer, model number, cells per battery, 8-hr discharge rate (e.g. 1495 ampere-hours (AH) at an 8 hour discharge rate to 1.75 V per cell) – this information is in the battery coping analyses that should be placed on e-portal}

Phase 2 FLEX DGs Sizing

Staff Conclusion: Based on its review of the summary of the licensee's calculation, the NRC staff finds that the FLEX DGs should have sufficient capacity and capability to supply the required loads.

Information needed to support conclusion:

1. Portable/pre-staged FLEX DGs

   a. State the FLEX DG rating (in KW and/or kVA) (North Anna FIP Section 2.3.11, Millstone, Unit 2 FIP Section 2.3.11)
   b. State total expected kW/kVA loading (R.E. Ginna Nuclear Power Plant (Ginna) FIP Section 3.3)
      i. Reference sizing calculation {place calculation on e-portal}

Phase 3 FLEX NSRC CTGs Sizing

Staff Conclusion: Based on its review of the summary of the licensee's calculation, the NRC staff finds that the 4160 Vac and 480 Vac equipment being supplied from the NSRC should have sufficient capacity and capability to supply the required loads.

Information needed to support conclusion:

1. Portable National Strategic Alliance of FLEX Emergency Response (SAFER) Center NSRC combustion turbine generators (CTGs)

a. State whether Phase 3 is only used as a backup to Phase 2 (i.e., same loads). Or, state whether the CTGs will be used to power additional loads (e.g., establish containment cooling or room cooling power installed boration equipment, get on shutdown cooling) and state whether these loads are required for indefinite coping or whether these loads are optional/defense in depth. This list is not intended to address recovery actions that are beyond the scope of the order. {load analysis if additional functions}

c. [If additional loads] State total expected kW/kVA loading It is acceptable to describe margin in generating capacity versus detailed lists of various loading combinations. (Ginna FIP Section 3.3, Millstone, Unit 2 FIP Section 2.5.3)

d. Reference sizing calculation {place calculation on e-portal discussing loads needed to support additional functions}

Spent Fuel Pool Cooling Strategies – SE Section 3.3.4.4 (Electrical Analysis)

Staff Conclusion: The staff reviewed the licensee's FLEX DG sizing calculation ABC, and determined that the FLEX DGs have sufficient capacity and capability to supply these loads, if necessary.

Information needed to support conclusion:

1. SFP Cooling – State whether plan relies on Phase 2 FLEX DGs or Phase 3 NSRC FLEX CTGs. (Millstone Unit 2 FIP Section 2.4.3)

Containment Function Strategies – SE Section 3.4.4.4 (Electrical Analysis)

Staff Conclusion: The staff reviewed a summary of calculation ABC, and determined that the electrical equipment available onsite and the supplemental equipment that will be supplied from the NSRC have sufficient capacity and capability to supply the required loads to reduce containment temperature and pressure, if necessary, to ensure that containment function is maintained and that key instrumentation remains functional.

Information needed to support conclusion:

1. Phase 1 – discuss strategy to maintain containment function and identify any time constraints (e.g., is containment cooling or ventilation needed? If so, when?) Discuss instruments used for monitoring containment pressure, temperature, level, etc., and equipment used for containment function. State that they are expected to function given the environmental conditions. (North Anna FIP Sections 2.5, 2.5.1, 2.5.5, Millstone, Unit 2 FIP Sections 2.5, 2.5.1, 2.5.5)

2. Phase 2 – discuss strategy to maintain containment function and identify any time constraints (North Anna FIP Sections 2.5.2, 2.5.5, Millstone, Unit 2 FIP Sections 2.5.2, 2.5.5)

3. Phase 3 - discuss strategy to maintain containment function and identify any time constraints (North Anna FIP Sections 2.5.3, 2.5.5, 2.5.8, Millstone, Unit 2 FIP Sections 2.5.3, 2.5.5, 2.5.8)

Planned Deployment of FLEX and Equipment Electrical Connections – SE Section 3.7.3.2 (Electrical Connection Points)

Staff Conclusion: Based on its review of conceptual single line electrical diagrams and station procedures, the NRC staff finds that the licensee's approach is acceptable given the protection and diversity of the power supply pathways, the separation and isolation of the FLEX DGs from the Class 1E Emergency Diesel Generators, and availability of procedures to direct operators how to align, connect, and protect associated systems and components.

Information needed to support conclusion:

1. Phase 2 - Portable/pre-staged FLEX DGs

    a. Primary and alternate staging location (North Anna FIP Sections 2.3.2, 2.3.5.7, 2.3.5.8, Millstone, Unit 2 FIP Sections 2.3.2, 2.3.5.7, 2.3.5.8)
        i. If pre-staged DGs are co-located, discuss physical protection {e-portal white paper on protection – see Brunswick, Robinson, and Harris examples}
    b. Primary and alternate connection points (e.g. breaker location, electrical bus, connecting to battery charger, etc.) (North Anna FIP Sections 2.3.2, 2.3.5.7, 2.3.5.8 Millstone, Unit 2 FIP Sections 2.3.2, 2.3.5.7, 2.3.5.8) {single line diagrams, protection scheme}
    c. Description of pathway / cable route for running cables (North Anna FIP Sections 2.3.2, 2.3.5.7, 2.3.5.8, Millstone Unit 2 FIP Sections 2.3.2, 2.3.5.7)
    d. Discuss how electrical isolation is maintained when connecting FLEX DGs (e.g., isolate sources, strip unnecessary loads, and isolate non-robust portions before aligning). (Ginna FIP Sections 2.3, 3.3, Calvert Cliffs FIP Section 3.5.1) {place procedures on e-portal}
    e. Phase rotation checks – statement that they were performed and/or state that operators will verify proper phase rotation when connecting FLEX portable DGs. Also reference use of color-coded cables if applicable. {place procedure on e-portal}

2. Phase 3 – Portable FLEX CTGs from NSRC **(discuss 4160Vac and 480Vac)**

    a. Primary and alternate staging location (North Anna FIP Section 2.3.5.9, Millstone, Unit 2 FIP Section 2.3.5.9)
    b. Primary and alternate connection points
        i. 4160 Vac – discuss power distribution panel, breaker location, electrical bus, etc. Clarify if the connection points and connection type/cables are the same as used for Phase 2. (North Anna FIP Section 2.3.5.9, Millstone, 2 FIP Section 2.3.5.9)
        ii. 480 Vac – discuss coping with only Phase 2 FLEX DG or replacing Phase 2 FLEX DG with 480Vac NSRC CTG. Clarify if the connection points and connection type/cables are the same as used for Phase 2. (Calvert Cliffs FIP Section 3.7.3)

Note: Must have generic, high level instructions/guidance to connect Phase 3 NSRC FLEX CTGs even if you are planning to continue coping using Phase 2 equipment.

c. Description of pathway / cable route for running cables (North Anna FIP Section 2.3.5.9, Millstone, Unit 2 FIP Section 2.3.5.9)
d. Discuss how electrical isolation is maintained when connecting FLEX DGs. {Place on e-portal procedures used in connecting and providing electrical isolation between the portable FLEX NSRC CTGs and Class 1E equipment. (Calvert Cliffs FIP Section 3.7.3) {procedures}
e. Phase rotation checks – state that operators will verify proper phase rotation of NSRC CTGs. Also reference use of color-coded cables if applicable. {place procedure on e-portal}

<u>Habitability and Equipment Functionality - Section 3.9.1.1 (Loss of Ventilation and Cooling)</u> (Note North Anna is light on detail here. Calvert is an outstanding example.)

Staff Conclusion: According to the licensee's calculation (ABC), the ABC Room is expected to remain below 120 °F. Based on temperatures remaining below design limits and/or 120 °F (the temperature limit, as identified in NUMARC-87-00 for electronic equipment to be able to survive indefinitely), the NRC staff finds that the equipment in the ABC Room will not be adversely impacted by the loss of ventilation as a result of an ELAP event. Note: This is standard language for equipment in most rooms, but not the battery room. See Battery Room section above for SE language.

Information needed to support conclusion:

Note: Previous analyses for SBO may only extend to the plant's coping time (e.g., 4 hours) which would not be appropriate for ELAP unless peak temperature is reached.

1. <u>Containment</u> (North Anna FIP Section 2.5, Calvert Cliffs FIP Section 6.2, 6.5, 6.6, 6.7)

    a. Discuss the temperature and pressure in containment and show that temperature and pressure remain below known limits of equipment (e.g. provide some basis for the capability of equipment (instrumentation, valve controls, etc.) inside containment to continue to function. {place on e-portal analysis of temperature, information on equipment temperature limits (with clarification of long-term or short-term limit)}
    b. Describe compensatory actions that are necessary in the near term (e.g., before Emergency Response Organization can be credited) to maintain acceptable temperatures and pressure. {place procedures on e-portal}

2. <u>Battery Rooms</u> (North Anna FIP Section 2.11, Millstone 2 FIP Section 2.11, Calvert Cliffs FIP Section 8.2.3)
    a. Discuss temperature in the battery room. If room temperature exceeds the design limit of the battery (typically 104 °F), discuss battery functionality at the higher temperatures, preferably supported by data from the battery vendor. {analysis on e-portal}

b. Discuss actions needed to maintain temperature {place procedure on e-portal}

3. Main Control Room (MCR) (North Anna FIP Section 2.11, Millstone, Unit 2 FIP Section 2.11, Calvert Cliffs FIP Section 8.2.3)

   a. Discuss the temperatures in the MCR. {place analysis on e-portal}.
   b. Describe compensatory actions that are necessary to maintain temperatures within limits (e.g., opening doors, removing ceiling panels). {place procedure on e-portal}

4. Battery Charger Room

   a. Discuss temperatures in the room when the battery chargers are reenergized. The analysis should show that the temperature remains below their design or some other justified limit of the battery chargers. {analysis on e-portal}
   b. Describe compensatory actions that are necessary to maintain acceptable temperatures within limits. {place procedures on e-portal}

5. Inverter room

   a. Discuss temperatures in the room when the inverters are energized. The analysis should show that the temperature remains below the design or some other justified limit of the inverters. {analysis}
   b. Describe compensatory actions that are necessary to maintain temperatures within limits. {place procedure on e-portal}

6. Other Rooms with Significant Heat Sources

   a. In some cases, licensees have pre-staged FLEX equipment, such as having diesel generators or electric-driven pumps indoors. Discuss temperatures in these rooms. The analysis should show that the temperature remains below the known limit of this equipment. {place analysis on e-portal}
   b. Describe compensatory actions that are necessary to maintain temperatures within limits. {place procedures on e-portal}

Habitability and Operations – SE Section 3.9.1.2 (Loss of Heating)

1. Battery Room

   a. Discuss temperature in the battery room. If room temperatures are expected to reach minimum design limits of the battery (typically 60°F), discuss battery functionality at the lower temperatures.
   b. Describe compensatory actions needed to maintain temperature. {procedure on e-portal}

<u>Habitability and Operations – SE Section 3.9.1.3 (Hydrogen Gas Accumulation in Vital Battery Rooms)</u> (North Anna FIP Section 2.11, Millstone 2 FIP Section 2.11)

Staff Conclusion: Based on its review, the NRC staff finds that the licensee's evaluation demonstrated that hydrogen accumulation in the Class 1E station battery rooms should not reach the combustibility limit for hydrogen (4 percent) during an ELAP as a result of a BDBEE since the licensee plans to open the battery room doors and place portable fans in service when the battery chargers are repowered during Phases 2 and 3.

Information needed to support conclusion:

1. <u>Battery Room</u>

    a. Discuss strategy for maintaining hydrogen below the explosive limits (i.e. less than 4 percent hydrogen concentration). E.g., identify whether normal ventilation will be repowered prior to charging batteries (hydrogen is only a concern during battery charging). If not using ventilation, state the expected hydrogen concentration during an ELAP. {place on e-portal analysis if not using ventilation fans and procedures if using ventilation or other actions}