PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 2

RESPONSES TO OPEN AND PENDING ITEMS FROM THE NRC AUDIT REPORT

On March 12, 2012, the NRC staff issued Order EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," (Reference 1) to all NRC power reactor licensees and holders of construction permits in active or deferred status. In response to the Reference 1 NRC Order, Northern States Power Minnesota, a Minnesota corporation (NSPM), doing business as Xcel Energy, developed and submitted an Overall Integrated Plan (OIP) (Reference 2) describing the diverse and flexible mitigation strategies (FLEX) for responding to beyond-design-basis external events at the Prairie Island Nuclear Generating Plant (PINGP). In Reference 8, the NRC documented their review of the PINGP OIP and provided Confirmatory Items (CIs) for NSPM to address. The NRC performed an onsite audit in May 2015. The results of that audit, including open or pending CIs and Safety Evaluation Items (SEs), are documented in Reference 9.

Initial responses to the open and pending CIs and SEs below have been provided to the NRC in the NSPM Fukushima Response online reference portal with the exception of SE.20. The information in response to SE.20 was formally submitted in the fifth six-month status report (Reference 7). NSPM provides the following formal responses to the open and pending items from the NRC Audit Report. Additionally, one closed CI is updated below based on the strategy change discussed in open item SE.16.

<u>NRC Audit Item Reference: CI 3.1.1.2.A (Open)</u>

NRC Audit Item in Reference 8: *Confirm the final storage locations for FLEX equipment and the deployment routes during extreme external events are acceptable to include further detail regarding seismic protection of connection points and the access to those points through seismically robust structures.*

Item Description as stated in Reference 9: *FLEX Equipment Deployment - access to connection points through seismically robust structures.*

Licensee Input Needed as stated in Reference 9: *Evaluate the Turbine Building pathway for seismic robustness and make the evaluation available for NRC review when completed.*

NSPM Response to NRC Audit Item:

1. Final FLEX Equipment Storage Location:

The final storage location for the portable FLEX equipment is the FLEX Storage Building. The FLEX Storage Building provides storage and protection for the portable FLEX equipment such that the equipment can be deployed following external events. The FLEX Storage Building is located within the PINGP Owner Controlled Area (OCA) and outside the Protected Area (PA). It is southwest of the power block.

The FLEX Storage Building is designed to withstand the site-specific design basis loads for high wind hazards (including tornado and tornado missile loads), environmental conditions and Safe Shutdown Earthquake (SSE) in accordance with the requirements of NEI 12-06 (Reference 10). The FLEX Storage Building is not designed to protect from the site design basis flood. Therefore, the PINGP FLEX strategy during a design basis flood, discussed in the SE.18 response, relies on the expected warning time and pre-deployment of SAFER equipment to the site prior to the site grade flooding. The building is designed to withstand ambient temperatures from -34°F to 108°F. During extreme cold, the building will maintain a minimum temperature of 40°F using thermostatically controlled unit heaters. No mechanical cooling is provided since the building is designed to only store equipment and the equipment stored in the building was specified to operate between -40°F and 120°F.

The results of five sets of CPTs (Cone Penetration Test) performed for the FLEX building site were evaluated for liquefaction of the soil in accordance with the requirements of NRC Regulatory Guide (RG) 1.198 for the station's SSE. Based on the results of the calculation it is concluded that the storage building site is not susceptible to liquefaction.

2. Debris Sources

Possible external debris sources due to an extreme external event include the following:

- Non-seismic structures, such as the elevated walkway in PA
- Transmission towers and power lines
- Light towers and portable lighting
- Fencing and razor wire
- Building material debris, such as siding, roofing, and lumber
- Temporary structures, such as trailers
- Downed trees
- Vehicles

Potential debris sources internal to structures include:

- lighting, non-seismically anchored cabinets and equipment, etc.

External deployment path debris removal will be performed using the equipment that is stored in the FLEX Storage Building. Other miscellaneous debris removal equipment such as cutters, chain saws, pry bars, shovels, and tow straps are also stored in the FLEX building for external and internal debris removal.

3. External Deployment Paths:

There are several external deployment routes from the equipment storage building to the equipment staging areas inside the PA. One of the paths is through the Southwest Security Gate, which is used for transport of Dry Casks from PA to the Dry Cask storage pad. Other deployment paths into the PA are available in addition to this path. Several of these paths into the PA were previously evaluated as heavy equipment haul paths.

Seismological investigations provide high confidence that the deployment paths are not subject to liquefaction. Therefore, deployment route damage as a result of potential soil liquefaction is expected to be minimal. Repairs to deployment paths can be made by the equipment that is stored in the FLEX Storage Building.

Based on the above, the deployment paths for equipment external to the buildings are acceptable and the necessary debris removal equipment is available to cope with extreme external events.

4. Connection Points:

All FLEX connection points are located in Class I, seismically robust structures. These locations are:

- Safeguards Cooling Water Pump Room Motor Control Center (MCC) (Screenhouse - Design Class I Area)
- Battery Rooms MCC (Turbine Building - Class I Aisle)
- Charging Pump MCC (Auxiliary Building – Class I Structure)
- Spent Fuel Pool (SFP) hose discharge or spray (Auxiliary Building – Class I Structure)
- Auxiliary Feedwater (AFW) Pump Room Piping (Turbine Building - Class I Aisle)

5. Internal Deployment Paths (Seismically Robust Paths) to Connection Points:

NEI 12-06, Section 5.3.2, identifies the considerations for the deployment of FLEX equipment following a seismic event. Consideration 2 states that at least one connection point of FLEX equipment will require access through seismically robust structures. This includes both the connection point and any areas that plant operators will have to access to deploy or control the capability. NEI 12-06 defines "robust" as the design of a System, Structure, or Component (SSC) that either meets the current design basis for the applicable external hazard or has been shown by analysis or test to meet or exceed the current design basis.

The PINGP Auxiliary Building, Unit 2 Safeguards Diesel Room (D5/D6 Building), Battery Rooms, and Auxiliary Feedwater Pump rooms are all Class I seismic structures (Class I defined in USAR Section 12.2.1.4). Therefore, deployment paths within these buildings or rooms in these buildings are seismically robust. However, the Screenhouse and Turbine Building are mixed classification structures, which are defined in the PINGP USAR, Section 12.2.1.4.3.6, "Mixed Classification Structures." Based on the mixed classification, NSPM evaluated the internal deployment paths in the Screenhouse and Turbine Building based on the NEI 12-06, Section 5.3.2 considerations. The evaluation was provided to the NRC in the NSPM Fukushima Response online reference portal. A summary of the evaluation is provided in Sections A and B below.

The Ground Motion Response Spectrum (GMRS) developed under NTTF Recommendation 2.1 for the Prairie Island site is bounded by the existing design basis SSE. This result provides additional confidence in the accessibility of the described pathways following a seismic event.

A. Screenhouse Deployment Paths:

The Screenhouse concrete structure is Design Class I and is analyzed for the Design Basis Earthquake Condition (USAR Section 12, Table 12.2-1). The Screenhouse structural steel framing main load carrying members are Design Class I* and are analyzed for the Design Basis Earthquake (DBE) Condition (USAR Section 12.2.1.4.1.b and Table 12.2-1). The steel framing is supported on the Design Class I concrete structure. This provides protection against failure of the steel structure during a DBE event.

Required screenhouse deployment paths for cable and hose for the Phase 2 portable equipment include:

1) Deployment of submersible pump and hose to a Screenhouse manway
2) Deployment of 480 VAC cables to the Safeguards Cooling Water Pump Rooms to repower 480 VAC MCCs

There are two possible pathways to access the Design Class I area from the outside of the screenhouse. Both paths traverse a portion of the Design Class I* areas of the building. Any debris generated within the structure during the seismic event is considered minor and is not expected to impede the equipment deployment. During deployment, the most accessible path would be identified and used. Based on the above, the deployment paths in the Screenhouse are considered accessible following a seismic event.

B. Turbine Building and Auxiliary Building Deployment Paths:

Deployment of FLEX equipment requires access in areas of the Turbine Building and Auxiliary Building. Due to the mixed classification of the Turbine Building, none of the multiple deployment paths through the Turbine Building are fully compliant with the NEI 12-06 definition of a "robust" structure, and therefore, are also not fully compliant with NEI 12-06, Section 5.3.2, Consideration 2. As noted, there are multiple deployment paths in the Turbine Building to each connection point. In areas where a seismically robust path does not exist, NSPM plans to use a path that is adjacent to the exterior wall of the Class I structure. Based on not being fully compliant with the endorsed NEI 12-06 guidance, NSPM is treating the PINGP strategies for deploying cables and hoses through the Turbine Building as an alternative method of compliance with Order EA-12-049. Additional discussion regarding the alternative is provided after the discussion of the deployment paths.

The Class I aisle in the Turbine Building, which contains the Battery Rooms, 480V Switchgear Rooms, AFW Pump Room, and Unit 1 4 kV Switchgear Rooms, is a Design Class I concrete structure that is located within the steel frame of the Turbine Building. The Turbine Building main frame is designed as a Class I* steel structure (described in USAR Section 12.2.1.4.3.6) that is designed for DBE loads. Therefore, the building itself will not collapse in a seismic event. Other portions of the Turbine Building have also been analyzed for DBE loads (the 735 foot elevation concrete floors and a portion of the 715 foot elevation concrete floors). The remaining internal areas of the Turbine Building structure are classified as Design Class III* (described in USAR Table 12.2-1), which meets Uniform Building Code (UBC) Zone 1 seismic requirements of 0.05g (USAR Section 12.2.1.4.1). Thus, the design includes some level of seismic capability, but less than the DBE, and therefore does not meet the definition of a "robust structure".

As stated above, Class I structures are seismically robust and capable of withstanding the DBE condition. The Class I design provides protection against failure of the wall, which in turn lessens the potential debris in the areas that are adjacent to the exterior of the Class I walls. It is judged there is also a likelihood that equipment attached to or running through the Class I wall will remain intact during and after a seismic event, further lessening the potential debris in the areas adjacent to the exterior of the wall. Therefore, use of a path that is adjacent to the exterior wall of a Class I structure provides reasonable assurance that the cables and hoses can be deployed.

Potential debris sources near the Class I walls still include any equipment located in the immediate area, such as overhead mounted equipment, duct work, cable trays, and piping that is not attached to or does not run through the Class I wall. However, the potential debris can be assessed and then moved or climbed over to deploy cables and hoses. Additionally, multiple spatially diverse paths exist to each connection point.

Deployment paths through the Turbine Building and Auxiliary Building for cable and hose deployment for the Phase 2 include:

1) Deployment of 480 VAC cables to the Battery Rooms in the Turbine Building
2) Deployment of 480 VAC cables to the Auxiliary Building to repower Charging Pumps
3) Deployment of Hoses to the SFP
4) Deployment of Hoses to the AFW Pump Rooms to Provide Alternative Feedwater Flow

Deployment path summaries:

1) <u>Deployment path to the Battery Rooms in the Turbine Building</u>:

There are three paths evaluated through the Turbine Building to the Battery Rooms. Each route traverses an area that has been analyzed for DBE loads with the exception of a small area near the Battery Room doors. This area of the deployment route is adjacent to the exterior wall of the Class I structure, (i.e., the Class I aisle in the Turbine Building), which lessens the potential debris sources for the pathway. Debris could be assessed and moved or an alternate path could be used. Therefore, based on building design and multiple optional pathways that are spatially diverse, it is expected that there is at least one deployment pathway to the Battery Rooms in the Turbine Building that is accessible following a seismic event.

NRC auditors requested walkdown information of the Turbine Building pathways. Therefore, NSPM provided a virtual walkdown of one of the more robust pathways. The information was provided in the NSPM Fukushima Response online reference portal.

2) <u>Deployment path to the Auxiliary Building for repowering Charging Pumps:</u>

The preferred and shortest deployment route to the Auxiliary Building is through the Turbine Building. This route is along the exterior of a Class I structure (i.e., the Auxiliary Building). Alternate paths exist to route the cables through either of the two Auxiliary Building Roll-Up Doors in the Fuel Receipt area of the Auxiliary Building. The alternate paths are entirely through Class I* and Class I structures. The route through the Class I* area is relatively open and includes a small amount of potential debris sources. If necessary, any debris generated from the event can be moved or the cables deployed around the debris. Therefore, there is at least one deployment pathway to the Auxiliary Building that is accessible following a seismic event.

3) Deployment path to the SFP Area:

Deployment paths for hoses exist through the Auxiliary Building Roll-Up Doors in the Fuel Receipt area of the Auxiliary Building. This area is a Class I* structure. From the Class I* structure, the hoses could be routed up the stairs to the pools. If for some reason these stairwells were not passable, another option would be to access the SFP area through the Class I and Class I* areas of the Auxiliary Building and route the hoses down through the drop area opening. The route through the Class I* area is relatively open and includes a small amount of potential debris sources. Therefore, there is at least one deployment pathway to the SFP that is accessible following a seismic event.

4) Deployment path to the AFW Pump Rooms

There is no time constraint for the deployment of hoses to the AFW pump rooms. Therefore, there is time available to assess options and select preferable paths. The deployment of the AFW hoses could be performed later in the event when additional personnel are on site to assist with debris removal and hose deployment.

The evaluation reviewed five different deployment paths to the AFW Pump room through the Turbine Building on the 695 foot elevation. The evaluation also reviewed a sixth deployment path to the AFW pump room through the Unit 2 Emergency Diesel Generator (D5/D6) Building. All paths have portions that traverse through areas that are not analyzed to the DBE loading. However, the paths are spatially diverse and follow the exterior wall of a Class I Structure. The deployment team would evaluate and select the most desirable path. These paths are described below:

- Two potential deployment paths are through the west and east Turbine Building roll-up doors and are along the exterior wall of the Class I Auxiliary Building. To reach the east Turbine Building roll-up door, the path goes through the Service Building, which is not seismically robust. There could be some debris generated due to failure of equipment internal to the Turbine Building structure; however, this debris could be assessed and moved if one of these routes were desired.
- Two potential deployment paths are from the personnel access doors on the west and east side of the Turbine Building to the AFW pump Rooms (these are extensions of the two paths also used for battery room cable deployment). A significant portion of these paths is in areas that have been analyzed for DBE loads. Once leaving the DBE analyzed area, the deployment path is through the area of the Turbine Pedestal. The Turbine Pedestal is a robust concrete structure that has been analyzed to UBC Zone 1 earthquake loads. Although the UBC Zone 1 loads are less than the DBE loads, there is reasonable assurance that the pedestal would not

collapse. It is a relatively short distance from the pedestal to the AFW pump room door in either Unit. Some debris due to failure of equipment internal to the structure may occur in some of these paths. This debris could be evaluated and moved if one of these paths were to be used.

- The fifth evaluated route would enter the Unit 1 Turbine Building above the north flood wall. This pathway is through an area that has been analyzed for DBE loads, but then enters an area that is not considered robust. In this area, the deployment route would be along the exterior wall of the Class I structure, i.e., the Turbine Building Class I aisle.
- The evaluation also reviewed a deployment path to the AFW pump room through the Unit 2 Emergency Diesel Generator (D5/D6) Building. The D5/D6 Building is a Class I Structure. This path would enter the D5/D6 building and use the internal stairwell to the 735 foot elevation to access the Turbine Building. The 735 foot elevation of the Turbine Building is analyzed for DBE loads. Above the 735 foot elevation is the Turbine Building frame and the cranes, which have also been analyzed for DBE loads. The hose deployment would drop to the 695 foot elevation through either the Unit 1 or Unit 2 side of the Turbine Building. This drop is adjacent to the Class I Structure (the Auxiliary Building wall). After the drop, there is an approximate 32 foot traverse following the exterior of the Class I Auxiliary Building wall to the AFW pump room door.

NRC auditors requested walkdown information of the Turbine Building pathways. Therefore, NSPM provided a virtual walkdown of one of the more robust pathways to the AFW pump room. The information was provided in the NSPM Fukushima Response online reference portal.

Based on the robust design of the main structures, the multiple and spatially diverse deployment paths, the use of paths that are adjacent to the exterior wall of the Class I structure, and debris removal equipment that can be used in clearing the path in these internal structures, sufficient access and timely deployment are ensured for the hoses and cables for Phase 2 portable equipment following a seismic event.

C. <u>Compliance with NEI 12-06 and Order EA-12-049</u>:

NEI 12-06, Section 5.3.2, identifies the considerations for the deployment of FLEX equipment following a seismic event. Consideration 2 states:

"At least one connection point of FLEX equipment will only require access through seismically robust structures. This includes both the connection point and any areas that plant operators will have to access to deploy or control the capability."

NEI 12-06 further defines "robust" as:

"the design of an SSC either meets the current design basis for the applicable external hazard or has been shown by analysis or test to meet or exceed the current design basis."

Based on the mixed classification of the Turbine Building described above, PINGP's mitigating strategies (deployment paths for FLEX equipment, cables and hoses) require access to areas of the Turbine Building that do not meet the above definition of robust and are not in full compliance with NEI 12-06, Section 5.3.2, Consideration 2. Therefore, the PINGP deployment paths internal to the Turbine Building are being treated as an alternative method of compliance to NEI 12-06, Section 5.3.2, Consideration 2. Based on the robust design of the main structures, the multiple and spatially diverse deployment paths, the use of paths that are adjacent to the exterior wall of the Class I structure, and the debris removal equipment available for clearing the path in these internal structures, sufficient access and timely deployment are ensured for the hoses and cables for Phase 2 portable equipment following a seismic event.

NRC Audit Item Reference: CI 3.2.4.9.A (Open)

NRC Audit Item in Reference 8: *Portable Equipment Fuel - Confirm the total fuel consumption need calculations when FLEX equipment designs are finalized and the methods for onsite fuel transport are acceptable.*

Item Description as stated in Reference 9: *Portable Equipment Fueling Strategy.*

Licensee Input Needed as stated in Reference 9: *Evaluate seismic robustness of preferred onsite fuel oil source or provide a refueling strategy that includes use of a seismically robust source.*

NSPM Response to NRC Audit Item:

This response provides information regarding the non-flood condition plan for refueling FLEX equipment during an extended loss of alternating current (ac) power (ELAP). The plan for refueling the FLEX equipment during an ELAP that occurs during a design basis flood is discussed in the response to SE.18.

All FLEX equipment and support equipment with onboard fuel tanks are filled with fuel while in standby so that it is available without any required fueling at the initiation of the event. The fuel tanks on the major pieces of equipment have been specified to provide enough fuel to run for approximately 12 hours without refueling. These tanks contain #1 diesel fuel to support startup operations during cold weather conditions. A Preventive Maintenance task has been initiated to perform periodic sampling/testing of the fuel stored in the FLEX equipment to confirm the fuel is of good quality.

The calculations of the fuel consumption rates for the Phase 2 FLEX equipment identified that a refueling supply of approximately 4,450 gallons would provide sufficient fuel to support operations for the first 72 hours of an ELAP event. Seventy-two hours was selected as a reasonable time for obtaining offsite support, which includes fuel deliveries.

The primary source for refueling the FLEX equipment during non-flood conditions is the 121 or 122 Heating Boiler Fuel Oil Storage Tanks, if available. These tanks are below grade and have a nominal capacity of 35,000 gallons each. Access to the tanks is through the manhole covers to the pits and then through the manhole covers on the tanks. These tanks are non-safety related and thus are not documented as seismically robust. In the event that these tanks are not available, fuel will be extracted from the safety-related (i.e., seismically robust, protected from high winds and associated missiles) 121, 122, 123, or 124 Diesel Generator Oil Storage Tanks, for Emergency Diesel Generators D1 and D2. These fuel oil storage tanks (FOSTs) are below grade and have a nominal capacity of 19,000 gallons each. The access to the manholes for these tanks is normally covered with large steel plates. Therefore, equipment is available to remove these plates, remove the manhole covers to the pits, and remove the manhole covers on the tanks. The fuel in these tanks is #2 diesel and provisions exist to add cold weather additives to the fuel that is extracted for refueling of FLEX equipment during cold weather.

The strategies for delivery of the fuel to the FLEX equipment involves extracting the fuel from one of the tanks through a diesel driven pump and transferring it to a 264 gallon transportable container on the bed of a truck. The truck is then moved near the FLEX equipment and the fuel transferred to the fuel tank of the equipment through a separate transfer pump. Based on the maximum fuel consumption rate (i.e., 22.7 gal/hr for the 480 VAC portable generators) and refueling a minimum of 200 gallons, the frequency of refueling the equipment is greater than eight (8) hours.

The FLEX equipment, transfer pumps, hoses, and equipment needed to extract the fuel from the storage tanks and transfer it to the FLEX equipment is stored in the robust FLEX building. Thus, this equipment is protected from seismic events and high winds and associated missiles.

NRC Audit Item Reference: CI 3.2.1.2.A (Pending)

NRC Audit Item in Reference 8: *RCP* [reactor coolant pump] *Seal Leakage. Confirm that since PINGP will install Flowserve N-9000 seals with Abeyance seal option, the licensee addresses the acceptability of the use of non-Westinghouse seals, and provides the acceptable justification for the RCP seal leakage rates for use in the ELAP analysis, to include whether the Flowserve white paper justifies the use of the Flowserve N-9000 seals and bounds the 21 gpm/seal leakage rate assumed in the analysis.*

Item Description as stated in Reference 9: *RCP Seal Leakage – Flowserve N-9000 seals with abeyance seal option.*

Licensee Input Needed as stated in Reference 9: *None. This is a pending item with the required action for NRC review and acceptance of the Flowserve white paper.*

NSPM Response to NRC Audit Item:

The Pressurized Water Reactor Owners Group (PWROG) submitted a Flowserve white paper regarding an assessment of the performance of the N-seals during an ELAP on August 5, 2015 (Reference 11). The NRC staff concluded in a November 12, 2015 letter (Reference 12) that the Flowserve proposed leakage rates are acceptable for use in demonstrating compliance with Order EA-12-049 with five limitations and conditions (L&C) that NSPM has addressed below.

L&C #1: *"Each licensee should confirm that its plant design and planned mitigation strategy are consistent with the information assumed in the calculation performed by Flowserve which is summarized in Table 1 of the white paper."*

NSPM has completed the installation of the Flowserve N-9000 seal package in both Unit 1 and Unit 2. NSPM's mitigation strategy is consistent with the information contained in Table 1 of the Flowserve white paper. Specifically:

- nominal full power RCS operating pressure is 2235 psig and cold leg temperature is 530°F,
- following an ELAP the reactor coolant system (RCS) cooldown and depressurization is expected to be initiated within the first two (2) hours of the event,
- the procedure directs a cooldown rate in the RCS cold legs of "less than 100°F/hr", thus it is expected that the cooldown rate will be between 70°F/hr and 100°F/hr,
- the initial RCS cooldown is to a steam generator (SG) pressure of 350 psig, which has a corresponding saturation temperature of 435°F.

L&C #2: *"Each licensee should confirm that the peak cold-leg temperature prior to the cooldown of the reactor coolant system assumed in Flowserve's analysis is equivalent to the saturation temperature corresponding to the lowest setpoint for main steam line safety valve lift pressure."*

The lowest nominal setpoint for the steam line safety valve lift pressure specified in the PINGP Technical Specification is 1077 psig. The corresponding saturation temperature for 1077 psig is 555°F. This value is bounded by the value used in the Flowserve analysis.

L&C #3: *"The NRC staff did not specifically review and is not endorsing the final column in Table 3, which estimates the maximum leakage rate in the case of seal failure modes more severe than expected during an ELAP event. This information is considered beyond the scope of determining licensees' compliance with Order EA-12-049. In particular, because actuation of the Abeyance seal is not expected during the ELAP event for any plant considered in the white paper, the NRC staff did not specifically review and is not endorsing the functionality of this component."*

Although NSPM's calculation that determined the minimum RCS makeup flow rate requirements during an ELAP conservatively included the maximum leakage rate in case of seal failure (limited by actuation of the Abeyance seal), NSPM's mitigation strategies assume the RCP seals function as designed, i.e., they do not fail requiring actuation of the Abeyance seal. Hence, calculations dependent upon RCS inventory loss (e.g., those that determine the RCS makeup time constraint and containment response) are based on the N-9000 seal package Controlled-Bleed-Off flow rates. Copies of the NSPM calculations have been provided to the NRC in the NSPM Fukushima Response online reference portal.

In summary, NSPM's mitigation strategies do not credit the functionality of the Abeyance seal.

L&C #4: *"In its white paper, Flowserve has generally specified leakage rates in volumetric terms. For converting the specified volumetric flow rates to mass flow rates, licensees should use a density of 62 lbm/ft^3 (approximately 993 kg/m3) throughout the ELAP event. This condition reflects observations made during testing conducted by Flowserve that simulated a loss of seal cooling, wherein the seal leakage mass flow rate remained roughly constant as the test apparatus underwent a significant cooldown and depressurization."*

NSPM's calculations that were dependent upon the mass flow rate through the RCP seal package (i.e., the determination of when RCS makeup must be re-established and the containment response) used a density of 61.27 lbm/ft^3. While this value is less than that listed in the L&C, the NSPM calculations used a volumetric flow rate that was slightly higher than that specified in the Flowserve white paper. The net result is that the mass flow rate used in the NSPM calculations is greater than that determined by using the volumetric flow rate listed in the Flowserve white paper and the density listed in the L&C. Copies of the NSPM calculations have been provided to the NRC in the NSPM Fukushima Response online reference portal.

L&C #5: *"The NRC staff conducted a sample audit of the plant-specific calculations performed by Flowserve for determining leakage rates as a function of time during an ELAP event. The NRC staff's audit calculations generally showed good agreement with the values calculated by Flowserve. Furthermore, licensees' mitigation strategies generally contain significant margin relative to the* *seal leakage rates calculated in the N-Seal white paper. However, if deemed necessary during plant-specific mitigation strategy audits, the NRC staff may perform additional audit calculations to confirm the appropriateness of the specific leakage rate assumptions and calculations for individual plants."*

NSPM's calculation for determining when RCS makeup must be re-established used a volumetric flow rate slightly higher than the Controlled-Bleed-Off listed in the Flowserve white paper. This calculation determined that RCS makeup must be re-established within 32 hours of the event. This time constraint provides significant margin to the time to exceed the thermal margin determined in the white paper. A copy of the calculation for determining when RCS makeup must be re-established to avoid the onset of re-flux cooling has been provided to the NRC in the NSPM Fukushima Response online reference portal.

NRC Audit Item Reference: CI 3.2.2.A (Closed)

NRC Audit Item in Reference 8: *Confirm the licensee's SFP spray capability from its existing B.5.b strategy is reasonably protected.*

Item Description as stated in Reference 9: *N/A – CI 3.2.2.A was closed and not listed in the audit report. However, with the change in strategy described in SE.16, a supplement to CI 3.2.2.A was necessary. This response replaces both the initial response and its supplement 1 that were provided in the NSPM Fukushima Response online reference portal.*

Licensee Input Needed as stated in Reference 9: *N/A - as noted above.*

NSPM Response to NRC Audit Item:

As part of the response to SE.16 provided below, NSPM re-evaluated the capabilities of the SG/SFP makeup pump in combination with the submersible booster pump. The re-evaluation determined that the pumps were capable of supporting simultaneous operation of SG make-up and SFP spray. Based on this, the SFP spray capability from the existing B.5.b strategy (and associated B.5.b equipment) is no longer the credited strategy to meet the Order requirements. Therefore, reasonable protection per NEI 12-06 is not required for the B.5.b equipment.

The FLEX submersible booster pump, SG/SFP makeup pump, hoses, and spray nozzles are stored in the robust FLEX storage building.

NRC Audit Item Reference: SE.16 (Open)

NRC Audit Item in Reference 8: *N/A – SE.16 in Audit Report only.*

Item Description as stated in Reference 9: *SFP Spray Flow – the number of protected B.5.b pumps and inability to deliver 500 gallons per minute under low river level conditions (downstream seismic dam failure) appears to be an alternative to NEI 12-06.*

Licensee Input Needed as stated in Reference 9: *Provide an updated strategy or basis for an alternative to the SFP spray provisions of NEI 12-06.*

NSPM Response to NRC Audit Item:

Table D-3 of NEI 12-06 provides a summary of performance attributes for pressurized water reactor (PWR) SFP Cooling Functions and includes a requirement of "Spray Capability via portable monitor nozzles from the refueling floor using a portable pump". The purpose of this requirement is to provide spent fuel cooling when SFP make-up rate is not sufficient. The listed performance attribute for this requirement is a minimum of 200 gpm per unit to the pool or 250 gpm if overspray occurs consistent with 50.54(hh)(2).

To satisfy the requirement of NEI 12-06, a SFP spray flow rate of 500 gpm is established for PINGP. In addition, the SFP spray would be in service simultaneously with SG make-up that requires a flow of 200 gpm (SFP make-up does not occur when the SFP spray is in service).

PINGP design basis seismic event assumes that Lock and Dam No. 3 is destroyed, which causes the water level in the intake bay to decrease to a point where the level is maintained at 666.5 feet through the 36-inch Emergency Intake Line (EIL). This water level is below the allowable suction lift capabilities of the SG/SFP make-up pump when staged on site grade elevation (695 feet). To overcome this limitation of the SG/SFP make-up pump, a booster (submersible) pump located at the bottom of the intake bay within the Screenhouse, is planned to be used.

NSPM has determined that the submersible booster pump supplying the SG/SFP make-up pump can support simultaneous operation of the SG make-up and SFP spray using the intake bay as the water source during a seismic event that results in a failure of Lock and Dam No. 3.

NRC Audit Item Reference: SE.18 (Open)

NRC Audit Item in Reference 8: *N/A – SE.18 in Audit Report only.*

Item Description as stated in Reference 9: *Develop integrated flood strategy.*

Licensee Input Needed as stated in Reference 9: *Provide integrated strategy for NRC review when developed.*

NSPM Response to NRC Audit Item:

Note: *All water elevations referred to in this response are in feet above 1929 adjusted mean sea level (MSL).*

A. Background

Prairie Island Design Basis Flood and Current Site Response

USAR Section 2.4.3.5, "Floods," discusses the design basis flood for the PINGP site. The design basis flood is a probable maximum flood (PMF) that would result from meteorological conditions that could occur in the spring. The design basis flood could reach maximum river level in approximately 12 days. It is estimated that the flood stage could peak at 703.6 feet and remain above the PINGP site grade level of 695 feet for approximately 13 days. The top of the flood protection walls that are installed as part of flood mitigation at the site are at 705.0 feet. Therefore, the flood protection is designed to resist the design basis flood.

The National Weather Service provides long range advisory projections and short-term forecasts of river stage and crest. These long range advisory projections and the short-term forecasts are used by NSPM for advanced planning and preliminary arrangements for plant operation during a flood.

The implementation of the flood procedure is based on the three-day forecasts of flood stage and actual flood stage at the plant site. The flood procedure is entered whenever the three-day forecast projects a flood level of 678 feet or higher. The procedure outlines actions to be taken in the event that three-day flood forecast exceeds predetermined elevations. Per this procedure, if the three-day flood forecast projects a crest greater than the minimum access road elevation, plant emergency fuel oil storage tanks are maintained on a "keep-full" status until the access road becomes impassable. Backup provisions for transportation of plant personnel and other plant supplies are determined. If the three-day flood forecast projects a crest greater than 692 feet at the plant site, the procedure requires placing both units in Mode 5, Cold Shutdown, and installing the flood bulkheads and sealing of doors.

Prairie Island Overall Integrated Plan (OIP)

The original PINGP OIP (Reference 2), outlined the design basis flood FLEX strategy as follows:

- Deployment of FLEX Equipment for flooding event:

  There will be sufficient time for pre-staging of the Phase 2 FLEX equipment within the flood-protected areas of the building or above the flood level before the design basis flood level is reached. Phase 3 equipment from the Regional Response Center can be requested prior to the flooding of the main access road and set up on site in advance of the probable maximum flood. Plant procedures require shut down in preparation for flooding. Current procedures require the plant to shut down when the river level is projected to exceed elevation 692 feet. Backup power supplies and pumps will be pre-staged as part of the plant procedures for construction of flood protection features. No other beyond design basis event is assumed to occur with the flood; therefore makeup from the Condensate Storage Tanks will be available. Portable pumps will be moved as necessary to ensure that they are protected from the flood but also have access to a water supply.

On-site NRC FLEX Audit

During the May 2015 on-site audit for Prairie Island's mitigating strategies Order response, NSPM discussed ELAP response during a design basis flood with the NRC. The NRC audit report notes that NSPM will use the expected warning time and pre-deploy its FLEX equipment to an area protected from the floodwaters (Turbine Building). NRC opened SE.18 to ensure documentation of the revised flood strategy. Following the audit, NSPM processed a FLEX Strategy Change for mitigating an ELAP during a design basis flood. This FLEX Strategy Change also changed the method of compliance. The revised ELAP mitigating strategy during a design basis flood is described in the following sections.

B. FLEX Strategy Change Overview

The revised strategy will use the Strategic Alliance for FLEX Emergency Response (SAFER) 4 kV turbine generators (TGs) and the equipment associated with operation of the generators to repower installed equipment. The SAFER equipment would be requested from SAFER in time to ensure delivery to the PINGP site staging area prior to the site access road flooding. The SAFER 4 kV TGs and associated equipment would be moved to the Turbine Building deck prior to the site grade flooding. If an ELAP occurs during the design basis flood, the RCS and SGs would heat-up and natural circulation would develop. Decay heat removal would be through the SGs with makeup from the Turbine Driven Auxiliary Feedwater Pump (TDAWFP) supplied from the Condensate Storage Tanks (CSTs). The SAFER 4 kV TGs would be used to repower a safeguards bus on each unit. Once the safeguards bus is repowered, one train of installed plant equipment (e.g., Component Cooling (CC), Residual Heat Removal (RHR), Charging (CVCS), Spent Fuel Pool (SFP) cooling, Containment Fan Coil unit (FCU), fuel oil transfer, etc.) will be available for normal shut down operations. Cooling water (CL) needed to remove heat from the CC and FCU systems would be supplied by the Diesel Driven Cooling Water Pump (DDCLP). The strategy does not require the use of the PINGP FLEX portable pumps or 480 V generators. However, PINGP fuel oil transfer equipment and exhaust ducting stored in the FLEX building would be used.

The sequence of the design basis flood preparation for staging of equipment to meet the FLEX strategy is detailed in the strategy section below.

C. <u>Detailed Discussion of FLEX Strategy during a Design Basis Flood</u>

The revised strategy involves entering the existing flood procedure, activating National SAFER Response Center (SAFER), and staging the SAFER 4 kV TGs and associated equipment on the Turbine Building deck for use if an ELAP occurs.

The existing plant flood procedure would be entered when the three-day forecasts a flood level of 678 feet or higher. In the event that the three-day flood forecasts a crest approaching the minimum access road elevation of 688 feet, the site will request the FLEX Phase 3 equipment from the National SAFER Response Center. At this time, the site will also maintain the plant emergency fuel oil storage tanks at "keep full status" until the access road is impassible and back up transportation provisions are made for plant personnel and other plant supplies. Twenty-four (24) hours after the request to SAFER, the equipment will arrive at the on-site staging area.

If three-day flood forecast projects a crest greater than 692 feet at the plant site, the flood procedure requires placing both units in Mode 5, Cold Shutdown, and installing the flood bulkheads and sealing of doors. Prior to installing the flood bulkhead on the Turbine Building roll-up doors, all four of the SAFER 4 kV TGs and related equipment will be lifted and pre-staged on the Turbine Building deck. The Turbine Building deck is at the 735 foot elevation. Related off-site equipment for the SAFER 4 kV TGs includes fuel cubes, ground resistors, crated cables and cable trailers, and distribution center trailers. The fuel oil transfer equipment will be pre-staged in the flood protected area of the Turbine Building. Additionally, PINGP equipment associated with venting the SAFER 4 kV TG exhaust will also be staged. It is planned to use the west side of the Turbine Building deck for pre-staging of equipment with the exhaust from the SAFER 4 kV TGs vented through the west wall of the Turbine Building. NSPM provided sketches of the planned equipment staging and the exhaust ducting on the NSPM Fukushima Response online reference portal.

Offsite power is expected to be available to the Turbine Building crane for lifting the equipment to the staging area based on:

1) two of the five sources for offsite power (i.e., the Hampton and North Rochester substations) are considered to have low risk of flooding during a regional flooding event and
2) an evaluation of the PINGP offsite source transformers demonstrated that they would be available to supply the non-safeguard loads (e.g., Turbine Building crane) up to a flood elevation of 698 feet.

Additionally, tabletop validation determined the needed equipment would be lifted to the Turbine Building deck prior to the flood reaching the site grade elevation of 695 feet. This is well before the expected loss of offsite power at the 698 foot elevation.

NSPM has controls in place for risk monitoring and risk management that also apply during emergent events. The procedures for responding to a flood event directs the Operations Manager to verify operators are trained and briefed on the applicable procedures for responding to an ELAP. This review, in conjunction with the controls in place for operations to assess risk associated with taking equipment out of service for elective maintenance, provides assurance that equipment needed to mitigate an ELAP will not be made unavailable by plant operations when the plant is in Mode 5 due to a predicted or ongoing flood event.

If the ELAP occurs during the design basis flood, the RCS will heat-up and natural circulation will develop through the SGs. When the SG pressure is sufficient to provide the driving force for the TDAFWP, water from the CSTs will be pumped to the SG for decay heat removal. This provides core cooling while steps are taken to repower one 4 kV safeguards bus on each unit from the SAFER 4 kV TGs. Two of the four staged SAFER 4 kV TGs are used to implement the flood strategy. NSPM provided the generator sizing evaluation for the flood condition on the NSPM Fukushima Response online reference portal. The two remaining TGs are available as spares for redundancy and defense-in-depth. Repowering of either train of safeguards power will allow restoration of equipment needed to maintain the safety functions. With a safeguard bus repowered, each unit will have power to operate a train of equipment needed for normal shut down operations. This effectively returns the operation of systems to within their design basis during a design basis flood.

Once a safeguards train on each unit is repowered, the operation of the CL system returns to within the system's design basis. During a flood, the potential exists for larger sized debris and a larger volume of debris. The size of the screenhouse trash racks and traveling screens provides assurance that the larger debris loading will not starve the DDCLPs. In addition, the EIL may also be used as a source of water to the DDCLPs. If an ELAP occurs during a flood, repowering a safeguards bus restores backwash capability to cooling water strainers on the outlet of the DDCLPs. This ensures that the downstream equipment will receive strained water, enabling the equipment to perform their heat removal function.

As the RCS and SG heat up to the point where SG pressure is sufficient to provide the driving force for the TDAFWP, it is likely that the pressurizer pressure will reach the Low

Temperature Overpressure Protection System (OPPS) or the RHR pump suction relief valve setpoints. However, the OPPS and RHR suction relief valve are designed to prevent the RCS from overpressurizing.

At the declaration of the ELAP, site procedures will direct the stripping of the same non-essential DC electrical loads as for the non-flood condition. This action preserves the safeguards batteries. Battery depletion calculations supporting the non-flood condition show the safeguards batteries will be available for 11.5 hours. Connecting the pre-staged SAFER 4 kV TGs will enable the battery chargers to be repowered thus supplying power to essential instrumentation.

All connection points for the SAFER 4 kV TGs are located within the flood protected area. No connection points require permanent modification to accommodate this FLEX strategy. However, connecting the SAFER 4 kV TGs directly to the safeguards bus does require reconfiguring the bus (e.g., removing current transformers, replacing portions of the bus bars, and attaching mounting blocks). Reconfiguring the bus for this connection is incorporated into the FLEX Support Guidelines (FSG). Additional resources will be on site to perform this work based on the procedural preparations in place for a flood.

Connection points are available to connect the SAFER 4 kV TGs to each of the safeguards buses (total of four – two per Unit), thus providing multiple ways to repower a train of installed equipment. The safeguard buses include unit cross-ties (i.e., Bus 25 to Bus 15 or Bus 26 to 16) further enhancing flexibility and reliability. The diverse ways to repower a safeguard bus on each unit are:

1) Connect two SAFER 4 kV TGs to Bus 25 and use the installed cross tie to repower Bus 15 or,
2) Connect two SAFER 4 kV TGs to Bus 26 and use the installed cross tie to repower Bus 16 or,
3) Connect two SAFER 4 kV TGs to Bus 15 and use the installed cross tie to repower Bus 25 or,
4) Connect two SAFER 4 kV TGs to Bus 16 and use the installed cross tie to repower Bus 26.

Diesel fuel will be supplied from the safety-related Unit 1 Emergency Diesel Generator (EDG) day tanks to the fuel cubes for the SAFER 4 kV TGs located on the Turbine Building deck. The diesel fuel will be transferred from the day tanks by portable fuel oil transfer pumps. The fuel oil transfer pumps will be located within the flood protected area of the Turbine Building. A check valve off the Unit 1 EDG day tanks will be reconfigured during the ELAP to provide connection to the fuel transfer pumps. Once the 4 kV safeguards buses are repowered, the installed fuel transfer pumps will be repowered and fuel will be transferred from the Unit 1, safety-related Fuel Oil Storage Tanks (FOSTs) to the Unit 1 EDG day tanks to provide fuel for continuous operation. NSPM has estimated that the time from when offsite power would be lost, and normal access to the site would be restored is 17 days (i.e., from a flood elevation of 698 feet to 688 feet). NSPM has also estimated the amount of useable fuel in the Unit 1 FOSTs and DDCLPs FOSTs will support operation of a DDCLP and two SAFER 4 kV TGs for 18 days.

Below is a summary of levels associated with a design basis flood and the revised FLEX strategy:

- 678 foot elevation (three day projected) – enter site procedure for flood condition preparations
- 688 foot elevation (three-day flood forecasts projecting a crest approaching the minimum access road elevation of 688 feet) – following actions are taken:
    - Request FLEX Phase 3 Equipment from SAFER
    - Maintain emergency fuel oil storage tanks at "keep full" status
    - Make back up transportation provisions for plant personnel and other plant supplies
- 688 foot elevation – access road begins to flood
- 692 foot elevation (three day projected) – following actions are taken:
    - Initiate shut down of both units to Mode 5, Cold Shutdown
    - Pre-stage SAFER 4 kV TGs and related equipment on the Turbine Building deck prior to installing Turbine Building roll-up doors bulkheads
    - Begin installation of flood protection bulkheads and seal doors
- 695 foot elevation – site grade level
- 703.6 foot elevation – design basis flood level
- 705 foot elevation – top of flood protection walls designed to resist the design basis flood

D. Assessment of Revised Flooding Strategy against the FLEX Order:

The revised strategy meets the requirements of Order EA-12-049 because there is sufficient time prior to the design basis flood to pre-stage the SAFER 4 kV equipment before the site grade floods. Based on the existing flood procedure, both units will be shut down and cooled down to Mode 5 (Cold Shutdown) prior to the flood impacting the site. Therefore, the status of the units prior to the ELAP occurring would be:

- RCS temperature less than 200°F and reduced pressure
- RCS temperatures maintained using the Residual Heat Removal (RHR) system
- RCS system would be intact and capable of being pressurized
- RCS is borated to the Cold Shutdown boron concentrations
- SI accumulators are isolated
- SGs are available as a backup to RHR for heat removal
- TDAFW Pump is available
- Three (3) CSTs are available with greater than 120,000 gallons in each tank

The key Safety Functions listed in Order EA-12-049 of maintaining core cooling, containment integrity and SFP cooling continue to be met as described below:

- Core Cooling
  - Heat removal functions:

    In the initial stage of an ELAP, core cooling and heat removal will be accomplished through RCS heat up and natural circulation using the SGs. As the RCS heat up progresses, the SG pressure will be sufficient to provide the driving force for the TDAFWP when the SG pressure reaches approximately 160 psig. The suction source for the TDAWFP will be the three cross-connected CSTs, which have sufficient volume to support over two days of decay heat removal. As noted in the OIP, the CSTs are expected to be available during a flood event. Thus, during the initial stages of an ELAP the SG will be used to remove decay heat with a supply of water from the CST via a TDAFWP.

    FSG procedures will direct the repowering of a 4 kV safeguard bus on each unit. This will allow restoration of one train of RHR for core cooling per unit.

  - RCS inventory functions:

    During the initial stages of an ELAP in Mode 5 with the RCS intact, the RCS pressure is much lower than an ELAP from Mode 1. The lower RCS pressure will ensure that the RCS inventory loss (via the RCP seal package) from Mode 1 bounds the RCS inventory loss during a flood ELAP. The Mode 1 time constraint for RCS make-up is 32 hours. Thus, the time constraint for reestablishing RCS makeup is much longer than the non-flood RCS makeup time constraint of 32 hours.

    When the 4 kV safeguards bus is restored and RHR has been returned to service, the RCS pressure will be reduced to near atmospheric pressure. Thus, there will be little to no loss of RCS inventory. However, with a 4 kV safeguards bus repowered, a charging pump will be available to provide any RCS makeup needed. Charging pump suction will be aligned to the Refueling Water Storage Tank (RWST).

- Containment Integrity
  - With the units in Mode 5 and the RCS intact, the RCS pressure is much lower than an ELAP from Mode 1. The lower RCS pressure will ensure that the mass and energy release (via the RCP seal package) from Mode 1 bounds the mass and energy release during a flood ELAP. Thus, the mass and energy release to containment is much less than the non-flood

mass and energy release. Since there is no time constraint associated with maintaining the Containment Function for an ELAP from Mode 1, there is no time constraint associated with an ELAP during a flood. When the 4 kV safeguards bus is restored and RHR has been returned to service, the RCS pressure will be reduced to near atmospheric pressure. Thus, there will be little to no mass and energy release to containment. However, with a 4 kV safeguards bus repowered operators may elect to restore active containment cooling using a containment FCU.

- Spent Fuel Pool Cooling
  - The heat load in the SFP during a flood is the same as during a non-flood. Thus, the time constraint associated with the Spent Fuel Cooling Function is the same, i.e., 33 hours. When the 4 kV safeguards bus is restored, normal SFP cooling will be available to provide active spent fuel pool cooling.

Support functions for the above safety functions are met:

- Direct Current (DC) Power: The procedure for addressing an ELAP during a design basis flood will include steps to perform a DC load shed to extend the life of the safeguard batteries. The DC loads to be shed are the same as those shed during a non-flood ELAP. Therefore, the Mode 1 time constraint of 11.5 hours for repowering a battery charger is applicable for mitigating an ELAP during a flood. When the 4 kV safeguards bus is restored, the battery chargers will power essential instrumentation and installed equipment for normal shut down conditions.

- Fuel Oil Transfer: To limit the fire load on the Turbine Building deck prior to the ELAP, the fuel tanks for the SAFER 4 kV TGs will be staged on the Turbine Building deck empty. If an ELAP occurs, fuel oil from the day tanks for the onsite Unit 1 safeguard EDGs will be used to fuel the SAFER 4 kV TGs fuel cubes. Pre-staged fuel oil transfer pumps will be located in the flood protected area of the Turbine Building and will transfer the fuel from the day tanks to the SAFER 4 kV TG. When the 4 kV safeguards bus is restored, the installed fuel oil transfer pumps will automatically transfer fuel oil from the safeguard storage tanks to the day tanks.

- Other Support Functions: Maintaining the other support functions such as, field instrument readings, room environmental conditions, lighting, communications remain the same as, or are bounded by, the non-flood ELAP strategies.

E. FLEX Strategy Change - Compliance Overview

This FLEX Strategy Change also changed the method of compliance. The revised NSPM strategy relies on offsite SAFER equipment to repower the installed plant equipment and does not rely on the majority of the PINGP portable onsite FLEX equipment. Based on repowering of installed equipment, no portable pumps are provided for SG and SFP makeup. Additionally, the revised strategy requires reconfiguration of the primary connection to repower the installed equipment through the safeguards bus. The repowered installed plant equipment will maintain the functions of core cooling, SFP cooling, and containment integrity. Therefore, the revised strategy meets the Order requirements, however, is considered an alternative to NEI 12-06 from the standpoint of meeting Section 3.2.2, "Minimum Baseline Capabilities."

NEI 12-06, Section 3.2.2, "Minimum Baseline Capabilities," contains the expectation that each PWR plant will establish capabilities consistent with Table 3-2, "PWR FLEX Baseline Capability Summary." In the revised flood strategy, the Safety Functions of Table 3-2, and Tables D-1, D-2 and D-3, will be provided by installed equipment rather than the portable PINGP FLEX equipment for the design basis flood ELAP mitigating strategy, making this strategy an alternate to the NEI 12-06 guidance.

- The Core Cooling and Heat Removal safety functions will be provided by installed equipment. The strategy is to repower the 4 kV safeguards buses with the SAFER 4 kV TGs and restore RHR cooling (installed equipment). No portable SG makeup pump will be provided to feed the SGs. Therefore, the revised strategy does not meet the baseline capability prescribed by NEI 12-06, Table D-1, for reactor core cooling and heat removal.
- The Spent Fuel Cooling safety function will be maintained by installed equipment. Repowering of the 4 kV safeguards buses with the SAFER 4 kV TGs provides power to the normal SFP Cooling. No portable FLEX makeup pump will be staged to provide SFP makeup or spray. Therefore, the revised strategy does not meet the baseline capability prescribed by NEI 12-06 for the Spent Fuel Pool Cooling function.

The Containment safety function was demonstrated by analysis as not being challenged. Thus, the revised strategy meets the baseline capability prescribed by NEI 12-06, Table 3-2 and Table D-2, for the Containment Function. In addition, repowering of the 4 kV safeguards buses with the SAFER 4 kV TGs provides power to the containment FCU fans (installed equipment), so they could be started for containment cooling if desired.

NEI 12-06, Section 3.2.2, "Minimum Baseline Capabilities," states that at a minimum, the primary connection point should be an installed connection suitable for both the on-site and off-site equipment. The secondary connection point may require reconfiguration (e.g., removal of valve bonnets or breaker) if it can be shown that adequate time is available and adequate resources are reasonably expected to be available to support the reconfiguration. In the revised flood strategy, the connection of the SAFER 4 kV

TGs to any of the safeguards buses requires reconfiguration of the bus (e.g., removing current transformers, replacing portions of the bus bars, and attaching mounting blocks). However, the revised strategy continues to meet the NEI 12-06 guidance and the Order EA-12-049 requirement in that:

- Based on the flood condition, there will be a sufficient amount of time to plan to have adequate resources on site for the bus reconfiguration.
- Tabletop validation demonstrated that the reconfiguration of the bus can be completed in an adequate amount of time. The SAFER 4 kV generators can supply power prior to the depletion of the safeguards batteries.
- The repowered installed plant equipment maintains the functions of core cooling, SFP cooling, and containment integrity, and therefore, meets the requirements of Order EA-12-049.

F. Summary and Conclusion for SE.18:

The revised strategy will use the off-site SAFER 4 kV TGs and the equipment associated with operation of the generators to repower installed equipment. There is sufficient time prior to the design basis flood to pre-stage the SAFER 4 kV equipment before the site grade floods. Although the revised strategy meets the Order requirements, NSPM considers the strategy an alternative to meeting the baseline capabilities discussed in Section 3.2.2 of the NRC endorsed NEI 12-06 guidance. The repowered installed plant equipment maintains the functions of core cooling, SFP cooling, and containment integrity, and therefore, meets the requirements of Order EA-12-049.

NRC Audit Item Reference: SE.19 (Open)

NRC Audit Item in Reference 8: *N/A – SE.19 in Audit Report only.*

Item Description as stated in Reference 9: *Accumulator borated water injection calculation.*

Licensee Input Needed as stated in Reference 9: *Provide a basis for the RCS vs SG pressure differential assumed in the borated water calculation, or provide a revised calculation that can be supported.*

NSPM Response to NRC Audit Item:

The basis for determining that sufficient Safety Injection (SI) Accumulator borated water will be injected into the Reactor Coolant System (RCS) during an Extended Loss of AC Power (ELAP) to maintain shutdown margin was provided to the NRC in the NSPM Fukushima Response online reference portal.

During an ELAP, NSPM's strategy is to perform an early RCS natural circulation cooldown and depressurization to provide borated water injection from the Safety Injection (SI) Accumulators. It is recognized that the rapid RCS cooldown will result in a steam bubble in the reactor vessel head and that this bubble will control RCS pressure (rather than the Steam Generator (SG) pressure) such that it will delay SI accumulator injection. Evaluations show that no boration is required for a minimum of 36 hours provided the SG pressure is maintained at 350 psig or higher. Within this 36 hour period, there is reasonable assurance that the reactor vessel head will cooldown sufficiently such that the RCS/SG pressure differential will be less than that assumed in the borated water calculation. Thus, it is expected that sufficient borated water will be injected from the SI accumulator injection to maintain shutdown margin down to a RCS temperature of 350°F.

As an additional defense in depth measure, the ELAP response procedure and guidelines include steps to be completed prior to the 36 hour time period that ensure shutdown margin is maintained by either 1) verifying sufficient SI Accumulator injection has occurred or 2) injecting sufficient borated water via the Charging Pumps.

NRC Audit Item Reference: SE.20 (Open)

NRC Audit Item in Reference 8: *N/A – SE.20 in Audit Report only.*

Item Description as stated in Reference 9: *The licensee's OIP dated February 26, 2013, indicates that there will be two FLEX DGs to support the overall strategy and that there will be two spare DGs to comprise "N+1" capability (four total). During the onsite audit it was identified that there will be only one spare "N+1" DG (three total).*

Licensee Input Needed as stated in Reference 9: *Provide justification for having one "N+1" DG. Include a discussion of the interchangeability between the three DGs, as well as a discussion of how the proposed configuration meets the intent of NEI 12-06.*

NSPM Response to NRC Audit Item:

The response to SE.20 was provided in the fifth six-month status update (Reference 7) in Section 4.0 of the Enclosure under the bullet titled, "OIP Compliance Change – N+1 Criteria for 480 VAC portable generators." The compliance change summary discusses that the PINGP FLEX strategy for N+1 sets of portable power supplies is not based by unit but rather by functions across both units. The Reference 7 summary also describes that the three 480 VAC portable generators are identical. Therefore, any two of the three are sufficient to support all required functions for both PINGP units. The PINGP FLEX strategy for portable power supplies is considered an alternative method to NEI 12-06 for complying Order EA-12-049.

References:

1. NRC Order EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012 (ADAMS Accession No. ML12054A735).

2. NSPM Letter (L-PI-13-007) to NRC, "Prairie Island Nuclear Generating Plant's Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 26, 2013 (ADAMS Accession No. ML13060A379).

3. Not used.

4. Not used.

5. Not used.

6. Not used.

7. NSPM Letter (L-PI-15-065) to NRC, "Prairie Island Nuclear Generating Plant's Fifth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) (TAC Nos. MF0834 and MF0835)," dated August 25, 2015 (ADAMS Accession No. ML15237A403).

8. NRC letter to NSPM, "Prairie Island Nuclear Generating Plant Units 1 and 2 - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC Nos. MF0834 AND MF0835)," dated February 27, 2014 (ADAMS Accession No. ML14030A540).

9. NRC Letter to NSPM, "Prairie Island Nuclear Generating Plant, Units 1 and 2 – 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. MF0834, MF0835, MF0832 and MF0833)," dated August 20, 2015 (ADAMS Accession No. ML15224B396).

10. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0, dated August 2012 (ADAMS Accession No. ML12242A378).

11. Flowserve Corporation report, "White Paper on the Response of the N-Seal Reactor Coolant Pump (RCP) Seal Package to Extended Loss of All Power (ELAP)," Revision A, dated August 5, 2015 (ADAMS Accession Nos. ML15222A356 (proprietary) and ML15222A357 (non-proprietary)).

12. NRC Letter to PWR Owners Group regarding endorsement of Flowserve White Paper, dated November 12, 2015, (ADAMS Accession No. ML15310A094).