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JAFP-17-0083
August 29, 2017

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

James A FitzPatrick Nuclear Power Plant
Renewed Facility Operating License No. DPR-059
NRC Docket No. 50-333

Subject: Report of Full Compliance With March 12, 2012, Commission Order to Modify Licenses With Regard To Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)

References:

1. NRC Order Number EA-12-049, Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, ML12056A045, dated March 12, 2012
2. Entergy letter, Overall Integrated Plan in Response to March 12, 2012, Commission Order to Modify Licenses With Regard To Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), JAFP-13-0025, dated February 28, 2013

Dear Sir or Madam:

On March 12, 2012, the Nuclear Regulatory Commission ("NRC" or "Commission") issued an order [Reference 1] to James A. FitzPatrick Nuclear Power Plant (JAF). Reference 1 was immediately effective and directed JAF to develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities in the event of a beyond-design-basis external event. Specific requirements are outlined in Attachment 2 of Reference 1. Initial compliance with EA-12-049 was submitted pursuant to Section IV, Condition C.1, in an Overall Integrated Plan (OIP) [Reference 2]. Status updates at six-month intervals, following submittal of the OIP, were submitted pursuant to Condition C.2.

The purpose of this letter is to provide the report for full compliance with NRC Order Number EA-12-049 [Reference 1] pursuant to Section IV, Condition C.3 of the Order. Attachments 1 and 2 provide a summary of EA-12-049 compliance; Attachments 3 and 4 provide responses to the remaining open Audit, Interim Staff Evaluation, and Confirmatory item responses; and, the Enclosure contains the Final Integrated Plan (FIP) which provides the strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities in the event of a beyond-design-basis external event at JAF.

This letter contains no new regulatory commitments. Should you have any questions regarding this submittal, please contact Mr. William C. Drews, Regulatory Assurance Manager at (315) 349-6562.

I declare under penalty of perjury that the foregoing is true and correct. Executed on 29th day of August, 2017.

Sincerely,

(for Pacher Acting)

Joseph E. Pacher
Site Vice President
Exelon Generation Company, LLC

JEP/WCD/mh

Attachment 1: Compliance with Order EA-12-049
Attachment 2: Order EA-12-049 Compliance Elements Summary
Attachment 3: Audit Items Currently Under NRC Staff Review
Attachment 4: Interim Staff Evaluation Open Item and Confirmatory Item Responses
Enclosure: Final Integrated Plan

cc: Director, Office of Nuclear Reactor Regulation
NRC Region I Administrator
NRC Resident Inspector
NRC Project Manager
NYSPSC
President NYSERDA

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Attachment 1

Compliance with Order EA-12-049

(1 Page)

Compliance with Order EA-12-049

On March 12, 2012, the NRC issued Order EA-12-049, Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (BDBEEs). This Order was effective immediately and directed sites to develop and implement strategies and guidance to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities in the event of a BDBEE.

James A. FitzPatrick Nuclear Power Plant (JAF) submitted an Overall Integrated Plan (OIP) by letter dated February 28, 2013. By letter dated February 21, 2014, the NRC provided the interim staff evaluation and requested additional information necessary for completion of the review.

JAF developed a Final Integrated Plan (Enclosure), documenting the diverse and flexible (FLEX) strategies, in response to NRC Order EA-12-049. The information provided herein documents full compliance with the Order for JAF.

The Audit Report for JAF had two items under NRC staff review (Attachment 3).

The following are the milestones completed since the issuance of the Order.

Milestone	Completion Date
Submit 60 Day Status Report	Oct 2012
Submit Overall Integrated Plan	Feb 2013
Submit Six-Month Updates:	
Report 1 (ML13241A204)	Aug 2013
Report 2 (ML14059A359)	Feb 2014
Report 3 (ML14241A261)	Aug 2014
Report 4 (ML15058A587)	Feb 2015
Report 5 (ML15240A370)	Aug 2015
Report 6 (ML16057A603	Feb 2016
Report 7 (ML16238A521)	Aug 2016
Report 8 (ML17059D564)	Feb 2017
Perform Staffing Analysis	Jan 2017
Modifications	June 2017
On-site FLEX Equipment	June 2017
Off-site FLEX Equipment	June 2017
Procedures	June 2017
Training	June 2017

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Attachment 2

Order EA-12-049 Compliance Elements Summary

(2 Pages)

Order EA-12-049 Compliance Elements Summary

The elements identified below are included in the James A. FitzPatrick (JAF) Final Integrated Plan (FIP) (Enclosure) and demonstrate compliance with Order EA-12-049.

Strategies – Complete

JAF strategies are in compliance with Order EA-12-049 and are documented in the FIP.

Staffing - Complete

The staffing study for JAF has been completed in accordance with 10 CFR 50.54(f), "Request for Information Pursuant to Title 10 of the Code of Federal Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force review of Insights from the Fukushima Dai-ichi Accident," Recommendation 9.3, dated March 12, 2012. JAF submitted the Phase 2 staffing assessment in response to the 50.54(f) letter on January 23, 2017 (Letter JAFP-17-0005).

Modifications – Complete

The modifications required to support the diverse and flexible strategies (FLEX) strategies documented in the FIP for JAF have been implemented in accordance with the station design control process.

Equipment – Procured and Maintenance & Testing – Complete

The equipment required to implement the FLEX strategies for JAF was procured in accordance with Nuclear Energy Institute (NEI) 12-06, Sections 11.1, Quality Attributes, and 11.2, Equipment Design, initially tested/performance verified in accordance with NEI 12-06, Section 11.5, Maintenance and Testing, and is available for use.

As discussed in the FIP, maintenance and testing is conducted through the use of the JAF preventive maintenance program such that equipment reliability is achieved.

Protected Storage – Complete

The storage facilities required to implement the FLEX strategies for JAF have been completed and provide protection from the applicable site hazards, as discussed in the FIP. The equipment required in order to implement the FLEX strategies for JAF is stored in its protected configurations.

Procedures – Complete

FLEX Support Guidelines (FSGs) for JAF have been developed, and integrated with existing procedures. The FSGs and procedures have been validated per NEI 12-06, Section 11.4.3, Development Guidance for FSGs, and have been issued for use in accordance with the site procedure control program.

Training – Complete

Initial compliance training has been completed in accordance with an accepted training process as recommended in NEI 12-06, Section 11.6, Training.

National SAFER Response Centers - Complete

Exelon has established a contract with the Pooled Equipment Inventory Company (PEICo) and has joined the Strategic Alliance for FLEX Emergency Response (SAFER) Team Equipment Committee for offsite facility coordination. PEICo is ready to support JAF with Phase 3 equipment stored in the National SAFER Response Centers in accordance with the site specific SAFER Response Plan.

Validation - Complete

Exelon has completed performance of validation activities in accordance with NEI 12-06

Order EA-12-049 Compliance Elements Summary

Appendix E guidance to assure required tasks and manual actions for FLEX strategies are feasible and may be executed within the constraints identified in the FIP for Order EA-12-049.

FLEX Program Document – Established

The JAF FLEX Program Document, EDSO-5, “Site Implementation of Diverse and Flexible Coping Strategies (FLEX) and Spent Fuel Pool Instrumentation (SFPI) Program” has been developed and issued in accordance with the requirements of NEI 12-06.

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Attachment 3

Audit Items Currently Under NRC Staff Review

(1 Page)

Audit Items Currently Under NRC Staff Review

An NRC onsite audit of the implementation of Orders EA-12-049 and EA-12-051 was conducted at James A. FitzPatrick (JAF) during the week of October 24, 2016. As documented in Attachment 3 of the audit report (ADAMS Accession No. ML16343A011), there are two audit items under NRC Staff review. These two audit items and their status are provided below.

Audit Item Reference	Item Summary Description	Status
AQ. 19	Provide additional information regarding the installed diesel-driven fire pump and the associated piping, fuel supply and support equipment to demonstrate that it is protected against all postulated BDBEEs.	Closed - The licensee provided additional information to the staff regarding the seismic evaluation of the 76P-1 fire pump. This evaluation is documented in Attachment 6.002 of P2E of EC 52736. The evaluation concludes that both diesel fire pump fuel tanks are well anchored and pose no seismic risk. In addition, walkdowns and evaluations performed show that pump 76P-1 is seismically rugged. The alternate pump 76P-4 is designed as seismic class II. However, EC 52736 Attachment 6.010 states that the pump 76P-4 is seismically robust and will be available following a FLEX event. EC52736 Attachments 6.002 and 6.010 have been uploaded to the ePortal for NRC staff review.
SE. 8	Provide a discussion/analysis on the ability of electrical and mechanical equipment (i.e., valve solenoids, instruments, relays, etc.) located within containment and other areas of the plant (i.e., Main Control Room, RCIC/HPCI Pump Rooms, SRV rooms, switchgear rooms, Battery Rooms, etc.) that is relied upon during an ELAP to function in the expected environmental conditions (for both extreme high and low temperatures) for the duration of the ELAP event (i.e., indefinitely).	Closed - Evaluation on the impacts of ELAP conditions on SRV components is documented in Attachment 6.037 of P2E of EC 52736. The evaluation concludes that the components important to the operation of the SRV's and the ADS Relief Control Panel, also necessary for the functioning of the SRV's, will remain functional during an ELAP event. EC 52736 Attachment 6.037 has been uploaded to ePortal for NRC staff review.

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Attachment 4

Interim Staff Evaluation Open Item and Confirmatory Item Responses

(18 Pages)

Interim Staff Evaluation Open Item and Confirmatory Item Responses

On February 21, 2014, the NRC issued the Interim Staff Evaluation (ISE) for James A. FitzPatrick Nuclear Power Plant (JAF) (ADAMS Accession No. ML14007A681). In that document, four (4) open items and twenty nine (29) confirmatory items were identified. An NRC onsite audit was conducted at JAF during the week of October 24, 2016, during which all of the open and confirmatory items were closed, with the exception of the items discussed in Attachment 3, as documented in the NRC Audit Report (ADAMS Accession No. ML16343A011). Listed below are the Exelon responses to the ISE open and confirmatory items. These responses were provided to the NRC before and during the onsite audit.

ISE Open Item 3.1.1.3.A

Procedural Interface (Seismic Hazard) - Evaluate the impacts from large internal flooding sources.

JAF Response:

Per EC 52736 Attachment 6.018, an evaluation of internal flood sources that are not seismically robust was completed for JAF. The evaluation looked specifically at areas where equipment was required to operate following a beyond design basis external event (BDBEE). Two areas of concern where the key FLEX equipment is located are the West Electrical Tunnel and the RCIC room.

Based on the results of the evaluation, there are no large internal non-seismically robust flooding sources whose failure coincident with the loss of AC power could adversely impact implementation of FLEX mitigation strategies.

ISE Open Item 3.1.3.1.A

Protection of FLEX Equipment (High Wind Hazard) - Evaluate the separation distance and the axis of separation considering the predominant path of tornados in the geographic area to demonstrate that at least N sets of FLEX equipment would remain deployable in the context of a tornado missile hazard.

JAF Response

Per EC 52736 Rev. 0, Section 3.1.51, NEI 12-06 Section 7.3.1 specifies that FLEX equipment may be stored in “diverse locations” considering high wind hazards to provide reasonable assurance that N sets of FLEX equipment will remain deployable. However, “diverse locations” is not defined since it will vary between the plants. The minimum separation distance between JAF FLEX storage locations is based on a reasonable tornado width.

Report JAF-RPT-15-00018 states that a reasonable separation distance that bounds a large majority of tornados in the region would be based on the 90th percentile tornado width value of 950 feet (using 1950-2013 data). Based on historical records, the axis of separation used at JAF should consider tornado paths from Southwest to Northeast and West to East. In order to bound both of these directions, the separation distance was expanded to 1400 ft on an axis from Northwest to Southeast. Separation of storage locations by this distance and direction provides reasonable assurance that N sets of FLEX equipment will remain deployable through most tornados.

ISE Open Item 3.1.4.2.B

Deployment of FLEX Equipment (Snow, Ice and Extreme Cold) - Evaluate the potential impact on the UHS due to ice blockage or formation of frazil ice as a result of extreme cold.

JAF Response

EC 52736 Rev. 0, Attachment 6.001 evaluates the potential for ice-induced blockage at JAF. The report assesses whether or not the required minimum flow for the plant (11,700 gpm) could be maintained under this condition and with the rack bar heaters out of service. The study documents that frazil ice tends to float up when the water velocity is below about 1 ft/sec and tends to be well-mixed when the water velocity exceeds about 1 ft/sec. The average water velocity at the JAF intake for the 11,700 gpm flow condition is 0.05 ft/sec. Because the velocity for 11,700 gpm at the intake is so low, significant frazil ice is not drawn into the intake.

Because the intake flow rate for FLEX (up to 2,500 gpm) is considerably lower than the minimum intake flow rate evaluated in the existing JAF study (11,700 gpm), it can be concluded that the velocity through the intake will be further reduced, and there will not be a frazil ice concern during a BDBEE event. Additionally, any frazil ice that enters the intake canal will have a lower velocity and more time to absorb heat from the ground/earth and melt ice crystals before entering the screenwell building.

The FLEX strategy uses fire pumps 76P-4 and 76P-1. Pump 76P-4 is upstream of the moving screens, and fire pump 76P-1 is downstream of the moving screens. The fire pump suction strainers are about 6 feet below the minimum water level. The frazil ice will be floating 6 feet above the strainers.

ISE Open Item 3.2.3.A

Containment – Verify that the implementation of Boiling Water Reactor Owners Group (BWROG) Emergency Procedure Guideline (EPG)/Severe Accident Guideline (SAG), Revision 3, including any associated plant-specific evaluations, has been completed in accordance with the provisions of NRC letter dated January 9, 2014 [Reference 23].

JAF Response

The NRC Letter (ADAMS Accession No. ML13358A206) referenced in the NRC ISE Open Item 3.2.3.A above states in part: “The BWROG paper addresses the venting strategy on a generic basis, but plant-specific implementation relies on such items as the capabilities of the installed vent path, net positive suction head for the reactor coolant system injection pumps, and guidance to prevent negative pressure in containment.”

The first response addresses the prevention of negative pressure in containment aspect of the letter. During Phase 3, when the FLEX strategy establishes shutdown cooling (SDC) and suppression pool cooling via residual heat removal (RHR) operation, there is the potential for negative pressure in containment which must be evaluated.

In order to assure that the primary containment cannot be subjected to an externally applied differential pressure load sufficient to cause it to collapse, the containment is designed with torus downcomer vacuum breaker valves (27VB-1 through 27VB-5). The five drywell vacuum-breaker valves between the pressure suppression chamber (torus) and drywell draw steam and non-condensables from the pressure suppression chamber to prevent the drywell vacuum rating of 0.5 psid from being exceeded. The vacuum breakers do not require power to operate. Additionally, two vacuum breaker valves in parallel are provided between the Reactor Building and the pressure suppression chamber. These two vacuum breakers are 27VB-6 and 27VB-7 and are known as the reactor building to torus vacuum breakers. Either valve has sufficient capacity to limit a vacuum in the suppression chamber to 0.5 psid. Note that the vacuum between the drywell and the atmosphere could be as large as -1.0 psig, because of the 0.5 psi difference between the drywell and torus and the 0.5 psid difference between the torus and atmosphere. Valves 27VB-6 and 27VB-7 are in series with air operated valves 27AOV-101A and 101B (27SOV-101A and 101B are their associated solenoid valves).

Interim Staff Evaluation Open Item and Confirmatory Item Responses

To credit the suppression chamber-to-reactor building vacuum breakers in the Phase 3 JAF FLEX strategy or during plant recovery, the power sources and air supply for the AOVs must be available.

The necessary power sources for the vacuum breakers will be available following deployment of the offsite NSRC generator. Valves 27AOV-101A and 27SOV-101A (powered from 120VAC 71ACA2) or valves 27AOV-101B and 27SOV-101B (powered from 120Vac 71ACB2) are re-powered in Phase 3 or during plant recovery when 600VAC 71MCC-263 (or 71MCC-254) gets re-powered by re-powering 4160VAC 71H06 by the NSRC supplied 4160V FLEX generator.

Per EC 52736 Rev. 0, Attachment 6.005, Pressure switches 27PS-110A and 110B sense pressure suppression chamber-to-reactor building differential pressure and open their respective AOV when their setpoints are exceeded; the pressure switches are mechanical devices which do not require a power supply. Because the SOVs are repowered by the FLEX generators, the AOVs will be functional; 27AOV-101A or 27AOV-101B, are functional during Phase 3 or plant recovery. These components are robust and will be available following a BDBEE.

An air supply will be available for the JAF FLEX strategy. Safety related nitrogen tanks (27TK-7A and 7B) provide pneumatic pressure to 27AOV-101A and 27AOV-101B. Per the EC 52736 these nitrogen tanks are available for all FLEX scenarios except tornados and high winds. When the nitrogen tanks are unavailable in FLEX scenarios, an NSRC air compressor will be utilized during Phase 3. Because a pneumatic supply will be available in Phase 3, the AOVs will be functional. Since only one pressure suppression chamber-to-reactor building vent path is required, avoidance of exceeding negative pressure limits is ensured.

Therefore, in the event of negative containment pressure due to re-establishing SDC and suppression pool cooling in Phase 3 or during plant recovery, the existing vacuum breakers will actuate, normalizing the pressure between the drywell, suppression chamber, and reactor building and relieve the negative pressure condition.

In regards to net positive suction head (NPSH) for the reactor pressure vessel (RPV) injection pumps, the strategy utilizes the RCIC pump drawing from the condensate storage tank (CST) and an installed DDFP drawing from Lake Ontario. These suction sources are the normal suction sources for these pumps and adequate NPSH is available per the existing design of these pumps. Elevated suppression pool temperatures do not have an impact on NPSH because the suppression pool suction MOV will be locked early on in the event to prevent the RCIC suction source from swapping from the CSTs to the suppression pool.

In regards to capability of the vent path, Modular Accident Analysis Program (MAAP) calculation JAF-CALC-15-00044, Rev. 0, was performed by considering both the currently installed GL 89-16 vent path and the proposed hardened containment vent system. Both of these vent pathways were determined to adequately remove steam from containment to maintain pressures within design requirements. Both of these vent paths are robust with respect to design basis events per Attachment 6.029 of EC 52736.

ISE Confirmatory Item 3.1.1.2.A

Deployment of FLEX Equipment- Confirm that soil liquefaction will not impede vehicle movement following a seismic event.

JAF Response:

Liquefaction is addressed in Section 3.1.6 of EC 52736. A subsurface exploration was performed to evaluate the engineering properties of the subsurface soils within the two proposed FLEX storage building sites, Staging Area B (the Phase 3 equipment staging area), helicopter landing zone and along the proposed travel paths. Based on the current and past explorations performed in the project area, overall the liquefaction potential for the locations previously listed is low. For a postulated earthquake scenario with PGA=0.15g and moment magnitude M=6.2, the analyses indicate that some minor ground deformations (estimated at less than 1 inch) could occur following an earthquake due to isolated pockets of loose/soft materials, should these materials become fully saturated. During construction of the FLEX buildings, any loose/soft or otherwise unsuitable soil overburden that was encountered was replaced with compacted fill, eliminating the potential for liquefaction under the buildings foundation. For the staging area, helicopter landing zone and the travel paths, such minor ground deformations due to strong shaking would not be expected to render the travel paths, the staging area and the helicopter landing zone inaccessible.

ISE Confirmatory Item 3.1.1.2.B

Deployment of FLEX Equipment- Confirm final design features of the new storage building including the susceptibility to the loss of ac power to deploy equipment.

JAF Response:

Per EC 59274 and EC 66099 (FLEX Storage building Engineering Changes), the FLEX equipment is located in two different FLEX Equipment Storage Buildings (FESB). One FESB, also referred to as the “N+1” FESB, is located outside the Protected Area west of the existing Wellness Center. The second FESB, also referred to as the “N” FESB, is located inside the PA.

The FESBs have been designed to ASCE 7-10. Both buildings were erected to withstand equivalent ASCE 7-10 seismic capacity of up to 1.55*SSE. This seismic capacity is based on the maximum GMRS/SSE ratio of 1.55.

The locations for the “N+1” and “N” FESBs are separated more than 1,400 ft (JAF-RPT-15-00018). Separation of storage locations by this distance provides reasonable assurance that N sets of FLEX equipment will remain deployable through a tornado event.

The snow loading design value for the FESBs is 60 psf, which bounds the plant’s design basis snow load of 50 psf.

The FESBs are designed with manually operated rollup doors. Therefore, there is no need for a power source to move or deploy the FLEX equipment.

ISE Confirmatory Item 3.1.1.2.C

Deployment of FLEX Equipment - Confirm the storage locations and means of protection against the seismic hazard of the super duty pickup trucks and the two flatbed trailers used for deployment of FLEX equipment.

JAF Response:

The super duty pickup truck and the super duty trailer stored inside the N+1 storage building are protected from the seismic hazard per the sliding and rocking evaluation submitted with Storage building EC 59274. The buildings are designed to be protected from the seismic hazard per the response to CI 3.1.1.2.B above.

ISE Confirmatory Item 3.1.1.4.A

Offsite Resources- Confirm location of offsite staging area(s), access routes and methods of delivery of equipment to the site considering the seismic, flood, high wind, snow, ice and extreme cold hazards.

Interim Staff Evaluation Open Item and Confirmatory Item Responses

JAF Response:

Per Section 3.1.42 of FLEX Basis EC 52736, the NSRC equipment laydown area is located in the contractor parking lot in the southwest corner of the site. This parking lot is accessible from the east and west via Lake Road and by the helicopter landing zone between the security owner controlled area and the protected area on the south side of the plant. The transfer path between the laydown area and the site has been evaluated in Storage Building EC 59274 and FLEX Basis EC 52736 to be available considering seismic, flood, high wind, snow, ice, or extreme cold hazards. An onsite debris removal tractor and tow truck can be used for deployment of NSRC equipment. The SAFER Response Plan provides the information on how the NSRC equipment will be transferred from off-site to the onsite NSRC equipment laydown area.

ISE Confirmatory Item 3.1.3.2.A

Deployment of FLEX Equipment (High Wind Hazard) - Confirm availability of debris removal equipment to facilitate deployment of FLEX equipment.

JAF Response

Per FLEX Basis EC 52736 Rev. 0, JAF credits a single set of debris removal equipment. This set of debris removal equipment includes a front end loader stored in the “N+1” storage building. The front end loader is protected from high winds because the storage building is designed to withstand 165 mph winds per the building design requirements document submitted with the “N+1 storage building EC 59274. The “N” storage building does not require storage of a front end loader because the deployed equipment can be deployed by hand or on small carts and does not rely on the use of a tow truck or equipment trailer.

ISE Confirmatory Item 3.1.3.2.B

Deployment of FLEX Equipment (High Wind Hazard) - Confirm protection of the means to move FLEX equipment.

JAF Response:

EC 52736, Attachment 6.028 addresses aspects of Phase 2 equipment deployment and storage (described in NEI 12-06 Sections 5.3.2, 6.2.3.2, 7.3.2, 8.3.2, 9.3.2, and 11.3) that may be impacted by debris resulting from the applicable extreme external hazards (described in NEI 12-06 Section 4.1 and identified in EC 52736). This assessment of expected debris along the deployment pathways assisted in determining recommendations for debris removal equipment and the manpower needed to meet Phase 2 timing requirements for equipment deployment.

The assessment report includes portions of the Phase 3 haul path because the Phase 3 staging area is located near the FLEX equipment storage building and utilizes the same haul paths as the Phase 2 equipment with the exception of the NSRC provided pump.

The assessment report acknowledges the following goals in support of Phase 2 timing requirements for equipment deployment:

- A goal of approximately 2 hours is used for debris removal based on factors such as time for personnel to get to debris removal equipment, the length of the haul path from the storage facility to the staging location, amounts of potential debris, etc.
- A goal of approximately 1 hour is used for equipment transportation based on distance of haul path, items to be deployed at different areas, etc. In cases where only a single haul path is evaluated for deployment, twice this value (i.e., 2 hours) is used for timeline input.

The minimum time-sensitive Phase 2 equipment are the diesel generator, supporting electrical cables, and associated tooling. To support the FLEX strategy, the generator will be operational and connected by 8 hours following the initiation of the event. To allow adequate time for completion of these activities, delivery of the diesel generator and equipment trailers should be completed within hour 6. Phase 3 equipment, including the NSRC generator and pump, are not scheduled to arrive until at least 24 hours from the initiation of the event. Therefore, it is deemed feasible to clear the haul path to the NSRC pump staging location and laying out of appropriate hose lengths within the 24 hour time period if the NSRC pump is required to be used.

The assessment report concluded that debris removal can be accomplished within 2 hours of declaring an extended loss of AC power (ELAP) and that staging the FLEX generator and equipment trailers within the required time is achievable based on the collective expertise of the cross functional assessment team.

ISE Confirmatory Item 3.1.4.2.A

Deployment of FLEX Equipment (Snow, Ice and Extreme Cold) - Confirm availability of snow removal equipment to facilitate deployment of FLEX equipment.

JAF Response:

EC 52736, Section 3.1.46 and Attachment 6.021 address this item. Both "N" and "N+1" buildings are designed to 60 psf snow load which is in excess of design basis snow loading for design Category 1 structures. Normal snow removal practices are used to keep paths around site clear. The "N+1" building is equipped with a front end loader that can be used for snow removal. As stated in the response to CI 3.1.3.2.A, deployment of equipment from the "N" building can be accomplished by hand or by the use of small carts such that snow accumulation following the event is not expected to impede deployment.

Snow and ice, as they relate to deployment routes, were considered. JAF would have ample warning of impending snow and ice storms and would take appropriate precautions per existing plant practice such as preparing for salting roads and walkways, preparing/staging snowplowing vehicles, etc. Administrative procedure AP-12.04 is used to ensure FLEX path ways are maintained clear of snow and ice.

ISE Confirmatory Item 3.2.1.1.A

Computer Code Used for ELAP Analysis - Benchmarks need to be identified and discussed which demonstrate that Modular Accident Analysis Program (MAAP) is an appropriate code for the simulation of an ELAP event at JAF.

JAF Response:

Calculation JAF-CALC-15-00044, "FitzPatrick Nuclear Plant Containment Analysis of FLEX Strategies," uses the Modular Accident Analysis Program 4 (MAAP4) computer code. This calculation is available on e-Portal. The MAAP4 analysis conforms to the Nuclear Energy Institute (NEI) position paper dated June 2013, entitled "Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications" (Agency wide Documents Access and Management System (ADAMS) Accession Number ML13190A201). According to the October 3, 2013 letter from the NRC to NEI (ADAMS Accession Number ML13275A318), NRC staff has reviewed this position paper and has not identified any concerns regarding the use of MAAP4 in performing containment analyses in satisfying the intent of the NRC Order EA-12-049. A list of limitations is provided for MAAP4 use in establishing a timeline for boiling water reactors (BWRs) which meets the intent of NRC Order EA-12-049. The FitzPatrick MAAP4 analysis conforms to these limitations and provides the relevant information for the NRC to confirm the acceptability of the analysis. Appendix 7 of JAF-CALC-15-00044 addresses the five limitations utilizing the industry developed template.

ISE Confirmatory Item 3.2.1.1.B

Computer Code Used for ELAP Analysis -Confirm that the collapsed level remains above Top of Active Fuel (TAF) and the cool down rate is within technical specifications limits.

JAF Response:

A MAAP4 analysis has been performed and is available on e-Portal (JAF-CALC-15-00044, Rev. 0). Appendix 7 of this calculation confirmed that the collapsed level remains well above the Top of Active Fuel (TAF) for the duration of the analysis (120 hours) and the cool down rate is within Technical Specifications limits (i.e. ≤ 100°F/ hour).

ISE Confirmatory Item 3.2.1.1.C

Computer Code Used for ELAP Analysis - Confirm that MAAP was used in accordance with Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013 position paper (ADAMS Accession No. ML13190A201).

JAF Response:

A MAAP4 analysis has been performed and is available on e-Portal (JAF-CALC-15-00044, Rev. 0). This calculation was performed in accordance with sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013 position paper, EPRI Technical Report 3002001785, “Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications” (ADAMS Accession Number ML13190A201).

ISE Confirmatory Item 3.2.1.1.D

Computer Code Used for ELAP Analysis - Confirm that the licensee, in using MAAP, identified and justified the subset of key modeling parameters cited from Tables 4-1 through 4-6 of the "MAAP Application Guidance, Desktop Reference for Using MAAP Software, Revision 2" (Electric Power Research Institute Report 1020236).

JAF Response:

The JAF MAAP analysis, JAF-CALC-15-00044, Rev. 0, determined the conditions in the nuclear station containment, drywell, and reactor vessel for 120 hours following a BDBEE resulting in an ELAP. The MAAP Version 4.0.5 BWR (Boiling Water Reactor) is used for this analysis. Appendix 7 of the calculation contains a JAF response to the letter of October 3, 2013 from Jack Davis (NRR) to Joe Pollock (NEI) (ADAMS Accession Number ML13275A318) regarding use of MAAP4 in simulating ELAP events for BWRs, addressing each one of the limitations stated on the NRC endorsement letter.

ISE Confirmatory Item 3.2.1.1.E

Computer Code Used for ELAP Analysis - Confirm that the specific MAAP analysis case that was used to validate the timing of mitigating strategies in the Integrated Plan has been identified and is available for NRC staff to review. Alternately, a comparable level of information has been included in the supplemental response. In either case, the analysis should include a plot of the collapsed vessel level to confirm that TAF is not reached (the elevation of the TAF should be provided) and a plot of the temperature cool down to confirm that the cool down is within technical specifications limits.

JAF Response:

A MAAP4 analysis has been performed and is available on e-Portal (JAF-CALC-15-00044, Rev. 0). The MAAP4 analysis conforms to the NEI position paper dated June 2013, entitled "Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications" (Agency wide Documents Access and Management System (ADAMS) Accession Number ML13190A201). According to the October 3, 2013 letter from the NRC to NEI (Accession Number ML13275A318), NRC staff has reviewed this position paper and has not identified any concerns regarding the use of MAAP4 in performing containment analyses in satisfying the intent of the NRC Order EA-12-049. A list of limitations is provided for MAAP4 use in establishing a timeline for BWRs which meets the intent of NRC Order EA-12-049. The FitzPatrick MAAP4 analysis conforms to these limitations and provides the relevant information for the NRC to confirm the acceptability of the analysis. Appendix 7 of JAF-CALC-15-00044, Rev. 0 addresses the five limitations utilizing the industry developed template.

ISE Confirmatory Item 3.2.1.2.A

Recirculation Pump Seal Leakage Models - Confirm the seal leakage model used in the updated MAAP analysis (which will address the MAAP code limitations when used for ELAP analysis). Evaluate the seal leakage rate model used, the details of the seal qualification tests and supporting test data, and leakage rate pressure-dependence.

JAF Response:

In the MAAP4 analysis, JAF-CALC-15-00044, Rev. 0, for the overall integrated plan RCS leakage is modeled in MAAP4. The postulated seal leakage is 18 gpm per pump (consistent with NUMARC 87-00), which is 36 gpm from both pumps, plus the Technical Specification RCS leakage limit of 25 gpm (Technical Specifications 3.4.4). This results in a total RCS leakage of 61 gpm. RCS leakage is a function of reactor pressure. Leakage is modeled by establishing 61 gpm of leakage at the beginning of the MAAP4 sequence, and allowing the leakage to decrease with depressurization. At 1 hour, recirculation water pump inlet and outlet valves are closed when depressurization begins. This reduces primary system leakage from 61 gpm at full pressure to 25 gpm, which is the Technical Specification leakage limit.

ISE Confirmatory Item 3.2.1.3.A

Sequence of Events (SOE) - Confirm the SOE timeline after reanalysis using the MAAP code which will address the limitations when used for the ELAP analysis.

JAF Response:

The revised sequence of events timeline after reanalysis using the MAAP code addressing the limitations stated on the NRC endorsement letter is presented in the table below:

ID	Action Required	Elapsed Time After ELAP	Notes
1	RCIC and HPCI start	60 sec	Reactor Operators initiate or verify initiation of RPV water injection with steam driven high pressure pumps and enter SBO

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ID	Action Required	Elapsed Time After ELAP	Notes
			procedure
2	OPS manual control of SRVs to limit cycling	10 min	SRVs cycle on & off in safety-relief mode at their setpoints for 10 minutes. Conservative because operators trained to quickly take control.
3	Operate RCIC Stop HPCI Complete Initial Battery Load Shed	30 min	Current SBO procedure AOP-49
4	Defeat RCIC trips and interlocks Additional Load Shed Open fire doors for RCIC & HPCI Rooms	1 hrs	Current SBO procedure AOP-49
5	Attempts to start EDGs unsuccessful. Enter ELAP Procedure.	1 hrs	Entry into Extended Loss of AC Power (ELAP) provides guidance to operators for ELAP actions
6	Operators manually depressurize the RPV (during cooldown, reactor pressure is maintained between 600 – 400 psi).	1 hrs	Action required at approximately 1 hour, per MAAP analysis, to keep reactor pressure and temperature away from Unsafe Region of HCTL curve.
7	Open door RCIC Room door R-227-5 and prop open RCIC Room doors R-227-3 and R-227-4	1 hrs	Provide RCIC Room ventilation; Doors R-227-3 and R-227-4 have a fusible link that fails at 135°F, at approximately 19 hours
8	Complete ELAP DC Load Shed	1.5 hrs	Load shed completed to assure 9.5 hours of battery life (per load shed calc)

Interim Staff Evaluation Open Item and Confirmatory Item Responses

ID	Action Required	Elapsed Time After ELAP	Notes
9	Close 39IAS-25 and 39IAS-28	2 hrs	Necessary only if tornado event were to take out CAD Nitrogen Tanks.
10	Manual control of SRVs depressurize RPV (to approximately 200 – 400 psig)	2.5 hrs	Manual depressurization to 200 psig per the MAAP calculation.
11	Open RB Doors Open Doors R-369-1, R-369-2, R-272-1, and R-272-2	5 hrs	Provide ventilation for Refuel floor and other areas of RB
12	Open containment / HCV vent path	5.5 hrs	Containment / HCVS vent path opened at 10 psig Suppression Chamber pressure to allow this path
13	Reactor Building Hose Runs and manual actions for elevations above El. 272’	5.7 hrs	The reactor building elevations about El. 272’ reach a temperature of 120°F at a minimum of 5.7 hours. It is recommended that manual actions in those elevations be completed before this time.
14	FLEX DG power to Division A or Division B	8 hrs	From Battery Time to Discharge analysis with DC load shed. 9.5 Hrs. for both Batteries while powering critical loads. (calculation JAF-CALC-15-00045)
15	Open 76FDR-HB-272-2, -3, -4, -5, -6	10 hrs	Ventilation for battery room and DC Equipment Room Heat up during extreme heat ambient conditions.
16	Defeat RCIC suction auto-swap to suppression pool from CST.	16 hrs	Time based on time to reach auto swap point of 59.9 inches CST level in OP-19 and average flowrate in MAAP

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ID	Action Required	Elapsed Time After ELAP	Notes
			calculation (2 hour margin provided).
16a	First diesel refueling cycle for the FLEX DG	19 hrs	Time constraint based on fuel usage analysis.
17	Establish UHS (Lake Ontario) flow using DG Fire Pump direct to Vessel injection	22 hrs	Total capacity of CSTs determines this time. Protected sections of the CSTs hold minimum 200,000 gallons
18	Establish flow to SFP via one of three identified methods	24 hrs	Flow not required until approximately 32.7 hours to stop boiling
19	First diesel refueling cycle for Diesel Driven Fire Pump	30 hrs	Time constraint based on fuel usage analysis
20	Continue to operate the Diesel-Driven Fire Pump feeding the SFP and the Reactor from the UHS (Lake Ontario)	72 hrs	Continues until Phase 3 initiated and RHR loop shutdown cooling established by repowering an RHR pump and aligning the DG Fire Pumps for RHRSW.
21	Deploy NSRC generators	72 hrs	
22	Align DDFP for Shutdown Cooling (SDC) by placing one RHR pump in service	72 hrs	After NSRC generator is deployed
23	Deploy NSRC Compressor	72 hrs	

<u>ISE Confirmatory Item 3.2.1.4.A</u>

Systems and Components for Consequence Mitigation - Confirm sizing of the FLEX pumps and 600 Vac FLEX diesel generator (DG) and the 4160 Vac generator to be obtained from the RRC.

<u>JAF Response:</u>

Calculation JAF-CALC-15-00012, Rev.0, performs the hydraulic analysis for the Phase 2 FLEX strategy, which uses DDFPs 76P-1 or 76P-4 to provide flow for RPV and spent fuel pool (SFP)

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makeup via existing piping and hoses. The calculation demonstrates that the required flow rates to the RPV and SFP can be provided individually and also that the required flow rates can be provided to the RPV and SFP (pipe or hose or spray) combined. The flow rates listed below are demonstrated by the calculation.

- RPV makeup 150 gpm
- SFP (pipe) 50 gpm
- SFP (hose) 50 gpm
- SFP (spray) 287 gpm

The loading calculation (JAF-CALC-15-00031, Rev. 0) for the 600 VAC generators for Phase 2 and 4160 VAC generator(s) for Phase 3 have been completed. The calculations develop conservative estimates of the electrical loading requirements for both the 600 VAC and 4160 VAC portable generators. The electrical loads include those which supply key safety functions and other supplementary loads in support of the Phase 2 and Phase 3 FLEX strategies. The calculation has been developed in accordance with approved design processes that utilize appropriate design inputs for calculating electrical loads and the necessary considerations for use in sizing generators and their drivers (e.g., load starting requirements, voltage and frequency recovery requirements between applied loads, etc.). Loading and unloading of the generators will be controlled by procedure, based on vendor recommendations, to prevent overloading or tripping of the generators. In addition, through the use of a 480VAC to 600VAC step up transformer, the NSRC 480VAC generator can be used as a Phase 2 backup.

ISE Confirmatory Item 3.2.1.5.A

Monitoring Instrumentation and Controls-Confirm ac powered torus temperature, pressure and level and drywell temperature and pressure instrumentation is modified to remain powered during an ELAP.

JAF Response:

Exelon has re-examined the initially provided list of instrumentation and determined that it included parameters not required by NEI 12-06, Table 3-1. In accordance with NEI 12-06, Table 3-1, the following parameters require monitoring during an ELAP:

- RPV level
- RPV pressure
- Containment pressure
- Suppression pool temperature
- Suppression pool level
- Spent fuel pool level

Based on reanalysis, it has been determined that all required instrumentation has battery backup and no modifications are required to plant instrumentation. Per EC 52736 Rev. 0, Table 3-1, the following instrumentation is credited following an ELAP, along with the current power source:

- RPV level
  - 02-3LI-85A (Battery A)
  - 02-3LR-85B (Battery A)
  - 02-3LI-91 (Battery A)
  - 02-3LR-98 (Signal: Battery B; Recorder: Battery A)
- RPV pressure

- 06PI-61A (Battery A)
- 06PI-61B (Battery B)

- Containment pressure
  - 27PI-115A1,2 (Battery A)
  - 27PI-115B1,2 (Battery B)
- Suppression pool temperature
  - 16-1TR-131A (Battery A)
  - 16-1TR-131B (Battery B)
- Suppression pool level
  - 23LI-202A (Battery A)
  - 23LI-202B (Battery B)

A single train of these instruments will remain available following repowering of either the Division 1 or 2 battery chargers in Phase 2.

In addition, spent fuel pool level instrumentation design includes dedicated batteries for instrumentation per EC 52728.

ISE Confirmatory Item 3.2.1.8.A

Use of Portable Pumps - Confirm that the use of raw water from Lake Ontario for long term core and spent fuel pool cooling strategies is acceptable.

JAF Response:

Per EC 52736 Rev. 0, Section 3.1.43 and Attachment 6.007, BWROG report BWROG-TP-14-006, generically addresses the BWR concern of nuclear fuel located in the reactor pressure vessel overheating from fuel inlet flow blockage from debris when injecting raw water and concludes that, “The BWR fuel can be adequately cooled when the core inlet is postulated to be fully blocked from debris injected with the make-up coolant. The fuel is effectively cooled when the inside shroud is flooded, and this is accomplished by either injecting make-up coolant inside the shroud or by maintaining the water level above the steam separator return elevation if injecting make-up in the downcomer. The clogging effect of raw water debris can be mitigated by adopting strainer screens, similar to ECCS strainers.”

BWROG report BWROG-TP-15-007, addresses INPO concerns and incorporates information from other related industry raw water work. The position of this BWROG report is “that an additional evaluation of the raw water usage in BWRs beyond that contained in current industry guidance is not warranted.” It goes on to say, “to respond to the NRC audit question, BWRs have generally cited BWROG-TP-14-006 as the technical basis for their strategy.” The report addresses INPO’s concern that as a result of boiling in the core, dissolved and suspended solids could precipitate or settle out on the surface of fuel pins and/or lower regions in the core by concluding that PWR steam generator degradation by the same fouling mechanisms can be applied to a BWR reactor vessel, which has a greater volume and more surface area. Significant degradation in heat transfer capability is not anticipated.

The JAF FLEX strategy is consistent with the positions stated in BWROG-TP-14-006 and BWROG-TP-15-007. The Phase 2 RPV injection strategy pumps raw water with the 76P-1 or 76P-4 DDFP to the vessel through the RHR A or RHR B injection lines. The water level in the core and shroud will remain above the top of the fuel. Fire pump 76P-1 takes suction downstream of the traveling screens. Fire pump 76P-4 takes suction upstream of the traveling screens. The 76P-4 pump has a suction strainer to prevent suction of debris into the pump.

The Phase 3 RPV injection strategy is initiation of SDC, which recirculates water from the suppression pool/torus, through the RHR heat exchanger, back into the reactor, and untreated lake water is not involved.

ISE Confirmatory Item 3.2.2.A

Spent Fuel Pool Cooling - Confirm the method of ventilation and power requirements, if any, of the spent fuel pool area.

JAF Response

Calculation JAF-CALC-15-00025, “Reactor Building Heat Up during Extended Loss of AC Power”, requires doors RB369-1 and RB369-2 opened for overall ventilation of the reactor building, which includes the SFP. Manual vent exhaust duct valves and dampers can be also opened to provide additional vent path as defense in depth. The reactor building track bay doors on the 272’ level are opened to provide an air intake low in the building.

Per EC 52736, Rev. 0, Attachment 6.014, the reactor building track bay door can be opened manually with no power requirements.

ISE Confirmatory Item 3.2.4.2.A

Ventilation (Equipment Cooling) - Confirm that additional evaluations of the RCIC room temperature demonstrate that an acceptable environment is maintained during the transition phase both for equipment in the room and habitability for operators who may need to enter the room.

JAF Response

The heatup of the RCIC room is addressed in calculation JAF-CALC-15-00046, Rev. 0. The only required operator actions in the crescent area are to open door R227-5 at one hour after the event and to verify doors R227-3 and R227-4 and the intake and exhaust dampers do not fail closed prior to 15 hours. At ≥ 15 hr, the RCIC room may reach 135°F, which is the setpoint for the fusible links.

With the RCIC room doors/fire dampers open, RCIC room temperature remains below 150°F throughout the 24 hour evaluation period, therefore the EG-M will not be impacted due to room temperature during the initial 24 hours. Although room temperature is still increasing at 24 hours, the credited FLEX strategy only utilizes RCIC for less than 24 hours and it is not expected to continue operation past this point.

Stay times are very short and personnel protection concerns can be managed with existing procedures if required.

ISE Confirmatory Item 3.2.4.2.B

Ventilation (Equipment Cooling) - Confirm that evaluations of the battery room temperature demonstrate that an acceptable environment, during both high ambient temperature and during extreme cold ambient temperature, is maintained during Phases 2 and 3.

JAF Response

Calculation JAF-CALC-14-00027, Rev. 0, was developed to provide information on what recovery actions (if any) would be required to maintain habitability and operability of the equipment in the battery rooms and DC equipment rooms. The acceptance criterion for equipment operability is to maintain room temperature below the upper limit of 110°F during extreme hot summer ambient

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condition and above the minimum electrolyte temperature limit of 65°F during extreme cold winter ambient condition.

The calculation determined that during extreme heat conditions the room temperature will reach peak temperature of approximately 109°F at 120 hours after loss of AC power. Operator action is required to open the fire doors (76FDR-HB-272-2, 3, 4, 5 and 6) within 10 hours after the event. This action is incorporated into the FLEX response procedures. The maximum temperature given above includes this operator action.

The calculation also determined that during extreme cold conditions the temperature in the battery room “A” approaches 66.7°F at 120 hours and the temperature in the battery room “B” approaches 65.7°F at 120 hours. The room temperature of both battery rooms remains above the battery minimum electrolyte temperature limit of 65°F. During extreme cold winter ambient condition, no operator action is required for FLEX mitigation strategies.

Per EC 52736, section 3.1.20, and Attachment 6.033, following 120 hours, NSRC equipment can be used to repower installed ventilation equipment to cool or heat these areas as needed. The battery room ventilation system is QA Category I.

ISE Confirmatory Item 3.2.4.2.C

Ventilation (Equipment Cooling) - Confirm the required ventilation flow or the size of the portable fans to maintain acceptable environmental conditions in the DC equipment room.

JAF Response

Calculation JAF-CALC-14-00027, Rev. 0, was developed to provide information on what recovery actions (if any) would be required to maintain habitability and operability of the equipment in the battery rooms and DC equipment rooms. The acceptance criterion for equipment operability is to maintain room temperature below the upper limit of 110°F during extreme hot summer ambient condition per guidance of NUMARC 87-00.

The calculation determined that during extreme heat conditions the room temperature will reach peak temperature of approximately 109°F at 120 hours after loss of AC power. Operator action is required to open the fire doors (76FDR-HB-272-2, 3, 4, 5 and 6) within 10 hours after the event. This action is incorporated into the FLEX response procedures. The maximum temperature given above includes this operator action.

Therefore no portable fans are used to assist with ventilation of the DC equipment rooms during ELAP events as the temperature does not exceed the acceptance criterion for equipment operability or habitability.

Per EC 52736, section 3.1.20, and Attachment 6.033, following 120 hours, NSRC equipment can be used to repower installed ventilation equipment to cool or heat these areas as needed. The battery room ventilation system is QA Category I.

ISE Confirmatory Item 3.2.4.3.A

Heat Tracing - Confirm completion of walkdowns and evaluation of where heat tracing may be needed for freeze protection of equipment or instruments used in the ELAP mitigation strategies.

JAF Response

Per calculation JAF-CALC-15-0030, Rev. 0, during a BDBEE, the DDFPs will take water from the screenwell and provide makeup to the SFP and the RPV. Hoses are utilized to transfer water from the pump outlets to the plant for makeup to the SFP and the RPV. A section of the hose runs through the screenwell building. The screenwell building is an uninsulated metal frame building. Flow is initiated through the DDFPs approximately 24 hours after power is lost due to the FLEX event. By that time, the temperature in the screenwell building is expected to drop to near the outdoor temperature. The hose has the potential to freeze if the ambient temperature is low enough, particularly the section of hose running through the screenwell building.

Calculation JAF-CALC-15-00030 determined the duration of time until stagnant water within the hoses freeze and determined the minimum flow rate at which the water will remain unfrozen. During extreme cold conditions, the flow rates in hoses are maintained above the values determined by this calculation to prevent freezing. If flow through a hose is stopped for a period of time, the hose is drained to prevent the stagnant water from freezing.

The calculation also determined the time it takes the water in the CST to reach 32°F and the amounts of ice accumulation.

Based on the results of this calculation and per EC 52736 Section 3.1.39, no heat tracing is needed for the JAF FLEX strategy

ISE Confirmatory Item 3.2.4.4.A

Lighting - Confirm need for additional portable lighting, such as dc powered lights.

JAF Response

Per Section 3.1.40 of EC 52736, part of the standard gear/equipment of operators with duties in the plant (outside the main control room) includes flashlights; flashlights would be available to operations personnel immediately following the start of the event. This requirement is currently in plant procedure EN-OP-115, Operator Rounds. Additionally, the reactor building, turbine building, and screenwell building are provided with 8 hour uninterruptible power supply (UPS) backed Appendix R lighting. The use of flashlights will provide enough illumination to accomplish FLEX manual operator actions. FLEX support guidelines have been prepared as necessary to address lighting requirements during the ELAP.

ISE Confirmatory Item 3.2.4.4.B

Communications - Confirm that upgrades to the site's communication system have been completed.

JAF Response

Per EC 53903, Rev. 0, portable radios will be used for communications between control room staff and operators/emergency personnel in the plant. This method of communication was described in the FitzPatrick Nuclear Power Plant response to the 10 CFR 50.54(f) information request for NTTF Recommendation 9.3, Emergency Preparedness Communications. The NRC reviewed and found the FitzPatrick communication assessment to be reasonable and that existing systems, enhancements, and interim actions would ensure communications are maintained consistent with the assumptions in NRC-endorsed guidance of NEI 12-01. The conclusion is documented in a letter addressed to FitzPatrick Nuclear Power Plant titled, "James A. FitzPatrick Nuclear Power Plant – Entergy Nuclear Operations Inc's. Response to U.S. Nuclear Regulatory Commission's request for information regarding Near Term Task Force Recommendation 9.3," dated May 15, 2013, ADAMS Accession No. ML13123A203.

The modifications included installing uninterruptible power supplies that lasts at least 19 hours to power the communications equipment with the ability to be repowered by a Phase 2 portable diesel generator prior to battery depletion. In addition, a survey was performed during development of the engineering change that shows that reception is very good at various locations and dead spots will not be a concern.

<u>ISE Confirmatory Item 3.2.4.8.A</u>

Electrical Power Sources - Confirm the technical basis for the selection and size of the FLEX generators to be used in support of the coping strategies.

<u>JAF Response</u>

Per EC 52736, Rev. 0, Section 3.1.34, Calculation JAF-CALC-15-00031 determines the load required and appropriately sizes the Phase 2 and Phase 3 FLEX generators based on the required FLEX strategy needs. The calculation determines that the most conservative Phase 2 electrical load is 148 kW. One 200 kW generator (176 KW continuous Prime Rating) is used to support the Phase 2 strategy. (Two generators are purchased, and one is stored in each FESB.) The calculation determines that the most conservative Phase 3 electrical load is 1208 kW.

Two NSRC generators (1 MW each) can be used to support the Phase 3 strategy of plant recovery. Per EC 52736, Rev. 0, the 1000 kW NSRC 480VAC diesel generator and 480VAC to 600 VAC step up transformer are adequate to backup the Phase 2 generator.

<u>ISE Confirmatory Item 3.2.4.10.A</u>

Load Reduction to Conserve DC Power - Confirm final load shed list and the evaluation of any potential adverse effects of shedding those loads.

<u>JAF Response</u>

EC 52736, Section 3.1.19 and JAF-CALC-15-00045 address load shedding.

Per EC 52736, Section 3.1.19, station service batteries A and B were evaluated in calculation JAF-CALC-15-00045 to determine their discharge capacity during an ELAP event. For this event, the batteries were evaluated after shedding non-essential loads identified in Appendix C of this calculation to maximize battery discharge time. This calculation started with load shedding employed by station blackout (SBO) procedures for 1 hour and then considered further load shedding accomplished within the subsequent 30 minutes for Battery A. This calculation showed that based on the assigned load shedding, Battery A lasts 9.5 hours and Battery B lasts 10 hours following an ELAP event. The loads that are shed are provided in calculation JAF-CALC-15-00045.

Two cases have been created to evaluate discharge times for Batteries A and B. Case 1, pertaining to Batteries A and B, evaluates shedding non-essential loads at 90 minutes. Case 2, only pertaining to Battery A, evaluates a deeper load shed which removes all loads not associated with the RCIC System at 90 minutes. For Case 2, one train of critical instruments and the Control Room emergency lights remain available on Battery B.

The 600 VAC FLEX DG must be connected at approximately 8 hours after the initial loss of power, because of the limiting discharge time of the division batteries.

A minimum cell voltage of 1.878V (=112.65 V/60 cells) is used for Battery A GNB NCN-35 and 1.838V (=110.26 V/60 cells) for Battery B GNB NCN-35 (2552 Ah @ 8 hr rate to 1.75 Vpc). This accounts for minimum operating voltages needed in Train A and Train B.

<u>ISE Confirmatory Item 3.2.4.10.B</u>

Load Reduction to Conserve DC Power - Confirm the final dc load profile with the required loads and the finalized minimum battery voltage.

Interim Staff Evaluation Open Item and Confirmatory Item Responses

JAF Response

EC 52736, Section 3.1.19 and JAF-CALC-15-00045 address load shedding and the resulting DC load profile. The minimum battery voltage of 112.65V is maintained throughout the event.

ISE Confirmatory Item 3.2.4.10.C

Load Reduction to Conserve DC Power- Confirm time after the ELAP for connecting the FLEX DG to the battery chargers.

JAF Response

See response to CI 3.2.4.10.B. The Phase 2 portable diesel generator is aligned to either battery charger by 8 hours following the event to maintain adequate DC bus voltage.

ISE Confirmatory Item 3.4.A

Off-site Resources- Confirm that NEI 12-06, Section 12.2 guidelines 2 through 10 are addressed, or that an appropriate alternative is justified.

JAF Response

Document 38-9247576, Revision 1, SAFER Response Plan for James. A FitzPatrick Nuclear Power Plant, provides the evaluation to ensure that the NSRC supplied equipment meets the guidelines specified in NEI 12-06 sections 12.2 items 2 through 10.

JAFP-17-0083

Enclosure

Final Integrated Plan

(91 Pages)

FINAL INTEGRATED PLAN DOCUMENT

James A. FitzPatrick NUCLEAR POWER PLANT

AUGUST 2017

Table of Contents

1. Background

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

The US Nuclear Regulatory Commission (NRC) assembled a Near-Term Task Force (NTTF) to advise the Commission on action the US nuclear industry should take to preclude core damage and a release of radioactive material after a natural disaster such as that seen at Fukushima. The NTTF report (Reference 3.1) contained many recommendations to fulfill this charter, including assessing extreme external event hazards and strengthening station capabilities for responding to beyond-design-basis external events (BDBEE).

The strategies for coping specify a three-phase approach for strategies to mitigate BDBEEs:

- Phase 1 - The initial phase requires the use of plant equipment and resources to maintain or restore core cooling, containment and spent fuel pool cooling capabilities.
- Phase 2 – This phase is the augment or transition phase from plant equipment to on-site FLEX equipment and consumables to maintain or restore these functions.
- Phase 3 – In this phase, the plant obtains additional capability and redundancy from off-site FLEX equipment until power, water and coolant injection systems are restored or commissioned.

The Nuclear Energy Institute (NEI) developed NEI 12-06 (Reference 3.3 which was endorsed by NRC – Reference 3.97) in response to NRC Order EA-12-049 (Reference 3.2), which provides guidelines for nuclear stations to assess extreme external event hazards and implement the mitigation strategies. NRC Order EA-12-049 was prompted by NTTF Recommendation 4.2 (Reference 3.1)

NRC Order EA-12-051 (Reference 3.5) required licensees to install reliable Spent Fuel Pool (SFP) instrumentation with specific design features for monitoring SFP water level. This order was prompted by NTTF Recommendation 7.1 (Reference 3.1).

NEI 12-02 (Reference 3.6) provided guidance for compliance with Order EA-12-051. The NRC determined that, with the exceptions and clarifications provided in JLD-ISG-2012-03 (Reference 3.7), conformance with the guidance in NEI 12-02 is an acceptable method for satisfying the requirements in Order EA-12-051.

NRC Order EA-13-109 (Reference 3.8) required Boiling Water Reactors with Mark 1 or Mark 2 containment designs to install containment vents capable of operating under severe accident conditions.

NEI 13-02 (Reference 3.9) provided guidance for compliance with Order EA-13-109. The NRC determined that, with the exceptions and clarifications provided in JLD-ISG-2015-01 (Reference 3.10), conformance with the guidance in NEI 13-02 is an acceptable method for satisfying the requirements in Order EA-12-109.

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

2.1 General Elements

2.1.1 Assumptions

The assumptions used for the evaluations of a James A. FitzPatrick Nuclear Plant (JAF) ELAP/loss of ultimate heat sink (LUHS) event and the development of diverse and flexible coping strategies (FLEX) are stated below.

Key assumptions associated with implementation of FLEX strategies for JAF are described below:

- Flood re-evaluation pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 (Reference 3.11) has been completed and submitted to the NRC on March 12, 2015 (Reference 3.17). Where appropriate, re-evaluated flood information have been considered and incorporated into the modifications implementing the FLEX strategies.
- The following conditions exist for the baseline case:
  - o Seismically designed dc battery banks are available.

- All installed AC and DC distribution that is seismically designed should be considered available. This include 600 and 4160 VAC distribution. This is consistent with NEI 12-06.
- Plant initial response is the same as station black-out (SBO) event.
- No additional failures of safety-related systems, structures and components (SSC) assumed except those in the base assumptions, i.e., ELAP and LUHS. Therefore, the steam-driven reactor core isolation cooling (RCIC) pump will operate either via automatic control or with manual operation capability per the guidance in NEI 12-06 Revision 4.

- Portable FLEX components are procured commercially and tested or evaluated, as appropriate, for environmental conditions.
- The design hardened connections are protected against all external events.
- Implementation strategies and roads are assessed for hazards impact.
- All Phase 2 components are stored at the site and are protected against the "screened-in" hazards in accordance with NEI 12-06. At least N sets of equipment that directly support maintenance of a key safety function will be available after the event.
- Additional staff resources are expected to arrive beginning at 6 hours and the site will be fully staffed 24 hours after the event. The FLEX strategy can be implemented through Phase 1 with only on-site resources if necessary.
- Maximum environmental room temperatures for habitability or equipment availability is based on NUMARC 87-00 (Reference 3.18) guidance if other design basis information or industry guidance is not available. Extreme high temperatures are not expected to impact the utilization of off-site FLEX equipment or the ability of personnel to implement the required FLEX strategies.
- This plan defines strategies capable of mitigating a simultaneous loss of all ac power and LUHS resulting from a BDBEE by

providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities. Though specific strategies have been developed, due to the inability to anticipate all possible scenarios, the strategies are also diverse and flexible to encompass a wide range of possible conditions. These pre-planned strategies developed to protect the public health and safety are incorporated into the unit emergency procedures and guidelines in accordance with established change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59.

The plant Technical Specifications contain the limiting conditions for normal unit operations to ensure that design safety features are available to respond to a design basis accident and direct the required actions to be taken when the limiting conditions are not met. The result of the BDBEE may place the plant in a condition where it cannot comply with certain Technical Specifications and/or with its Security Plan, and, as such, may warrant invocation of 10 CFR 50.54(x), 10 CFR 73.55(p) and/or 10 CFR 72.32(d). (Reference 3.19)

- NEI 12-06, Section 3.2.1, General Criteria and Baseline Assumptions:
    - The assumptions listed in NEI 12-06, Section 3.2.1, are applicable to the strategies developed for JAF

2.2 FLEX Strategies

The objective of the FLEX strategies is to establish an indefinite coping capability in order to 1) prevent damage to the fuel in the reactors, 2) maintain the containment function and 3) maintain cooling and prevent damage to fuel in the SFP using plant equipment, FLEX equipment, and off-site FLEX equipment. This indefinite coping capability will address an ELAP (loss of off-site power, emergency diesel generators and any alternate ac source (as defined in 10 CFR 50.2) but not the loss of ac power to buses fed by station batteries through inverters) with a simultaneous LUHS. This condition could arise following external events that are within the existing design basis with additional failures and conditions that could arise from a beyond-design-basis external event.

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

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

- Phase 1 – Initially cope by relying on plant equipment and on-site resources. (from hour zero to approximately hour 8 after the event)
- Phase 2 – Transition from plant equipment to on-site FLEX equipment. (hour 8 through hour 24 after the event)
- Phase 3 – Obtain additional capability and redundancy from off-site FLEX equipment and resources until power, water, and coolant injection systems are restored or commissioned. (more than 24 hours after the event)

The strategies described below are capable of mitigating an ELAP/LHUS resulting from a BDBEE by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities at JAF. Though specific strategies have been developed, due to the inability to anticipate all possible scenarios, the strategies are also diverse and flexible to encompass a wide range of possible conditions. These pre-planned strategies developed to protect the public health and safety are incorporated into the JAF emergency operating procedures in accordance with established EOP change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59.

2.3 Reactor Core Cooling and Heat Removal Strategy

During the first 22 hours after shutdown caused by the BDBEE, the reactor remains isolated and pressurized with the steam-driven RCIC pump providing core cooling, drawing water from the condensate storage tanks (CSTs). Steam from the reactor pressure vessel (RPV) will drive the RCIC turbine and will be vented through the main steam safety relief valves (SRVs) to the suppression pool to remove decay heat and to begin to depressurize the RPV to maintain operation in the safe region of the heat capacity temperature limit (HCTL) curve.

The operator is directed to take steps to minimize the load on the station batteries by shedding unnecessary loads in accordance with station SBO procedures; load shedding is completed by 1.5 hours ensuring the station batteries are available for a minimum of 9.5 hours at which time the FLEX diesel generator (DG) is available to repower the station battery chargers.

During the first hour after the ELAP, operators will take manual control of reactor pressure within 10 minutes. When the suppression pool temperature approaches the unsafe region of the heat capacity temperature limit (HCTL) curve a rapid cooldown will be performed (≤100°F/hr). Reactor pressure is maintained sufficiently high (200-400 psig) to preserve motive force for the RCIC turbine.

As containment pressure approaches 10 psig at 5.5 hours, a containment vent path is opened to minimize containment pressure and limit the overall increase in suppression pool temperature.

At approximately hour 22, core cooling is transitioned to one of the plant diesel-driven fire pump (DDFP) with suction from the ultimate heat sink(UHS) (Lake Ontario) prior to depletion of the CST's. Installation of temporary pipe adapters and fire hoses, combined with completion of local valve alignments enables either one of the plant DDFPs to inject water into the RPV to maintain RPV level. RPV depressurization to approximately 50 psig will allow RPV injection with the DDFP for RPV makeup and core cooling.

As mentioned above, the plant DDFP can maintain core cooling indefinitely until recovery actions using National SAFER Response Center (NSRC) equipment are implemented.

2.3.1 Phase 1 Strategy

At the initiation of the BDBEE, main steam isolation valves (MSIVs) automatically close, feedwater is lost, and SRVs automatically cycle to control pressure, causing reactor water level to decrease. When reactor water level reaches the reactor pressure vessel low-low water level, RCIC and high-pressure coolant injection (HPCI) automatically start with suction from the CSTs and operate to inject makeup water to the reactor pressure vessel (RPV). The CSTs are a robust source of water with approximately 192,000 gallons (96,000 gallons/tank) available for the BDBEE (Reference 3.34). After the initial recovery of reactor water inventory, operators will manually secure HPCI at approximately 30 minutes into the event to minimize load on the station battery and rely on RCIC for reactor core cooling.

The RCIC system will continue to operate after the reactor level returns to the normal band. During the first 22 hours after shutdown, the reactor remains isolated and pressurized with RCIC providing the core cooling, drawing water from the CSTs.

The SRVs control reactor pressure and operators will take manual control of reactor pressure by approximately 10 minutes to stabilize pressure below 1080 psig in accordance with EOP-2 (Reference 3.43). Manual control consists of cycling one SRV at a time, alternating SRVs to allow equal usage and to distribute heat in the suppression pool (or torus). When operators determine that an ELAP is in progress and/or when torus temperature approaches the unsafe region of the heat capacity temperature limit (HCTL) curve, they will begin to reduce reactor pressure to a pressure range that provides margin to the unsafe region of the HCTL curve. This depressurization is performed at a cooldown rate of ≤ 100 °F/hr. In accordance with recent Boiling Water Reactor Owners Group (BWROG) guidance (Reference 3.44), depressurization is to be halted and controlled at a range that would support continued RCIC operation, because the steam-driven RCIC is the preferred means of core cooling (e.g., 200 – 400 psig). This reactor pressure is sufficient to preserve steam for RCIC operation while minimizing challenges to the HCTL curve. The RCIC trip signals and isolation signals that could possibly prevent RCIC operation when needed during the ELAP will be overridden in accordance with procedural direction (Reference 3.41).

The operators are directed to take steps to minimize the load on the station batteries by shedding unnecessary loads in accordance with station SBO procedures (Reference 3.25). One hour into the event, the determination that the emergency diesel generators (EDGs) cannot be restarted is made and the operating crew classifies the event as a beyond-design-basis event and anticipates a loss of power for an extended time period.

The BWROG has performed RCIC studies (References 3.31, 3.32 and 3.33) that assess the operation of the RCIC system for long term operation at elevated suppression pool temperatures. For the successful implementation of the JAF FLEX Strategy, the RCIC system is operated for approximately 22 hours total time without reliance on the water inventory in the suppression pool, therefore suppression pool temperature increase does not limit RCIC availability. Short term operation of RCIC at elevated temperatures is considered well within the capabilities of the system, and therefore the suppression pool water inventory provides additional defense in depth to the CST's but is not specifically credited for the FLEX strategy. Since the credited suction source for RCIC is the CST's, suppression pool water temperature and containment pressure have no direct impact on net positive suction head (NPSH) for RCIC.

At approximately 22 hours after shutdown the inventory of water available in the CST's may be depleted (Reference 3.34). At this time the core cooling strategy will transition from RCIC to one of the two plant DDFPs (76P-1 or 76P-4) (see Figure 1), which will draw water from the UHS (Lake Ontario) and inject it to the reactor vessel via a hose connection to the residual heat removal service water (RHRSW) system. An alternate FLEX injection can be implemented using the other DDFP (Figure 1).

Electrical/Instrumentation – Load stripping of all non-essential loads would begin within 1 hour after the occurrence of an ELAP/LUHS and completed within the next 30 minutes. With load stripping, the useable station Class 1E battery life is calculated to be approximately 9.5 hours for the station batteries. (See Section 2.3.11)

2.3.2 Phase 2 Strategy

Primary Strategy Core Cooling

Prior to the depletion of the CST, JAF will establish the flow path from one of the seismically-qualified DDFP, 76P-1, to provide makeup of 150 gpm to the RPV. This flow rate bounds the boil off rate and the seal leakage rate (Reference 3.34). Because the DDFPs are low pressure pumps, the RPV will be depressurized to approximately 50 psig using manual control of SRVs prior to establishing this method of core cooling. A pre-staged hose will be used to connect the fire protection system to the RHRSW system at valve 10RHR-432 (see Figure 1). RHRSW system is then connected to the residual heat removal (RHR) system through the cross-connect flow path by opening valves 10MOV-148A and 10MOV-149A. RPV injection is accomplished via the "A" loop of the normal RHR injection flow path through valves 10MOV-27A and 10MOV-25A.

The strategy for this transition phase (Phase 2) will be capable of maintaining core cooling capabilities from the time it is implemented until off-site FLEX equipment is provided in the final phase.

A hydraulic calculation (Reference 3.26) was prepared to confirm that DDFPs can provide required flow through the RHR and RHRSW system flow path to the RPV.

The RPV makeup will transition from RCIC drawing water from the CST to the DDFP drawing water from Lake Ontario. Section 2.3.10.2 addresses the impact on the use of raw water.

Alternate Strategy Core Cooling

The alternate flow path to provide makeup to the RPV is from the other plant DDFP, 76P-4. To provide connections for this alternate flow path two adapter pieces are required to be connected to the existing piping system. The first new adapter piece, which is stored in the 76P-4 pump room, will be attached to the 12-inch flange downstream of the discharge of the pump. Fire hose will be attached to the adapter piece and run to the RHRSW pump room. Expansion joint 10EXJ-4B on the discharge of RHRSW pump 10P-1B will be removed and replaced with the second adapter piece with a hose connection. The hose from the discharge of pump 76P-4 will be connected to the RHRSW pump discharge. The RHRSW system is then connected to the RHR system through the cross-connect flow path by manually opening valves 10MOV-148B and 10MOV-149B. RPV injection is then accomplished via the B loop of the normal RHR injection flow path by manually opening valves 10MOV-25B and 10MOV-27B (Figure 1).

The primary and alternate flow paths for Phase 2 injection are completely independent of one another; they share no common piping. In addition, the primary and alternate flow paths for Phase 2 are capable of being cross-connected. In addition, the NSRC supplied low pressure medium flow pump with the suction lift booster pump can be used as backup to the Phase 2 strategies described above.

Primary Strategy to Repower Battery Chargers

The primary strategy is to connect the pre-staged 600 VAC FLEX diesel generator (located in the "N" FLEX equipment storage building (FESB)) to the Division I electrical distribution system. The 600 VAC FLEX DG is connected to safety related, seismic Category I motor control center

(MCC) located in the South EDG Switchgear Room (71MCC-254). This MCC is directly connected to 71MCC-252 which provides power to Battery A charger. The 600 VAC FLEX DG will be connected to the MCC bus using a modified MCC bucket with receptacles to receive the power cables from the 600 VAC FLEX DG (Figure 2).

Additionally, should the pre-staged 600 VAC FLEX DG located in the "N" FESB be unavailable, the deployable 600 VAC FLEX DG stored in the "N+1" FESB would be located adjacent to the "N" FESB and connected as described above.

Alternate Strategy to Repower Battery Chargers

The alternate strategy provides for connecting the deployable 600 VAC FLEX DG stored in the "N+1" FESB to the Division II electrical distribution system. The "N+1" 600 VAC FLEX DG is connected to safety related, seismic Category I MCC located in the North EDG Switchgear Room (71MCC-264). This MCC is directly connected to 71MCC-262 which provides power to Battery B charger. The 600 VAC FLEX DG will be connected to the MCC bus using a modified MCC bucket with receptacles to receive the power cables from the 600 VAC FLEX DG (Figure 3).

FLEX Diesel Generator Deployment Strategy

Transition from Phase 1 (reliance on station batteries) to Phase 2 (repowering station battery chargers) will be made using a 600 VAC FLEX DG(s) to supply power to the MCCs as described above. There are two 600 VAC FLEX DGs available for the site. The "N" 600 VAC FLEX DG is a fixed installation inside the "N" FESB on the north side of the Screenwell Building. This "N" 600 VAC FLEX DG has been provided with a ventilation package to remove diesel exhaust from the "N" FESB during operation. The "N+1" 600 VAC FLEX DG is a "portable" unit that is stored outside the Protected Area (PA) in the "N+1" FESB and can be deployed if necessary. Both generators are rated at 200 kW, 600VAC, 3 phase (Reference 3.45). The expected load during Phase 2 is approximately 148 KW/203 KVA (Reference 3.45). The phase rotation check on the bus was conducted during Refuel Outage RF22 and phases were color coded. The FLEX DG cable connection will be performed per FSG-001 Attachment 4 (Reference 3.72). Electrical isolation when connecting the FLEX DG will be maintained per actions as described in FSG-002 (Reference 3.81).

2.3.3 <u>Phase 3 Strategy</u>

The strategy for Phase 3 is to continue with use of the DDFPs for makeup to the RPV. As additional capability, the NSRC medium flow/low pressure pump combined with the NSRC suction lift booster pump can be deployed as backup to the DDFPs (note: an identical submersible portion of the lift booster pump is stored in the Screenwell Building Since the "as supplied" NSRC pump cart (includes pump head, floating strainers, framework, etc.) is dimensionally too large to fit in the trash rack opening located inside the Screenwell Building). This strategy can continue indefinitely and is only limited by fill rate to the torus (potential cover-up of the containment vent path) barring any action to adjust makeup rate to match vent mass flow rate. Based on the Modular Accident Analysis Program (MAAP) analysis (Reference 3.34), significant time is available before the containment vent path is challenged due to torus water level increase (at least 60 days (Reference 3.49, Attachment 6.023). To support long term plant recovery, the NSRC medium flow/low pressure pump (with suction lift booster pump) can be placed in service to provide cooling water flow to the RHR heat exchangers for one loop of RHR shutdown cooling (SDC).

This can be accomplished by powering up the opposite Class 1E bus from that being fed by the 600 VAC FLEX DG utilizing the NSRC 4160 VAC FLEX gas turbine generators supplied by the NSRC (Figures 4 and 5). The need to use both NSRC generators on the same bus to pick up the required loads has been evaluated. It is determined that two 1 MW, 4160VAC diesels will be necessary to support the starting requirements of the RHR pump motor. Repowering either bus provides power to an RHR pump that can provide flow to the respective divisional RHR heat exchanger. One of the seismically qualified DDFPs (76P-1 or 76P-4) or the NSRC low pressure-medium flow pump in conjunction with the NSRC suction lift booster pump (Figure 1) will be used to provide lake water to the tube side of the heat exchanger of the RHR division that is selected to receive the cross-connect flow. If the primary strategy, RHR Division I (or Division II) is unavailable, the alternate strategy is to power the opposite division RHR Division II (or Division I) to provide shutdown cooling.

2.3.4 Systems, Structures, Components

2.3.4.1 Reactor Core Isolation Cooling (RCIC)

The RCIC system consists of a steam turbine-driven pump designed to supply water from the CST to the vessel via a feedwater line and spargers. It utilizes reactor steam to drive the turbine which is exhausted into the suppression pool.

The RCIC system automatically starts when reactor water level reaches the RPV low-low water level following an ELAP/LUHS event. The RCIC suction is from the CST and operates to inject makeup water to the RPV. RCIC pump injection rate can be controlled by manual speed control of the RCIC turbine or in conjunction with other recommended options (Reference 3.49, Attachment 8.004). The RCIC system operates completely independent of ac power, plant service air and external cooling water systems.

The RCIC system is designed to operate with reactor pressure between 150 psig and 1195 psig. It has makeup capacity sufficient to prevent the reactor vessel water level from decreasing to the level where the core would be uncovered.

The RCIC system can also be manually started and operated with a loss of ac and dc power in accordance with JAF procedure TSG-8, Extending Site Black-Out Coping Time, Starting an EDG/Injecting to Vessel with No dc Power Available (Reference 3.65).

The RCIC pump and turbine are augmented quality components, and are housed in a seismic Category I structure, therefore, is protected from all BDBEE.

2.3.4.2 Safety Relief Valves

During an ELAP/LUHS event, with the loss of all ac power and instrument air compressors, SRVs automatically cycle to initially control reactor pressure.

The primary method of reactor pressure control following an ELAP is by operation of the SRVs. Operator control of reactor pressure using SRV requires dc control power and pneumatic pressure (supplied by station batteries and the drywell pneumatic system). During Phase 1 of the FLEX strategy, the power for the SRVs is supplied by the station batteries, and the nitrogen contained in the system piping supplies pneumatic pressure for SRV operation. Also, each SRV is provided with an accumulator to operate the valve for a set number of cycles.

The number of actuations of the SRVs is described in the containment analysis (Reference 3.34). This analysis determined that a total of 127 SRV actuations are required for a period of 120 hours. For non-tornado events, the CAD tanks provides more than adequate nitrogen supply for the duration of the event. The CAD tanks are not protected from tornado missiles, so for a tornado event, supplemental air is required. An analysis (Reference 3.46) determined that the number of SRV actuation cycles required by the FLEX strategy can be performed if valves 39IAS-25 and 39IAS-28 are closed within two hours of the start of the event if the CAD nitrogen tanks are unavailable due to a tornado missile. This action is controlled by FSGs. Administrative controls ensure that only 2-stage SRV's are used for pressure control. The analysis determined that the available nitrogen would be depleted after 72 hours. After this period of time a compressor from the NSRC will be available.

An evaluation of the main steam SRV solenoid operated valves and supporting equipment during an ELAP determined that these components will continue to function as expected throughout the event (Reference 3.49, Attachment 6.037).

2.3.4.3 Suppression Pool

The suppression pool (torus) is the heat sink for reactor vessel SRV discharges and RCIC turbine steam exhaust following a BDBEE. It is also an alternate suction source for the RCIC pump.

The design basis for the pressure suppression pool, which is contained in the pressure suppression chamber, is to initially serve as the heat sink for any postulated transient or accident condition in which the normal heat sink, main condenser, or shutdown cooling system is unavailable. Energy is transferred to the pressure suppression pool by either the discharge piping from the reactor pressure relief valves or the drywell vent system. The relief valve discharge piping is used as the energy transfer path for any condition which requires the operation of the relief valves. The drywell vent system is the energy transfer path for all energy releases to the drywell.

The pressure suppression pool receives this flow, condenses the steam portion of this flow, and releases the non-condensable gases and any fission products to the pressure suppression chamber air space. The condensed steam and any water carryover cause an increase in pool volume and temperature. Energy can be removed from the suppression pool when the residual heat removal system (RHR) is operating in the suppression pool cooling mode. During a BDBEE energy is removed from the suppression pool by utilization of the suppression pool vent which vents the suppression pool to atmosphere.

The suppression pool water volume is maintained per LCO 3.6.2.2 of the Technical Specifications (Reference 3.23).

2.3.4.4 Condensate Storage Tanks

The design of the CSTs ensures that at least 192,000 gallons of water are protected against all BDBEE and will be available to RCIC for injection into the reactor vessel (Reference 3.34). The CST volumes are expected to be able to support reactor pressure vessel makeup for approximately 22 hours without any replenishment of the CST.

2.3.4.5 Diesel-Driven Fire Pumps

Existing DDFPs will be employed to provide direct injection to the RPV during Phase 2. The pumps are located in separate bays of the seismic Category I Screenwell Building (Reference 3.48). The DDFPs are powered by internal combustion, diesel fueled engines, utilize 24V battery powered control and starting systems, and are each located in a separate fire rated room. Sufficient fuel is provided to allow each DDFP to operate for at least 8 hours without refueling. Fuel is stored in a fuel tank located in each diesel fire pump room.

Both DDFPs, associated piping and fuel tanks are seismically robust and surrounded by concrete block walls (Reference 3.48 and Reference 3.49, Attachments 6.002, 6.010 and 6.011). The block walls enclosing each fire pump are evaluated by calculation JAF-CALC-15-00011 (Reference 3.88) and are shown to survive a seismic event up to the re-evaluated GMRS. The pumps and associated piping are evaluated in Reference 3.49. Therefore, the DDFPs will be available following a BDBEE.

In order to achieve the required flows in the system during Phase 2 and Phase 3 a combination of orifice plates and throttle valves are used. The orifice plates will handle the majority of the pressure drops required for flow balancing with the remaining required pressure drops typically between 0 and 20 psi which can be handled by the ball valves to be installed in the hoses. For those few cases that require pressure drops greater than 20 psi, these can be handled by the ball valves in the hoses, or the throttle valves, or a combination of both (Reference 3.49, Attachment 6.022).

2.3.4.6 Ultimate Heat Sink

At approximately hour 22, transition from RCIC to FLEX equipment (Phase 2) for the low pressure core cooling function occurs by placing the DDFPs in service with injection from the UHS.

The UHS for the site comes from Lake Ontario and is accessed by DDFPs via the intake bay. The large volume of Lake Ontario is sufficient to provide water makeup indefinitely.

2.3.4.7 Batteries

The safety related batteries and associated dc distribution systems are located within safety related structures designed to meet applicable design basis external hazards and will be used to initially power required key instrumentation and applicable dc components. Load shedding of non-essential equipment provides an estimated total service time of approximately 9.5 hours of operation (Reference 3.47). Reference 3.47 evaluated the battery discharge capacity following the guidance endorsed by the NRC, included in Section 3.1.2.13 of NEI 12-06.

2.3.5 FLEX Connections

2.3.5.1 Primary Core Cooling Phase 2 Connection Point

Prior to transition to the Phase 2 core cooling strategy, at approximately 22 hours after shutdown, a DDFP (76P-1) will be aligned to allow injection to the RPV. The flow path from the DDFP for RPV makeup is established using a pre-staged hose to connect the fire protection system and the RHRSW system (at valve 10RHR-432). The RHRSW system is then connected to the RHR system through the cross-connect flow path. RPV injection is then accomplished via the "A" loop of the normal RHR injection flow path. The hose connection is located on the fire protection piping in the Screenwell Building, a seismic Category 1 structure. The piping credited in the FLEX strategy is isolable from the remainder of the system piping. Non-seismic components will be closed, if necessary, to isolate the non-seismic fire protection piping to prevent a piping failure from adversely affecting the capabilities of the seismic piping to deliver cooling water to the RPV (Figure 1). A hydraulic calculation was performed to demonstrate the feasibility of the flow path (Reference 3.26).

2.3.5.2 Alternate Core Cooling Phase 2 Connection Point

In the event that the primary Phase 2 core cooling strategy is not available, an alternate connection is available using the other plant DDFP (76P-4). An adapter piece, which is stored in the DDFP pump room will be attached to the blind flange downstream of the discharge of the pump. The adapter piece is a blind flange with a Storz connection. A hose will be attached to the adapter piece and run to the RHRSW pump room. An expansion joint (10EXJ-4B) on the discharge of RHRSW pump 10P-1B will be removed and replaced with a second adapter piece with a hose connection. The hose from the discharge of pump 76P-4 will be connected to the RHRSW pump discharge. The RHRSW system is then connected to the RHR system through the cross-connect flow path. RPV injection is then accomplished via the "B" loop of the normal RHR injection flow path.

The primary and alternate flow paths for Phase 2 injection are completely independent of one another; they share no common piping. In addition, the primary and alternate flow paths for Phase 2 are capable of being cross-connected.

2.3.5.3 Electrical Connections

In order to provide a connection point for the 600 VAC FLEX DGs, JAF developed a proto-type MCC bucket. The proto-type bucket utilizes surface mounted connectors, which are directly connected to the MCC bucket stabs. The bucket is outfitted with female connectors one for each of the three phases. Female connectors were selected for the bucket based on the potential for the MCC bucket installed on a live bus. This configuration will require a section of cable (approximately 3' to 5') with male connectors on each end to make up the connection at the MCC. Procedural controls are in place such that the cables will be installed and connected to the MCC (71MCC-254 (primary) or 71MCC-264 (alternate)) prior to energizing the bus from the 600 VAC FLEX DG. These male-to-male adapter cords are stored with the modified bucket. Each of the motor control centers (71MCC-254 and 71MCC-264) have three space options available for use. The bucket can be inserted into any one of these space options

The modified MCC bucket will be a FLEX-specified plug-in bucket, staged in the "N" FESB. It is not to be installed during normal plant operation. The plug-in bucket is restrained in its staging location to prevent it from being damaged. Another modified MCC bucket will be stored in the "N+1" FESB.

2.3.6 Key Reactor Parameters

Instrumentation providing the following key parameters is credited for all phases of the RPV inventory and core heat removal strategy and RPV pressure boundary and pressure control:

- RPV Level
  - 02-3LI-85A (Battery A)
  - 02-3LR-85B (Battery A)
  - 02-3LI-91 (Battery A)
  - 02-3LR-98 (Signal: Battery B; Recorder: Battery A)
- RPV Pressure
  - 06PI-61A (Battery A)
  - 06PI-61B (Battery B)
- Suppression Pool Temperature
  - 16-1TR-131A (Battery A)
  - 16-1TR-131B (Battery B)
- Suppression Pool Level
  - 23LI-202A (Battery A)
  - 23LI-202B (Battery B)

The above instrumentation is available prior to and after load stripping of the dc and ac buses during Phase 1. Availability during Phases 2 and 3 will be maintained by repowering battery chargers for divisions A station batteries using a 600 VAC FLEX DG.

Reference 3.49, Attachment 6.035, evaluated the critical instruments credited by the JAF FLEX strategy for impacts due to the environmental conditions in the Reactor Building. This evaluation showed that the required accident profile for each piece of equipment fully bounds the ELAP profiles in thermal equivalency and peak temperature. Therefore, the equipment will not be effected by the thermal conditions caused by an ELAP event.

Seismic studies have shown that even seismically qualified electrical equipment can be affected by beyond-design basis seismic events. In order to address these considerations, JAF identified alternate access points for monitoring the critical parameters listed above. Reference 3.49, Attachment 6.036, provides guidance on obtaining instrument readings outside the control room.

FLEX equipment is supplied with the instrumentation needed to operate the equipment. The use of these instruments is detailed in the associated FSGs for use of the equipment. These procedures are based on inputs from the equipment suppliers, operation experience, and expected equipment function in an ELAP.

2.3.7 Thermal Hydraulic Analyses

The JAF FLEX strategy timeline is supported by the results of a plant specific Modular Accident Analysis Program 4 (MAAP4) core and containment analysis (Reference 3.34).

Case 4 of the JAF MAAP4 analysis was the specific run selected to represent the scenario as described in JAF FLEX strategy. Operators will take manual control of reactor pressure by approximately 10 minutes to stabilize pressure below 1080 psig. Manual control will consist of cycling one SRV at a time, alternating SRVs to allow equal usage and to distribute heat in the torus. When suppression pool temperature approaches the unsafe region of the heat capacity temperature limit HCTL they will begin to reduce reactor pressure to a pressure range that provides margin to the unsafe region of the HCTL curve. When the temperature cannot be maintained outside the Unsafe Region of the HCTL, a rapid cooldown (with cooldown rate ≤ 100 °F/hr) must be performed. Depressurization is to be halted and controlled at a range that would support continued RCIC operation, because the steam-driven RCIC is the preferred means of core cooling (e.g., 200 – 400 psig).The JAF Technical Specifications limit is 100°F/hour averaged over a period of one hour (Reference 3.23). The resulting plot of the RPV pressure from the MAAP4 analysis confirms this cool down rate and the collapsed RPV water level remains over 9 feet above the top of active fuel (TAF) at its lowest point at the end of RCIC operation and depressurization.

These analyses support the FLEX strategies discussed in subsections 2.3.1, 2.3.2 and 2.3.3.

Utilization of the MAAP4 Code:

MAAP4 code benchmarking for the program's use in support of Post-Fukushima applications is discussed in detail in Section 5 of EPRI Report 3002001785 "Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications" (Reference 3.28), which includes MELCOR Code result comparisons as well as direct result comparisons to actual plant pressure and temperature data from Fukushima Dai-ichi Units 1, 2, and 3. The EPRI report concludes that the MAAP4 code is acceptable for use in support of the industry response to Order EA-12-049 (References 3.2 and 3.4).

The JAF MAAP4 analysis was performed in accordance with Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013 position paper, EPRI Technical Report 3002001785.

Key modeling parameters cited in Tables 4-1 through 4-6 of the "MAAP4 Application Guidance, Desktop Reference for Using MAAP4 Software, Revision 2" (Electric Power Research Institute Report 1020236, Reference 3.29) are specifically addressed in the MAAP4 Analysis (Reference 3.34). The reactor vessel and containment nodalization followed standard schemes that are described. The MAAP4 Code is readily capable of analyzing the two-phase flow conditions from the RPV, and validations were performed for the key parameters that are checked for these two-phase level and flow conditions. Modeling of heat transfer and losses from the RPV, decay heat, and the plant-specific inputs are also described and followed standard practices.

2.3.8 Recirculation Pump Seal Leakage

Reactor Coolant System (RCS) leakage is modeled in MAAP4. The postulated seal leakage is 18 gpm per pump (Reference 3.18, Appendix J), which is 36 gpm from both pumps, plus the maximum technical specification RCS leakage limit of 25 gpm (Reference 3.23). This results in a total RCS leakage of 61 gpm used in the MAAP4 analysis. RCS leakage is a function of reactor pressure. Leakage is modeled by establishing 61 gpm of leakage at the beginning of the MAAP4 sequence, and allowing the leakage to decrease with depressurization. At 1 hour, recirculation water pump inlet and outlet valves are closed when depressurization begins (Reference 3.25). This reduces primary system leakage from 61 gpm at full pressure to 25 gpm, which is the technical specification leakage limit.

2.3.9 Shutdown Margin Analysis

Per NEI 12-06 section 2, bounding conditions for the FLEX strategies includes the following:

"Each reactor is successfully shut down when required (i.e.: all control rods inserted, no ATWS)."

The JAF Technical Specification (Reference 3.23) for the cold shutdown margin demonstration (T.S. Section 3.1.1) requires that the shutdown margin at any time during the fuel cycle be equal to or greater than: 0.38% $\Delta k/k$ with the highest worth rod analytically determined. Core designs provide a minimum design limit of 1 % shutdown margin (Reference 3.98).

This requirement is verified during the startup after each refueling by an in-sequence control rod withdrawal. Because core reactivity values will vary through core life as a function of fuel depletion and poison burnup, the demonstration of shutdown margin is performed in the cold (68°F), xenon-free condition and must show the core to be subcritical by at least R + 0.38% $\Delta k/k$. The value of R, in units of % $\Delta k/k$, is the difference between the calculated values of maximum core reactivity (cold, with the highest worth rod withdrawn) throughout the operating cycle, and that at beginning-of-cycle (BOC).

A shutdown margin check per RAP-7.4.09 was performed for the February 2017 refueling and current operating cycle and determined that the shutdown margin at BOC to be 1.27 $\Delta k/k$ (Reference 3.82), or approximately 3 to 4 times the Tech Spec requirement. Therefore, JAF will remain shut down during a simultaneous ELAP and LUHS event with all control rods fully inserted.

2.3.10 FLEX Pumps and Water Supplies

2.3.10.1 FLEX Low Pressure Injection Pumps

JAF RPV water injection capability is provided using one of two plant DDFPs (76P-1 or 76P-4) through a primary or alternate connection. When RPV pressure drops to approximately 50 psi above suppression pool pressure, core cooling will be transitioned (Phase 2) from RCIC operation to the DDFP. The flow to the RPV will be maintained sufficient to maintain water level above the top of active fuel. When injecting with raw water from the UHS, the target RPV water level will be above normal to ensure water can enter the core through the steam separator as well as through the fuel bundles. The DDFPs are rated at 2500 gpm at 125 psig discharge pressure. The maximum required injection flow rates for RPV makeup and SFP makeup (or SFP Spray) are 150 gpm, 50 gpm (or 250 gpm for spray), respectively

(Reference 3.26). Conservative analysis demonstrates that the DDFPs are capable of providing the required injection flow rates (Reference 3.26). The DDFPs are seismically qualified, housed in robust structures and protected against external hazards (References 3.48 and 3.49).

The DDFPs take suction from the UHS and feed the RPV via a hose connected to the RHRSW system at one of two locations. Either DDFP is capable of being connected to either division of RHRSW/RHR (Figure 1). The hoses required for the connection of the DDFPs are stored in a protected location. The JAF FLEX strategy utilizes two complete sets (N and N+1) of hoses.

Proceudres and training have been implemented to support the deployment of hoses and operation of the DDFPs in the FLEX mode in accordance with the FLEX Program Document EDSO-5 (Reference 3.73).

2.3.10.2 Makeup Water Supplies

Condensate Storage Tanks

Because the CST's are not fully protected from tornado missiles over their full height, only the volume below the protected level is assumed to be available (approximately 192,000 gallons). This volume is sufficient to maintain RPV injection for approximately 22 hours. If the CST's were to fully survive the external event the availability of the CST's as a water source for RCIC would be substantially extended.

Ultimate Heat Sink

Lake Ontario is the UHS for JAF. The available volume from the UHS for use by the DDFPs is sufficiently large to be suitable for unlimited operation of the pumps. The JAF FLEX strategy is consistent with the positions stated in BWROG-TP-14-006 (Reference 3.39) and BWROG-TP-15-0 07 (Reference 3.50). The Phase 2 and Phase 3 RPV injection strategy pumps raw water with one of the DDFP (76P-1 or 76P-4) to the vessel through the RHR A or RHR B injection line. The water level in the core and shroud will remain above the top of the fuel. DDFP 76P-1 takes suction downstream of the traveling screens. DDFP 76P-4 takes suction upstream of the traveling screens. The intake is through a long offshore tunnel well underwater in Lake Ontario. During a FLEX event, the flow velocities are extremely small, except near the suction to DDFP 76P-4, and the basin water is not well-mixed. Consequently, DDFP 76P-4 has inherent filtering by virtue of the fact that high density sediment will sink to the bottom and low density debris will float to the top of the inlet basin. Because there is not enough force at the bottom or surface to entrain high or low density debris, only suspended debris will be in the DDFP 76P-4 or DDFP 76P-1 flow streams, which go through the inlet strainers.

While the water in Lake Ontario is categorized as raw water, it is fresh water of generally good quality and low salinity and is not expected to impact heat transfer characteristics of the fuel in the time period needed for Phase 3 recovery activities to be undertaken.

2.3.10.3 Borated Water Supplies

Not applicable to BWRs for FLEX as the reactor is maintained shutdown in all conditions with all control rods fully insert following the loss of AC power consistent with the assumption of NEI 12-06.

2.3.11 Electrical Analysis

The station batteries and plant Class 1E dc distribution system provides power for RCIC system operation and monitoring instrumentation. At the onset of the event, the operator is directed to take steps to begin minimizing the load on the station batteries by shedding unnecessary loads in accordance with station SBO procedure (Reference 3.25). Additional load shedding is completed within 1.5 hours after the event. As a result of the shedding of non-essential loads, the station Division I and Division II battery will maintain voltage above minimum requirements and will be capable of supplying power to the required loads for approximately 9.5 hours, and prior to battery depletion (Reference 3.47).

Transition from Phase 1 (reliance on station batteries) to Phase 2 will be made using a fixed (or deployable) 600 VAC FLEX DG to repower either Division I (primary strategy) or Division II (alternate strategy) electrical distribution system prior to depleting the station batteries. The decision to connect the 600 VAC FLEX DG will be made during the initial response phase. With load shedding, the usable station Class 1E battery life is extended for approximately 9.5 hours and the 600 VAC FLEX DG will be placed into service before 8 hours to recharge the Division I or Division II batteries as discussed in Section 2.3.2. Therefore, the time margin between the calculated battery duration for the FLEX strategy and the expected deployment time for FLEX equipment to supply the dc loads is approximately 1 hour.

Each of the two 600 VAC FLEX DG is equipped with a 250 gallon diesel fuel tank which supports approximately 12 hours run time at full load (Reference 3.49). See Section 2.9.4 regarding refueling of diesel driven FLEX equipment and the assumed amount of fuel contained in each piece of essential diesel driven equipment at the beginning of the event. JAF FLEX strategy utilizes two complete sets of cables (N and N+1).

2.4 Spent Fuel Pool Cooling/Inventory

The basic FLEX strategy for maintaining SFP cooling is to monitor SFP water level and provide makeup water to the SFP sufficient to maintain the SFP water level above the top of the stored spent fuel.

2.4.1 Phase 1 Strategy

Phase 1 strategy will be the use of plant design to maintain cooling for fuel in the SFP via the large inventory and heat capacity of water in the SFP. Water level in the SFP will be maintained above top of the stored fuel.

The normal SFP water level at the event initiation provides for at least 21 feet, 7 inches (Reference 3.23) of water inventory above the top of the stored spent fuel. During normal operation (Modes 1-3), the SFP water inventory will heat up from an initial 114°F to 212°F in 32.7 hours (Reference 3.35) and the fuel in the SFP will uncover in 264 hours following the loss of normal spent fuel pool cooling due to the loss of ac power. Thus, the transition from Phase 1 to Phase 2 for SFP cooling function will occur prior to 32.7 hours for Modes 1-3 for the limiting condition in which fuel has been transferred to the pool after a refueling. Conservatively, the Phase 2 equipment (i.e., provisions for makeup to the SFP) will be in place for utilization at approximately 22 hours.

2.4.2 Phase 2 Strategy

As described above, the SFP will reach 212°F and begin boiling at 32.7 hours into the event. The required makeup rate to cool the fuel stored in the SFP during this time is 37 gpm (Reference 3.35). The FLEX strategy conservatively uses an SFP makeup rate of 50 gpm (for makeup via plant piping or via hose). All three methods described below include manual operator actions for valve manipulations, and, for staging of hoses, nozzles, manifolds and required flow measurement instruments. The actions to store any material on the refueling floor will be completed well before bulk fuel pool boiling occurs because of accessibility and habitability concerns.

Method 1 - Makeup via permanent piping

The first method of providing makeup to the SFP is using the RHRSW system which is cross-connected to the RHR system via the plant fire protection system crosstie at valve 10RHR-432. A permanent, DDFP (same as used for core cooling) is used to supply water through the existing fuel pool cooling assist mode piping and the valves of the RHR system to establish makeup flow to the SFP through spargers mounted directly in the SFP. All permanent piping and valves are seismically qualified. The Phase 2 hydraulic calculation (Reference 3.26) demonstrates that the DDFPs can provide sufficient flow for core cooling as well as SFP makeup. For makeup using 76P-1, pre-staged FLEX hose, fittings, flow meters and valves will be used to connect the fire protection system at valve 76FPS-720 to the RHRSW system at valve 10RHR-432. For makeup using 76P-4, the connection is from the spool piece installed at the discharge blind flange of 76P-4 to the adapter installed at the expansion joint on the discharge of RHRSW pump 10P-1B as was discussed earlier for core cooling (Section 2.3.5.2).

Method 2 – Makeup via hose

The second method is to provide make-up to the SFP using temporary hoses that are placed over the side of the pool. The strategy for this method involves the use of either of the DDFPs. One available route is from 76P-1 at the emergency service water-FP cross connect (Reference 3.51). One end of the hose is connected to the cross-connect downstream of valve 76FPS-2000. The hose will run through the Screenwell Building, the Turbine Building, and the Admin Building to the Reactor Building. At the base of the Reactor Building stairs, the hose will be split via a Y-connection, and two hoses will then be routed up the northeast stairwell to the refuel floor where they can be used to establish SFP makeup flow or SFP spray. The Y-connection is located at the bottom of the Reactor Building stairs so that after initial setup, actions for initiation of either the makeup mode or the spray mode can be accomplished from an area outside the refuel floor area. A similar available route is from 76P-4.

Method 3 – Makeup via spray

The third method to provide water to the SFP utilizes the same hose routes as described in the Method 2 makeup via hose above up to the splitter located in the Reactor Building stairwell and uses the splitter to provide flow between hose makeup and the spray monitor. An additional length of hose is supplied to complete the route from the splitter up the stairwell to the monitor pre-staged on the refuel floor. Hose will be pre-staged nearby to allow connection to monitor spray nozzles on the refuel floor. The hoses and Y-connections will be arranged such that after initial setup, actions for initiation of either the spray mode or the makeup mode can be accomplished from an area outside the refuel floor area.

The monitor spray nozzles are used as necessary to provide spray flow over the SFP. The monitor nozzles provide a minimum spray capability of 200 gpm, or 250 gpm if overspray occurs. JAF strategy provides a minimum of 250 gpm flow because overspray is possible. The guidance NEI 12-06, Rev. 4, allows the elimination of spray capability, provided that an evaluation confirms that the SFP is seismically adequate. The seismic adequacy of the SFP at JAF was reevaluated against the new ground motion response spectrum (Reference 3.76). The results of this evaluation confirmed that the SFP is seismically adequate; therefore, spray capability is not required. However, the FLEX strategies at JAF retain the availability of spray capability and this ability is considered defense in depth.

2.4.3 <u>Phase 3 Strategy</u>

The spent fuel can be cooled indefinitely using the makeup methods described in Phase 2. Additional capabilities will be available from the NSRC as a backup to the on-site FLEX equipment.

2.4.4 Structures, Systems, and Components

2.4.4.1 Makeup Connection

Makeup Strategy Method 1 (Permanent Piping)

Method 1 uses either of the existing DDFP (76P-1 or 76P-4) and piping and valves in the safety related RHRSW and RHR systems. No access to the refuel floor is required for this method.

Makeup Strategy Method 2 (Makeup via hose)

One of the DDFP and associated hoses and connections routed to the spent fuel pool achieve the intended function of adding water to the SFP.

Makeup Strategy Method 3 (Spray)

Similar to Method 2, one DDFP and associated hoses and connections will be used in conjunction with the monitor spray nozzles.

2.4.4.2 Ventilation

SFP bulk boiling will create adverse temperature, humidity, and condensation conditions in the Reactor Building. NEI 12-06 requires a ventilation vent pathway to exhaust the humid atmosphere from the SFP/refuel floor area. This ventilation path is created by actions to open doors R-369-1, R-369-2, R-272-1, and R-272-2 to the outside within 5 hours of the start of the event (Reference 3.52). The temperature at the refueling floor (Elevation 369') will reach 120°F at approximately 13.6 hours into the event and relative humidity is expected to be 100% when the SFP starts to boil (Reference 3.52). The FLEX strategies are to complete the Reactor Building Hose run and manual actions for elevations above 272' as early as possible but prior to hour 5.7 into the event when the temperature at Reactor Building elevation 272' reaches 120°F (Reference 3.52).

2.4.5 Key SFP Parameters

The key parameter for the SFP makeup strategy is the SFP water level. The SFP water level is monitored by the instrumentation that was installed in response to Order EA-12-051 (Reference 3.5).

- Spent Fuel Pool Level
  - 19LI-60A (Independent Battery)
  - 19LI-60B (Independent Battery)

2.4.6 Thermal-Hydraulic Analyses

The normal SFP water level at the event initiation provides for at least 21 feet, 7 inches (Reference 3.23) of water inventory above the top of the stored spent fuel. During Modes 1-3, the SFP water inventory will heat up from an initial 114°F to 212°F during the first 32.7 hours (Reference 3.35). That calculation also predicts that there would be approximately 264 hours before any uncovering of the fuel would occur.

2.4.7 FLEX Pump and Water Supplies

2.4.7.1 Diesel-Driven Fire Pumps

For Method 1, 2 or 3 makeup to the spent fuel pool is accomplished by use of one of the existing seismically qualified DDFPs (76P-1 and 76P-4) with water inventory supplied from Lake Ontario. The pumps are nominally rated at 2,500 gpm at a discharge pressure of 125 psig (Reference 3.27) well in excess of the required makeup rate of 37 gpm.

2.4.7.2 Lake Ontario

DDFP 76P-1 (or DDFP 76P-4) will be aligned for reactor core cooling/injection and SFP makeup. Both DDFPs are sized to allow the concurrent addition of water to the RPV and to the SFP from Lake Ontario for inventory makeup as the SFP boils or to provide concurrent spray capability.

2.4.8 Electrical Analysis

The SFP is monitored by instrumentation (19LE-60A and 19LE-60B) installed by Order EA-12-051 (Reference 3.5). Each instrument has the capability to connect to a source of power independent of the normal ac/dc power system. The power for this equipment has backup battery capacity for 7 days (Reference 3.77). Spare batteries are available for beyond 7 days.

2.5 Containment Integrity

During the BDBEE containment integrity is maintained by design features of the containment including the containment structure, containment isolation valves and the existing containment vent. Decay heat from the reactor is transferred to the containment from conduction to the drywell atmosphere and via RCIC operation and SRV steam discharge to the suppression pool. Increased temperatures will cause increased containment pressure. The JAF FLEX strategy is based on performing suppression pool venting for containment heat removal when the containment pressure approaches 10 psig which is well below the primary containment pressure limit (PCPL) of 62 psig. Plant equipment/features are used to maintain containment integrity throughout the duration of the event.

2.5.1 Phase 1 Strategy

During Phase 1 containment integrity is maintained using the normal plant design features of the containment such as the containment isolation valves and the containment vent. Until the hardened containment vent system (HCVS) is installed and operable (Reference 3.16), the existing standby gas treatment system (SGTS) (i.e., GL 89-16 vent) will be used. The GL 89-16 vent path is available to protect the containment function during all phases of the BDBEE response. The availability of the GL 89-16 vent is addressed in Reference 3.49, Attachment 6.029. The wetwell is vented via the existing SGTS by opening filter train access hatches allowing the torus to vent to the SGST room and opening the SGTS doors to the outside allowing the torus to in turn vent to the atmosphere.

According to thermal-hydraulic analysis the containment pressure will approach 10 psig at approximately 5.5 hour (Reference 3.34). The containment vent will be opened at this time to allow steam from the suppression pool to vent minimizing the containment pressure increase and removing decay heat from the containment via the steam released.

The JAF strategy does not rely on use of the suppression pool for RCIC pump water supply therefore net positive suction head (NPSH) for the RCIC pump is unaffected by the venting of containment.

Monitoring of containment drywell pressure and suppression pool water level and temperature will be available via normal plant instrumentation discussed in Sections 2.5.5 and 2.3.6.

2.5.2 Phase 2 Strategy

The strategy to maintain containment integrity for Phase 2 is the same as for Phase 1. The GL 89-16 vent is available to protect the containment function during all phases of the BDBEE response. Given no change in the strategy to regulate and control RPV makeup at a lower rate/RPV level, the influx from the SRVs to the torus will eventually result in the torus going solid (SRV discharge exceeds mass flow rate out of vent path) blocking off the containment vent nozzle located at the apex of the torus. The evaluation in Reference 3.49, Attachment 6.023, shows that the level in the torus will not reach this critical level until 60 days after the BDBEE.

2.5.3 Phase 3 Strategy

For long-term response to the BDBEE, the containment function can continue to be protected using the same primary strategy as recommended for Phases 1 and 2 above and shutdown cooling (SDC) provides core cooling.

2.5.4 Structures, Systems, Components

2.5.4.1 Containment Vent (GL 89-16)

JAF will rely on the existing GL 89-16 vent for venting during a BDBEE until the HCVS is installed. The GL 89-16 vent path is available to protect the containment function during all phases of the BDBEE response. The following recommended manual actions are in addition to the actions in EP-6 (Reference 3.74):

1. Open the access doors to the SGTS filter units 01-1 25F-2A/B.
2. Open SGTS room doors to outside.
3. Verify closed (or manually close) valves 01-125MOV-15A/B.
4. Manually open valves 01-125MOV-14A/B.
5. Manually close valves 01-125MOV-11/12.
6. Manually open 27MOV-120 /121.

7 Manually open torus vent PCIVs 27AOV-117/118 as described in EP-6.

The FLEX containment vent strategy and the interim manual actions to initiate venting through the GL 89-16 vent is required to be performed early and completed within 5.5 hours.

2.5.5 Key Containment Parameters

The Phase 1 coping strategy for containment integrity involves monitoring containment pressure using either one of the following plant instrumentation and is available for the duration of the ELAP:

- Containment Pressure – Drywell
  - 27PI-115A1,2 (Division I);
  - 27PI-115B1,2 (Division II)

The above instrumentation is available prior to and after load stripping of the dc and ac buses during Phase 1. Availability of these instruments during Phases 2 and 3 will be maintained by repowering Class 1E battery chargers for either one division of station batteries using the 600 VAC FLEX DG. See Section 2.3.6 for a discussion on the evaluation (Reference 3.49, Attachment 6.035) of these critical instruments for impacts due to the environmental conditions in the Reactor Building.

FSGs provide approaches to obtain necessary instrument readings to support the implementation of the coping strategy. The FSGs include control room and non-control room readouts and also provide guidance on how and where to measure key instrument readings (Reference 3.49, Attachment 6.036) where applicable using a portable instrument.

2.5.6 Thermal-Hydraulic Analyses

Conservative evaluations have concluded that containment temperature and pressure will remain below containment design. Refer to Section 2.3.7 regarding the use of the MAAP4 computer code.

2.5.7 FLEX Pump and Water Supplies

No FLEX pump or water supplies are credited for containment integrity coping strategies.

2.5.8 Electrical Analysis

Power requirements for containment critical instrumentation is provided by the station batteries. The 600 VAC FLEX DGs are used to repower station battery chargers and to repower ac powered instrumentation.

2.6 Characterization of External Hazards

2.6.1 Seismic

The seismic design for Category I structures and equipment is based on dynamic analysis using acceleration response spectrum curves normalized to a ground motion of 0.08g for the operating basis earthquake (OBE) and 0.15g for the design basis earthquake (DBE). The Safe Shutdown Earthquake (SSE) for JAF corresponds to a horizontal ground acceleration of 0.15g. The basis for these criteria is presented in the JAF UFSAR (Reference 3.22) Section 2.6. Per NEI 12-06 (Reference 3.3, Section 5.2), all sites will consider the seismic hazard. The storage locations and appropriate haul routes were evaluated for access per NEI 12-06, Section 5.3.2 (including liquefaction). The possibility for soil liquefaction that could impede movement following a seismic event was evaluated (Reference 3.53, Attachment 6.001). It was concluded that it is highly unlikely that liquefaction would adversely impact the FLEX storage and deployment strategies under the postulated earthquake conditions at JAF.

In accordance with the NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding the Seismic Aspects of Recommendation 2.1, 2.3, and 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident (Reference 3.11), a seismic hazard and screening evaluation was performed for JAF (Reference 3.13). A Ground Motion Response Spectra (GMRS) was developed solely for purpose of screening for additional evaluations in accordance with NRC endorsed EPRI Report 1025287 (Reference 3.12). Based on the results of the screening evaluation JAF screened in for a SFP evaluation. Subsequently in Reference 3.14, JAF also committed to perform a high frequency confirmation and a relay chatter review. In addition, JAF completed the Expedited Seismic Evaluation Process (ESEP) that is responsible for establishing a new ground motion response spectra (GMRS). Reference 3.15, Section 5.1, specifies that the maximum GMRS/DBE ratio between the 1 and 10 Hz range occurs at 10 Hz where the ratio is 1.55. This factor was applied to the current DBE loads to ensure the new GMRS accelerations are bounded. The following new FLEX components have been qualified to the new GMRS:

- N" and "N+1" FLEX equipment storage buildings
- Storage boxes stored within the plant for storage of hoses, adapters and miscellaneous tools
- Phase 3 suction lift booster pump storage in the Screenwell Building

All other existing FLEX structures have been evaluated to the current design basis earthquake in accordance with NEI 12-06.

2.6.2 External Flooding

Site Layout and Topography

The JAF site is situated on the southeast shore of Lake Ontario, Oswego County, New York, approximately seven miles northeast of the City of Oswego. The JAF site grade elevation is approximately 272 feet USLS35. The shoreline frontage of the JAF site consists principally of near vertical bedrock cliffs which extend from an elevation of about 240 ft USLS35 to near the plant grade elevation. Plant structures are located a minimum of 150 ft away from the vertical bedrock cliffs. There is a minor, unnamed perennial stream located along the western boundary of the JAF site. The streambed elevation where the stream meets Lake Ontario is approximately 248 feet USLS35 (Reference 3.56).

Current Design Basis Flood Elevations

The current design basis and related flood elevation from natural sources is described in the JAF Final Safety Analysis Report (FSAR) Section 2.4.3.7 and in the James A. FitzPatrick Nuclear Power Station Walkdown Submittal Report (Reference 3.83) for resolution of Fukushima Near-Term Task Force Recommendation 2.3 required as part of the response to the 10 CFR 50.54(f) letter.

The JAF design basis flood level is 260 ft USLS35, which is postulated to occur coincident with the maximum recorded lake level (248 ft USLS35), maximum precipitation induced increase to lake level (+0.35 ft), maximum wind setup (+4.1 ft), and maximum wave run up (+7.5 ft). The Current Licensing Basis (CLB) also includes a postulated flood elevation assuming a higher regulated lake level of 250 ft USLS35. The resulting peak flood level is 262 ft USLS35. The probable maximum flood elevation inside the Screenwell Building (hydraulically connected to Lake Ontario) was postulated to be approximately 255 ft USLS35 assuming the higher assumed lake level of 250 ft USLS35. Flood levels in the Screenwell Building are not considered to be affected by waves (Reference 3.56).

Current Licensing Basis Flood Protection and Mitigation Features

Flood protection features credited in the CLB consist of the conduit seals at eight (8) exterior manholes which contain conduits connecting to the Reactor Building (Reference 3.56). Additionally, roof drains on the Reactor Building roof are credited to mitigate the IPEEE Probable Maximum Precipitation (PMP) event.

Flood Hazard Reevaluation

In Reference 3.11 the NRC staff requested plants reevaluate the potential flood hazards that could affect the station. JAF completed this re-evaluation and submitted the results to the NRC in Reference 3.17. The conclusion of this report was that certain hazards including the effects of local intense precipitation (LIP) and flooding from a local unnamed stream had not been evaluated in the original design of the facility and were not bounded by previous analysis. The Flood Hazard Reevaluation Report (FHRR) determined that the Local Intense Precipitation (LIP) and Unnamed Stream Probable Maximum Flood (PMF) are the controlling flood mechanisms and the maximum stillwater elevation is 272.8 ft USLS35 (Reference 3.56). The maximum period of inundation for the doors is less than 9 hours (Reference 3.56). The flood water elevation resulted from LIP and PMF exceeds the CLB of 262'. Due to the limited depth and duration of these conditions the analysis concluded that there was no impact on safe shutdown equipment and no additional actions were warranted (see Section 2.7 for further discussion).

The Reactor Building is a poured-in-place reinforced concrete structure up to the refueling floor. Pre-formed water stops are incorporated in all construction joints below grade for watertightness. Conduits that penetrate the Reactor Building below grade are sealed to prevent ground water instruction into the building (Reference 3.83). Therefore, the ground water in-leakage is not a concern and will not impact FLEX strategies.

2.6.3 Severe Storms with High Wind

JAF is located above the 35th parallel. Per NEI 12-06 guidance, tornado hazards are the only high wind hazards applicable to JAF. Figure 7-2 of NEI 12-06 shows that JAF is located in Region 2 and has a recommended tornado design wind speed of 169 mph. Section 12.4.5 of the UFSAR indicates that the design basis tornado consists of a tangential wind velocity of 300 mph with a translational velocity of 60 mph. This bounds both the recommended tornado from NEI 12-06 and the hurricane force winds and it was used to determine if a structure can survive high winds in the development of the FLEX coping strategy.

The JAF FESBs are commercial structures. In order to credit at least one of the FESBs as being available following a tornado BDBEE, a tornado size and path study was performed for JAF (Reference 3.84). The study determined that the tornado separation distance should be 1,400 ft on an axis perpendicular to the prominent tornado paths. The locations for the "N+1" and "N" FESBs exceed 1,400 ft which provides assurance at least 'N' sets of FLEX equipment remain available if one FLEX storage building is impacted by tornado wind/missiles.

Figure 7-1 of NEI 12-06 shows that JAF is in a region with severe winds from hurricanes less than 130 mph wind speed guidelines for the identification of sites with the potential to experience severe winds from hurricanes. Therefore, the hazard associated with severe winds from hurricanes is not applicable and therefore screened out at JAF. The FESB is not required to be designed for protection from the high winds of a hurricane. As such, N+1 FESB meets the intent of NEI 12-06 revision 4 section 7.3.1.1.c and section 7.3.1.2.c 3rd bullet. However, a higher wind load based on the current licensing basis for the site is used for the FESB design. The FLEX strategy for JAF considers high winds up to 165 mph and complies with the NEI 12 06 and ASCE 7 10 requirements for structures that store FLEX equipment (References 3.53 and 3.54).

2.6.4 Ice, Snow and Extreme Cold

The guidelines provided in NEI 12-06 (Section 8.2.1) determine that an assessment of extreme cold conditions must be performed for sites above the 35th parallel. JAF is located above the 35th parallel (Reference 3.22, Section 2.1.1) and is subject to the extreme cold hazards, including snow and ice. The site is located within the region characterized by National Oceanographic and Atmospheric

Administration (NOAA) as subject to significant accumulations during three-day snowfalls. The site is located within the region characterized by EPRI as ice severity level 5 (Reference 3.3). As such, the JAF site is subject to severe icing conditions that could also cause catastrophic destruction to electrical transmission lines. Thus the extreme cold, ice and snow hazard, are considered in the development of the FLEX strategies at JAF.

The lowest recorded temperature for JAF from 1860 to 1950 is -23°F (Reference 3.22). A search of the NOAA Climatic Data Center showed that for the time period between 1948 and 2015, the lowest recorded temperature for Oswego, NY from was -21°F. Extreme low temperatures of -23°F are considered in the development of the FLEX coping strategy.

The plant's design basis for snow load is 50 psf per Table 12.4-1 of the FSAR (Reference 3.22). Figure 7-1 of ASCE 7-10 (References 3.53 & 3.54) identifies JAF as a Case Study region and does not provide a specific value. Figure 1608.2 of the Building Code of the State of New York (Reference 3.57) provides a snow load for the JAF area of 60 psf. Since this bounds the plant's current design basis (60 psf > 50 psf) and is a local code to New York, this loading is appropriate for the FESB.

2.6.5 <u>High Temperatures</u>

Per NEI 12-06 Section 9.2, all sites will address high temperatures. While the NEI 12-06 guidance notes that virtually every state in the lower 48 has seen summer temperatures of 110 °F. JAF, in its location on the southern shore of Lake Ontario, is not expected to experience that extreme temperature. The highest recorded temperature for JAF from 1860 to 1950 is 100°F (Reference 3.22). A search of the NOAA Climatic Data Center showed that for the time period between 1948 and 2015, the highest recorded temperature for Oswego, NY was 97°F. Extreme high temperatures of 100°F are considered in the development of the FLEX coping strategy.

Site industrial safety procedures currently address activities with a potential for heat stress to prevent adverse impacts on personnel. Thus the high temperature hazard is applicable to JAF.

The maximum design temperature of FESBs is 120°F during the extreme high temperature condition (References 3.53 & 3.54).

The FLEX DG is rated at 122 °F ambient temperature per Reference 3.85.

The FLEX hoses are manufactured to NFPA 1961 standards. Over-aging tests are done at a temperature of 158°F +/- 3.6°F for 96 hrs (Reference 3.86). The hoses and fittings for the FLEX equipment will be cooled by the lake water flowing through them.

The Phase 3 Suction Lift Booster Pump is stored in the Screenwell Building which is subjected to the extreme high temperature. The pump can withstand the postulated extreme temperature range up to 225 °F (Reference 3.87). The storage boxes are made out of steel. Components stored within the storage boxes are passive, commercially rugged equipment that can survive extreme temperatures by inspection.

2.7 Planned Protection of FLEX Equipment

JAF will protect the FLEX equipment in two ASCE 7-10 structures. One smaller structure is inside the protected area close to the deployment location ("N" FESB). A second building is located outside the protected area ("N+1" FESB). With exception of the Submersible Pumps which is stored in the substructure of the Screenwell Building, FLEX equipment listed in Table 3 is stored in FESBs. Deployments of the FLEX equipment from the FESBs are not dependent on off-site power. Roll up doors for the FESBs are manually operated.

The FLEX FESBs are designed for wind loading determined per ASCE 7-10 (References 3.53 and 3.54). The storage buildings are designed for seismic loading determined per ASCE 7-10. Both buildings are erected to withstand equivalent ASCE 7-10 seismic capacity of up to 1.55 times the safe shutdown earthquake (SSE). This seismic capacity is based on the maximum GMRS/SSE ratio of 1.55. The "N" FESB has an overall footprint of approximately 25'x25'. The "N+1" FESB has an overall footprint of approximately 80'x60'. This size was developed based on the equipment to be stored within the buildings. Arrangement of all items to be stored in the storage buildings was established based on optimizing ease of deployment (Figure 6).

Seismic Considerations:

Section 5.3.1.2 of NEI 12-06 (Reference 3.3) states that large FLEX equipment should be secured as appropriate to protect them during a seismic event and that stored equipment and structures should be evaluated and protected from seismic interactions. A calculation, (Reference 3.70), evaluated the rigid body sliding and rocking of unanchored equipment to determine the required separation distance of the equipment within the storage buildings to ensure that they protected from seismic interactions. The minimum spacing of equipment within the FLEX storage buildings is governed by the maximum displacement of the equipment during sliding and rocking. This calculation shows the equipment will not slide or rock. For access purposes, the equipment is located with a minimum of 18-inch spacing to prevent seismic interactions. As a result, no equipment tie downs have been provided in the storage buildings. A subsurface exploration was performed (Reference 3.71) to evaluate the engineering properties of the subsurface soils within the two FESB sites, Staging Area B (the Phase 3 equipment staging area), and along the travel paths. This report concluded that the liquefaction potential for the FESBs locations, staging area, helicopter landing zone and the designated travel paths is low.

A mitigating strategies assessment (MSA) for new seismic hazard information is currently being conducted in accordance NEI 12-04 Appendix H Path 4 to ensure that FLEX strategies developed can be implemented for the Mitigating Strategies Seismic Hazard Information (MSSHI). The scheduled completion date of this assessment is December 2017. Recommendations, if any, from the MSA will be incorporated in the FLEX implementation program.

High Wind Considerations:

Protection of FLEX equipment against high wind hazard events will be performed in accordance with Section 7.3.1.1c of NEI 12-06. This section states that the equipment should be stored in structures separated by a sufficient distance that minimizes the probability that a single event would damage all FLEX mitigation equipment such that at least N sets of FLEX equipment would remain deployable following the high wind event.

FESBs at JAF are not designed for tornado missile protection. Reference 3.55 states that a reasonable separation distance that bounds a large majority of tornados in the region would be based on the 90th percentile tornado width value of 950 ft (using 1950-2013 data). Based on historical records, the axis of separation used at JAF should consider tornado paths from Southwest to Northeast and West to East. In order to bound both of these directions, the separation distance should be expanded to 1400 ft on an axis from Northwest to Southeast. Separation of storage locations by this distance and direction provides reasonable assurance that N sets of FLEX equipment will remain deployable through most tornados. The two locations at JAF meet the tornado separation distance requirement discussed in Option C of Section 7.3.1.1 of NEI 12-06. The distance between these two locations, on an axis perpendicular to the projected tornado path is more than 2,000 ft, which therefore, exceeds the calculated separation distance of 1400 ft.

Since JAF does not have a hurricane event in the plant's design basis, the only remaining high wind events are those provided in ASCE 7-10 and the current licensing basis. The ASCE 7-10 wind load for JAF is 115 mph and the current licensing basis wind speed is 90 mph. A wind speed of 165 mph used for the design of the FESBs bounds both the ASCE 7-10 and the design basis wind speeds.

External Flooding Considerations:

JAF is built above the design basis flood level. Per UFSAR Chapter 2 the probable maximum flood (PMF) elevation is 255 ft (2.4.3.2 of Reference 3.22) with wave runup to 262.5 ft (2.4.3.4 of Reference 3.22). The grade level at JAF is 272 ft (including at the Screenwell Building).

Lake Ontario is regulated by the International Joint Commission (IJC). Since 1960, IJC Plan 1958DD had been in effect and lake level had been regulated between elevation 243' (USLS35) and elevation 248' (USLS35). Plan 2014 (IJC) was introduced in the past to address Great Lake ecosystem impact concerns (conservation of marsh lands, etc.) and has now been approved (effective January 2017) to adjust the lake level regulated band from the previous values of IJC Plan 1958DD by as much as 8" (242.25' USLS35) on the low side and 2" (248.17' USLS35) on the high side.

An evaluation was performed to determine the impacts on the FLEX strategies due to the change in the lake level regulated band (Reference 3.49, Attachment 6.038). The results of this evaluation concluded that there are no consequential impacts on the FLEX strategies.

In response to the Near Term Task Force (NTTF) recommendations, the NRC requested all operating power licensees to gather information to re-evaluate flooding hazards at U.S. operating reactor sites. The NRC information request requires licensees to re-evaluate their sites using updated flooding hazard information and present-day regulatory guidance and methodologies and then compare the results against the site's current licensing basis (CLB) for protection and mitigation from external flood events. This flooding re-evaluation is documented in Reference 3.56.

According to Reference 3.56, the limiting flood elevations at the site result from the local intense precipitation (LIP) and the PMF on the local unnamed stream flood events. The "controlling" flood hazard (worst case) was determined to be the re-evaluated LIP event. Reference 3.56 identifies the LIP and PMF flood depths at locations surrounding the plant power block buildings, including potential water depths near plant exterior doors. The flood re-evaluation indicates that there are no impacts to equipment important to safety as a result of the re-evaluated flood elevations. The overall conclusion reached is that the new flooding hazard posed no threat to safe shutdown equipment because of physical characteristics of construction that serve to mitigate any impact to these SSCs.

Reference 3.49 summarizes the results of the flood re-evaluation in areas of concern affecting FLEX strategies. All plant equipment credited in the FLEX strategy, (i.e., switchgear, DDFPs, fire protection system connection points in the screenwell house, and Reactor Building hose connection points) was evaluated and it was determined that they are sufficiently elevated that will not be affected by the new flood elevation. In addition, this evaluation also determined that the re-evaluated flood hazard has no impact on the ability to implement the FLEX strategy using equipment from the "N" FESB and the equipment stored within the "N" FESB is assured of being available and deployable after the flood event. The top of the concrete elevation for the FESBs are above the LIP and PMF elevations determined by Reference 3.56. Therefore, the FLEX equipment located inside the FESBs is above flood levels and protected from external flooding.

The FLEX haul paths are shown on Figure 6. Since physical ponding at the "N" FESB is limited to only about 1.2 inches of water, there is no threat to deployment of equipment out of the "N" FESB. Any deployed equipment is small, manually deployed on carts and relatively light weight. Cables will be routed from the pre-staged "N" 600 VAC FLEX DG (located inside the "N" FESB) and routed on the ground. The cables are designed to be used in wet conditions. Submergence in the ponded water will have no impact on the cables.

Deployment of equipment from the "N+1" FESB is impacted by the flooding due to LIP. Water depths along the haul path vary from a maximum expected height of 4 feet to approximately 1 to 2 feet. Since the FLEX portable equipment stored in the "N" building is fully protected from the re-evaluated flood levels and deployment of FLEX equipment from the "N" building is assured for the flood, the FLEX strategy is not consequentially impacted because of potential flooding conditions along the haul paths from the "N+1" building. Therefore, the "N" building and its equipment are the primary credited FLEX equipment for use during the FLEX strategy in the event of a LIP initiated external flooding event. Any "N+1" FLEX equipment may be utilized at the discretion of the Emergency Response Organization (ERO) once the flood waters recede.

The diesel fuel strategy relies on the use of the EDG fuel oil storage tanks. The fill pipe where fuel will be extracted extends above grade and is surrounded by a concrete block enclosure that is 2 ft tall. Reference 3.56 indicates that the LIP and PMF in this area of the plant produce water depths of 1.1 ft and 1 ft respectively. These water depths are below the concrete block enclosure and will therefore not impact the refueling strategy.

Impact of Snow, Ice and Extreme Cold:

Section 8.3.1 of NEI 12-06 requires that FLEX equipment be protected from the impacts due to extreme cold by maintaining equipment at a temperature within a range to ensure its likely function when called upon. In accordance with Section 8.3.1b, the storage of equipment shall be in a structure designed to or evaluated equivalent to ASCE 7-10 for the snow, ice and cold conditions from the site's design basis.

The plant's design basis low temperature is -23°F, per JAF UFSAR (Reference 3.22, Section 2.2.2.2). A review of the NOAA database, for a time frame following the meteorological data used in the UFSAR yielded similar results and is bounded by the values outlined in the UFSAR. To ensure the equipment's likely function when called upon, the inside of the FESBs will be maintained at 40°F during the winter months. Space heaters powered by offsite power will be used to provide adequate interior heating to maintain a minimum temperature of 40°F.

Reference 3.67 determined the duration of time until stagnant water within the hoses and existing pipes freeze and determined the minimum flow rate at which the water will remain unfrozen. During extreme cold conditions, the flow rates in hose and pipes are maintained above the values to prevent freezing. If flow through a hose or pipe is stopped for a period of time, the hose or pipe is drained to prevent the stagnant water from freezing.

The plant's design basis for snow load is 50 psf per Table 12.4-1 of the UFSAR (Reference 3.22). Figure 7-1 of ASCE 7-10 identifies JAF as a Case Study region and does not provide a specific value. Figure 1608.2 of the Building Code of the State of New York (Reference 3.57) provides a snow load for the JAF area of 60 psf. Since this bounds the plant's current design basis and is a local code to New York, this loading is appropriate for the FESBs.

Impact of High Temperatures:

The extreme high ambient temperature for JAF of 100°F is found in Reference 3.22. For the design of the storage buildings, a maximum indoor temperature limit of 120°F was used with respect to the extreme ambient temperature (References 3.53 and 3.54). Protection of the FLEX equipment from impacts due to extreme high ambient temperatures during storage is provided by natural circulation through louvers and/or fans to maintain necessary airflow to maintain the indoor temperature within the maximum design temperature of 120°F.

2.8 Planned Deployment of FLEX Equipment

2.8.1 Haul Paths and Accessibility

The "N+1" FESB will include one full set of FLEX equipment. The "N" FESB will contain an additional set of FLEX equipment with the exception that selected equipment will be pre-staged in deployment areas that are protected against all BDBEEs. The site uses a combination of pre-staged equipment located inside robust structures and the "N" FESB. Some of the pre-staged equipment consists of job boxes containing hose fittings and tools.

The "N" FESB is immediately adjacent to the Screenwell Building, allowing for cable to be run from the generator to the emergency switchgear without a need to transport the generator. This location would require a much smaller debris removal effort to establish the FLEX connections.

Standard small debris removal equipment with the exception of the large front end loader will be stored within the "N" FESB. Deployment of equipment from this location is limited to small equipment such as hard carts and cables.

In conjunction with staging the set "N" 600VAC FLEX DG, storage for the remaining "N" FLEX equipment will be in the same location and in the seismic robust structure inside the power block. The N FESB structure is robust per NEI 12-06.

Deployments of the FLEX equipment from the FESBs are not dependent on off-site power.

Deployment routes to be utilized to transport FLEX equipment are via the normal site roadways and access points as shown in Figure 6. The paths will be accessible during all modes of operation and comply with NEI 12-06, Section 5.3.2. This strategy is included within the FLEX program (Reference 3.73) in order to keep pathways clear.

Pre-determined, preferred haul paths have been identified and documented in the FLEX Support Guidelines (FSGs). Figure 6 shows the haul paths from the FLEX storage areas to the deployment location. These haul paths have been reviewed for potential soil liquefaction and have been determined to be stable following a seismic event (Reference 3.71). Debris removal equipment is protected from the severe storm and high wind hazards such that the equipment remains functional and deployable to clear obstructions from the pathway between the FLEX storage areas and its deployment location.

The potential impairments to required access are: 1) doors and gates, and 2) site debris blocking personnel or equipment access. The coping strategy to maintain site accessibility through doors and gates is applicable to all phases of the FLEX coping strategies, but is immediately required as part of the immediate activities required during Phase 1.

Doors and gates serve a variety of barrier functions on the site. One primary function is security and is discussed below. However, other barrier functions include fire, flood, radiation, ventilation, tornado, and High Energy Line Break (HELB). As barriers, these doors and gates are typically administratively controlled to maintain their function as barriers during normal operations. Following an a BDBEE and subsequent ELAP event, FLEX coping strategies require the routing of hoses and cables to be run through various barriers in order to connect FLEX equipment to station fluid and electric systems. For this reason, certain barriers (gates and doors) will be opened and remain open. Access to the protected area during a BDBEE is addressed in the FSGs and FSG Support Procedures. In particular Reference 3.72 Initial Assessment and FLEX Equipment Staging, addresses security implementation of FLEX strategies.

The ability to open doors for ingress and egress, ventilation, or temporary cables/hoses routing is necessary to implement the FLEX coping strategies. Security doors and gates that rely on electric power to operate opening and/or locking mechanisms are barriers of concern.

The security force will initiate an access contingency upon loss of the security diesel and all ac/dc power as part of the Security Plan. Access to the site Protected Area, and areas within the plant structures will be controlled under this access contingency as implemented by security personnel.

The deployment of onsite FLEX equipment to implement coping strategies beyond the initial plant capabilities (Phase 1) requires that pathways between the FLEX storage area(s) and deployment location be clear of debris resulting from BDB seismic, high wind (hurricane or tornado), or flooding events.

Phase 3 of the FLEX strategies involves the receipt of equipment from off-site sources including the NSRC and various commodities such as fuel and supplies. Transportation of these deliveries can be through airlift or via ground transportation. Debris removal for the pathway between the site and the NSRC receiving location and from the various plant access routes may be required. The same debris removal equipment used for on-site pathways could be used to support debris removal to facilitate road access to the site.

2.9 Deployment of Strategies

2.9.1 RPV Primary Makeup Strategy

Prior to depletion of the water inventory for the RCIC pump, in anticipation of transition to Phase 2, at approximately 22 hours after shutdown, a hose will be connected between DDFP 76P-1 and the RHRSW system (see Figure 1). Appropriate valve lineups will be manually completed in the fire protection water system, RHRSW system, and RHR system to allow injection of water from the UHS to the RPV. Required actions to maintain dc power and critical instrument are discussed below in Section 2.9.3.

2.9.2 Alternate RPV Makeup Strategy

The alternate FLEX hydraulic water source injection point will be a hose connected between DDFP 76P-4 and the RHRSW system. Either DDFP (76P-1 or 76P-4) can be connected to either division of RHRSW depending on plant conditions.

2.9.3 Electrical Strategy

Transition from Phase 1 (reliance on station batteries) to Phase 2 will be made using one 200kW diesel generator being in service to restore 600 VAC power to either the Division I (Primary Strategy) or Division II (Alternate Strategy) Electrical Distribution System prior to depleting the station batteries.The decision to connect the "N" 600 VAC FLEX DG will be made during the initial response phase. The operator is directed to take steps to minimize the load on the station batteries by initially shedding unnecessary loads in accordance with station SBO procedures and within 1.5 hours of the event initiation shedding additional unnecessary loads in accordance with the FSGs. The load shedding ensures the station batteries will have greater than 9.5 hours of capability.

Prior to depletion of the batteries, the "N" 600 VAC FLEX DG will be placed into service at or before 8 hours and connected to recharge the Division I as discussed in Section 2.3.2. Therefore, the time margin between the calculated battery duration for the FLEX strategy and the expected connection time for FLEX equipment to supply the dc loads is approximately 1 hour.

The required 600 VAC FLEX DGs ("N" and "N+1") will be maintained at the two on-site FLEX storage locations. Two 600 VAC FLEX DGs are required to be stored on-site to satisfy the N+1 requirement. In case needed, the trailer mounted "N+1" 600 VAC FLEX DG will be transferred and staged via specific haul paths/pre-defined routes (see Figure 6) evaluated for impact from applicable external hazards. Programs and training have been implemented to support the deployment and operation of the 600 VAC FLEX DGs.

2.9.4 Fueling of Equipment

The FLEX strategies for maintenance and/or support of safety functions involve several elements including the supply of fuel to necessary diesel generators, hauling vehicles, compressors, etc. The general coping strategy for supplying fuel oil to diesel driven FLEX equipment, i.e., pumps and generators, being utilized to cope with an ELAP/LUHS, is to draw fuel oil out of any available existing diesel fuel oil tanks on the JAF site. Diesel fuel to support operation of the Phase 2 FLEX equipment for at least 9 hours for the DDFP and 12 hours for the 600 VAC FLEX DG will be stored with the FLEX equipment. Additional diesel fuel is available in the four underground EDG fuel storage tanks. The Division I & II EDG fuel oil storage tanks contain a minimum of approximately 32,000 gallons of fuel oil each (Reference 3.23). The EDG tank centerline level is assumed to be at the lowest level possible for fuel transfer. This is based on the FLEX strategy fuel transfer requirements that consider the performance of the fuel suction pump. The volume of fuel at the EDG tank centerline is assumed to be 18,500 gallons. The fuel volume at which fuel transfer can no longer occur is 18,500 gallons. Therefore, the usable fuel per EDG tank is:

- EDG tank usable fuel=(32,000–18,500) gallons = 13,500 gallons.

There are four EDG tanks, thus the total on-site available fuel is approximately 54,000 gallons. The underground EDG fuel oil storage tanks contain sufficient fuel oil to support all Phase 2 strategies and beyond. Fuel can be removed from the tanks and delivered to diesel fuel users using the diesel fuel transfer skid. One such skid is located in each FESB. The diesel fuel transfer skid consists of a pump and appropriate hose fittings, along with a relief valve that recirculates back to the fuel tank.

Based on a fuel consumption study (Reference 3.49, Attachment 6.025), the total fuel consumption rate, with a 20% margin added, is approximately 41.3 gallons/hour. On-site fuel resources are more than adequate to support the continuous operation of FLEX equipment and support vehicles for at least 55 days (well beyond 72 hours). Essential diesel-driven FLEX equipment will be kept fueled during storage.

Diesel fuel in EDG fuel tanks is maintained for operation of the emergency DGs and is routinely sampled and tested to assure fuel oil quality is maintained to ASTM standards (Technical Specifications 5.5.10, Diesel Fuel Oil Testing Program, Reference 3.23). Fuel oil in the fuel tanks of diesel engine driven FLEX equipment will be maintained in the Preventative Maintenance program in accordance with the EPRI maintenance templates.

2.9.5 Access to UHS

Since JAF utilizes installed Diesel Driven Fire Pump whose suction is approximately 6' below the surface (Reference 3.96), access to the UHs is not impacted by ice or frazil ice.

2.10 Off-site FLEX equipment

2.10.1 Regional Response Center

The industry established two National SAFER Response Centers (NSRCs) to support utilities during BDBEEs. Exelon has established contracts with the Pooled Equipment Inventory Company (PEICo) to participate in the process for support of the NSRCs as required. Each NSRC holds five sets of generic equipment, four of which will be able to be fully deployed when requested; the fifth set will have equipment in a maintenance cycle. In addition, on-site FLEX equipment hose and cable end fittings are standardized with the equipment supplied from the NSRC or utilize adapters stored in the FESBs. In the event of a BDBEE and subsequent ELAP/LUHS condition, equipment will be moved from an NSRC to a local assembly area established by the Strategic Alliance for FLEX Emergency Response (SAFER) team. Requests to the NSRC for Phase 3 equipment are directed by FLEX Procedures.

JAF is a participant in the industry NSRC which will provide support for Phase 3 response equipment. A site specific response plan has been developed (Reference 3.66). The NSRC SAFER response plan has been developed in accordance with the "National SAFER Response Center Operational Status" letter (Reference 3.40) listed in NEI 12-06, Table 3.2.1.13. Participation in the NSRCs is an acceptable means to meet the Phase 3 off-site equipment requirements (NEI 12-06, Section 12).

For JAF, on site Staging Area 'B' is located at the contractor parking lot in the southwest corner of the site. The helicopter landing zone (HLZ) has been identified as the area between the SOCA and Protected Area fences on the south side of the plant.

For JAF, an off-site staging area (Staging Area C) has been defined at the Syracuse Hancock International Airport which is approximately 39 miles from the JAF site (Reference 3.66).

From Staging Area C, equipment can be taken to the JAF site and staged at Staging Area 'B' by helicopter if ground transportation is unavailable. Communications will be established between the JAF plant site and the SAFER team via satellite phones or normal communications if available and required equipment moved to the site as needed. First arriving equipment will be delivered to the site within 24 hours from the initial request. The order at which equipment is delivered is identified in the JAF "SAFER Response Plan" (Reference 3.66).

2.10.2 Equipment List

For JAF the NSRC equipment will provide a backup to Phase 2 FLEX equipment stored on site and support recovery from the ELAP event. The equipment provided by the NSRC is listed in Table 4. Since all the equipment will be located at the local assembly area, the time needed for the replacement of a failed component will be minimal.

2.11 Habitability and Operations

2.11.1 Equipment Operating Conditions

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

The key areas identified for all phases of execution of the FLEX strategy activities are the main control room (MCR), RCIC room, battery rooms, dc equipment rooms, the DDFPs rooms, and the SFP area.

2.11.1.1 Main Control Room and Relay Room

MCR accessibility must be maintained for the duration of the ELAP. During the ELAP, some control room vital electronics, instrumentation and emergency lighting remain energized from emergency dc power sources. Under ELAP conditions with only simple mitigating actions taken, an analysis projects the temperature in the control room will not exceed 110°F considering a loss of ventilation for 120 hours (Reference 3.37). Therefore, no operator actions or FLEX equipment are required for FLEX mitigation strategies for the initial 120 hours following the BDBEE. After this period of time, sufficient offsite resources are available through the ERO and the NSRC provided equipment to mitigate the MCR temperature exceeding 110°F after 120 hours following the BDBEE. Prior to temperature reaching habitability limits, the MCR can be cooled by restarting normal control room ventilation provided power by the NSRC 4160 VAC generator. Repowering the normal control room ventilation will repower components that will provide at least 1,920 cfm of outside air to the MCR and 1,300 cfm to the Relay Room. This is equivalent to 1 air exchange per hour for both the MCR and Relay Rooms. With the maximum external ambient temperature at JAF being 100°F and accounting for diurnal variations, this air exchange will maintain the heat up of the MCR and Relay Rooms below the habitability temperature of 110°F. Additionally, AOP-49 (Reference 3.25) requires opening all MCR panel doors in the control room within 30 minutes of the beginning of an SBO to minimize heat-up of the components contained in the MCR panels.

2.11.1.2 Reactor Core Isolation Cooling Room

An analysis (Reference 3.36) determined the temperature in the RCIC enclosure for a period of 72 hours following an ELAP/LUHS event and the recovery actions required to maintain the operability of the equipment in the RCIC enclosure. The limiting room temperature for this evaluation is 150°F to ensure operability of the EG-M module for the turbine governor. The calculation determined that the temperature in the RCIC enclosure remains below 150°F for the 24 hour evaluation period if the following actions are taken (Reference 3.72):

- Open door R-227-5 at 1 hour
- Ensure doors R-227-3 and R-227-4 are open and do not fail shut due to fusible link trip temperature of 135°F. Disable fusible link connection for doors R-227-3 and R-227-4 prior to 19 hours into the event.

With the RCIC room doors open the temperature of the RCIC room at 24 hours is 137°F. RCIC room temperature remains below 150°F throughout 60 hours after the event, therefore the EG-M will not be impacted due to room temperature during the initial 24 hours. Although room temperature is still increasing at 24 hours, the credited FLEX strategy only utilizes RCIC for 24 hours and it is not expected to continue operation past this point.

2.11.1.3 Battery Room and dc Equipment Room

An analysis (Reference 3.38) was developed to determine the required actions to maintain habitability and functionality of the equipment in the battery rooms and dc equipment rooms. The acceptance criterion for equipment operability is to maintain room temperature below the upper limit of 110°F during extreme hot summer ambient condition (Reference 3.58) and above the minimum electrolyte temperature limit of 65°F during extreme cold winter ambient condition. In addition, the acceptance criterion for room temperature should also be maintained below habitability limit of 110°F per guidance of the NUMARC 87-00 (Reference 3.18) so that the room environmental condition does not prevent the operators from performing necessary actions.

The calculation determined that during extreme heat conditions the room temperature will reach peak temperature of approximately 109°F at 120 hours after loss of ac power. Operator action is required to open the fire doors (76FDR-HB-272-2, 3, 4, 5 and 6) within 10 hours after the event (Reference 3.72). This action is incorporated into the FSGs. The maximum temperature given above includes this operator action. Following 120 hours, NSRC equipment can be used to repower plant ventilation equipment.

The calculation also determined that during extreme cold conditions the temperature in the Battery Room "A" approaches 66.7°F at 120 hours and the temperature in the Battery Room "B" approaches 65.7°F at 120 hours. The room temperature of both battery rooms remains above the battery minimum electrolyte temperature limit of 65°F. The calculation assumes that the outdoor temperature remains constant at the extreme minimum value of -23°F for the entire cold weather transient, which is not reflective of daily temperature variation, so this result is conservative. During extreme cold winter ambient condition, no operator action is required for FLEX mitigation strategies. Following 120 hours, NSRC equipment can be used to repower plant ventilation equipment.

An analysis (Reference 3.59) determined that the battery rooms will exceed 2% hydrogen concentration by volume 120.3 hours after battery charging begins, or at least 128.3 hours after the start of the ELAP/LUHS. Based on the results of the calculation, ventilation of the battery rooms is not required for FLEX Phase 2. Phase 2 for the electrical strategy starts when the FLEX generator is available to recharge the batteries, at least 8 hours after the start of the event. Phase 2 continues until off-site FLEX equipment from the NSRC arrives and is connected and ready for use. FLEX Phase 3 begins when the NSRC equipment is operational. Ventilation to remove hydrogen is not required until at least 120 hours after the start of the event. To provide ventilation for the battery rooms during Phase 3, and to prevent the concentration of hydrogen from exceeding 2%, the existing plant battery room ventilation fans are restarted using the 600 VAC FLEX DG and the NSRC generator.

2.11.1.4 Diesel-Driven Fire Pump Room

The ambient condition in the DDFP rooms must remain within the operating range of the DDFPs. A calculation (Reference 3.60) determined that the maximum allowed ambient temperature in the east and west DDFP rooms is 119°F. Reference 3.61 determined that the plant ventilation system for the DDFPs will not be operable in Phase 2, and that the doors to the Screenwell Building need to be opened while the DDFP is operating (Reference 3.72). Additionally, Reference 3.61 determined that the east and west DDFP rooms will indefinitely remain within the allowed temperature range if the doors to the east and west DDFP rooms are open prior to operation of the DDFPs. Room heating during extreme cold is not a concern due to the large heat load coming off of the operating DDFP.

The DDFPs have exhaust piping to remove the diesel exhaust from the pump rooms. The piping exits the building through the north wall of the Screenwell Building and extends approximately a foot beyond the building wall. The exhaust pipe has a flapper at the end to prevent weather or animals from entering. If a missile were to impact the exhaust pipe outside the Screenwell Building, the pipe could simply be cut off at the wall. The diesel exhaust piping is nonseismic. Reference 3.61 calculates the buoyancy driven natural circulation through the open DDFP room doors and determines that if a seismic event were to incapacitate the diesel exhaust piping, there is sufficient air exchange to prevent a buildup of diesel exhaust in either pump room that could choke the diesel engine.

2.11.1.5 Spent Fuel Pool Area

A calculation (Reference 3.52) determined the temperature profiles at all levels of the Reactor Building following an ELAP. The calculation evaluates two cases, one in which doors at the refuel floor and at grade are opened, and one in which the exhaust vent is opened in addition to the doors. Both cases include propping open a number of interior doors. Based on the results of this calculation, to minimize the area temperatures in the Reactor Building, the following manual actions should be performed (Reference 3.72):

- Ensure Doors R-227-3 (RCIC enclosure stairway side fire door) and R227-4 (RCIC enclosure RHR side fire door) remain open
- Open Doors R-369-1, R-369-2, R-272-1, and R-272-2 to the outside within 5 hours of the start of the event

Under this secanrio, the temperature in the refuel floor will reach 120°F at 13.6 hours into the event. All manual actions at the refueling floor will be completed prior to temperature reaching 120°F (Reference 3.49).

The following actions evaluated in the calculation may be performed and are considered defense in depth (not required):

- Open Reactor Building exhaust duct dampers 66AOV-101A, 66AOV-101B, and 66AOD-106A or 106B to the outside

2.11.1.6 Switchgear Room

A calculation (Reference 3.69) determined the steady-state temperature in the El. 272' east and west electrical bays and the El. 272' EDG switchgear rooms A and B during the Phase 2.

The steady-state temperature of the east electrical bay is 104.8°F during the Phase 2 alternate electrical strategy of the FLEX response to a BDBEE. This is lower than the acceptance criterion of 120°F based on NUMARC 87-00; therefore, no additional cooling is required. The steady-state temperature of the east electrical bay bounds the steady-state temperature of the west electrical bay.

The steady-state temperature of EDG switchgear room "A" is 105.6°F during the Phase 2 electrical strategy of the FLEX response to a BDBEE. This is lower than the acceptance criterion of 120°F; therefore, no additional cooling is required. The steady-state temperature of EDG switchgear room "A" bounds the steady-state temperature of EDG switchgear room "B".

During Phase 3, switchgear room ventilation is repowered using the NSRC generator.

2.11.1.7 Containment Venting

At JAF, Phase 1 of HCVS is scheduled to be implemented prior to June 30, 2018. Thus, as an interim measure, JAF will rely on the existing GL 89-16 vent for venting during a BDBEE until the HCVS is installed. To accomplish this, access to Standby Gas Treatment Building, Reactor Building Track Bay, and Reactor Building Elevations 272' and 344' are required prior to 5.5 hours into the event (Reference 3.49). The temperatures in these areas (with exception of Standby Gas Treatment (SBGT) Building) will be less than the access limit of 120°F (Reference 3.52). The temperature is the SBGT Building is expected to be lower than 120°F.

2.11.2 Heat Tracing

The JAF FLEX strategy does not have dependency on heat tracing for any required equipment after the initiation of the event. The FLEX equipment is protected from low temperatures and freezing during normal plant operation using electric heaters. Such heaters are provided for all diesel engine block heaters.

2.12 Personnel Habitability

Certain areas in the plant may be considered a hot environment if the BDBEE occurs during the summer. The area temperatures at every elevation of the Reactor Building are evaluated in Reference 3.52. The results of that calculation demonstrate that all elevations of the Reactor Building will become very hot over the course of the event. All equipment deployment actions will be performed early in the event.

Individual room heatup calculations were performed for the RCIC room, the battery rooms, and the switchgear rooms, where there were equipment operability concerns. None of these rooms require personnel access during a FLEX event after the initial equipment setup and deployment.

Operator actions required later in the event in all buildings are subject to applicable site and fleet procedures, including but not limited to, EN-IS-108 (Reference 3.79) in order to mitigate the risks of working in a hot environment. Following a BDBEE, EN-IS-108, FLEX support guidelines, and current site conditions will be used to determine operator stay times and need for personnel protection such as ice vests.

If the BDBEE occurs during the winter, cold temperatures would not affect the accessibility of equipment inside any plant buildings. There is no expected debris generation outdoors due to an extreme cold event. Snow and ice, as they relate to personnel routes to the FLEX equipment storage buildings and equipment deployment routes, are a consideration. However, JAF would have ample warning of impending snow and ice storms and will take appropriate precautions per existing plant practice such as preparing for salting roads and walkways, preparing/staging snowplowing vehicles, etc. Administrative procedure AP-12.04 and the FSGs are used to ensure FLEX path ways are maintained clear of snow and ice.

2.13 Lighting

Part of the standard gear/equipment of operators with duties in the plant (outside the main control room) includes flashlights; flashlights would be available to operations personnel immediately following the start of the event. This requirement is currently in plant procedure EN-OP-115, Operator Rounds (Reference 3.68). Additionally, the Reactor Building, Turbine Building, and Screenwell Building are provided with 8 hour uninterruptible power supplies (UPS) backed emergency lighting (Reference 3.78), some of which is repowered by the 600 VAC FLEX DG. The use of flashlights will provide enough illumination to accomplish FLEX manual operator actions. Portable lighting is available in the Control Room, TSC and OSC Emergency lockers for on-shift personnel. Portable lights, flashlights, and head lamp lights are located on the Electrical Cable Trailer stored in the N+1 FESB. Additionally, Mobile Lighting Tower will be provided by NSRC as part of Phase 3 generic equipment inventory.

2.14 Communications

Portable UHF radios will be used for communications between the MCR staff and operators/emergency personnel in the plant. This method of communication was described in Reference 3.20. The NRC reviewed and found the FitzPatrick communication assessment to be reasonable and that existing systems, enhancements, and modifications would ensure communications are maintained per NRC endorsed guidance of NEI 12-06 (Reference 3.3). The conclusion is documented in Reference 3.21.

On site:

A combination of batteries, uninterruptible power supplies (UPSs) and the phase 2 FLEX Diesel Generator to power site communication equipment are available. The site strategies will result in: (1) each satellite phone will be provided a 24-hour power supply capability through batteries; (2) radios will be provided a 24-hour power supply capability through batteries, and (3) radio repeater systems will be provided back up power by a combination of UPS units and portable diesel generators to support long term operation. The 600 VAC FLEX DG and power cables will provide continuous power to the credited equipment, once this equipment is connected during Phase 2.

The JAF MCR is equipped with a fixed satellite phone to provide operators in the MCR with outside communication without the need to leave the MCR envelope during a BDBEE.

The equipment required is located in different locations that, as a minimum, are constructed equivalent to the structural guidance presented for NUREG 0696. The EP communication equipment is reasonably protected during earthquakes, high winds (other than tornadoes) and floods. However, this equipment does not need to be shown to be seismically adequate by test or analysis. All onsite FLEX credited EP equipment is located inside the administration building. The administration building is a Seismic Class 2 structure (Reference 3.22), which has been evaluated for both OBE and SSE (Reference 3.22, Section 12.5.2). Although, the administration building is a seismic Class II structure, certain areas within the building are designed to meet the requirements of seismic Class I structures. The MCR envelope inside the administration building is one of these areas, which is also designed to survive both OBE and SSE (Reference 3.22, Section 12.2.2). Therefore, this structure can survive a BDBEE. The TSC, OSC and the fan room are in the Administration Building but outside the MCR envelope. The TSC, OSC and the assistant operations manager's office (AOM) also known as Office No. 3, are located inside the administration building at El. 286'. All the EP communication equipment located inside the TSC/OSC and the fan room were evaluated for seismic interaction to ensure they would survive a BDBEE (Reference 3.100).

Off Site:

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

2.15 Water sources

2.15.1 Secondary Water Sources

FLEX Raw Water Strategy Considerations:

The JAF FLEX strategy is, by necessity, a "raw water" strategy, that is, in the extreme case of losing all preferred sources of RPV makeup water (i.e., CST), the UHS raw water (Lake Ontario) which may be used in accordance with guidance for handling such low quality but plentiful water sources. This strategy is in accordance with NEI and BWROG guidance.

NEI 12-06 (Reference 3.3) Section 3.2.2, Minimum Baseline Capabilities states:

> "Under certain Beyond-Design-Basis Conditions, the integrity of some water sources may be challenged. Coping with an ELAP/LUHS may require water supplies for multiple days. Guidance should address alternate water sources and water delivery systems to support the extended coping duration. Cooling and makeup water inventories contained in systems or structures with designs that are robust with respect to seismic events, floods, and high winds, and associated missiles are assumed to be available in an ELAP/LUHS at their nominal capacities.
>
> Finally, when all other preferred water sources have been depleted, lower water quality sources may be pumped as makeup flow using available equipment (e.g., a diesel-driven fire pump or a portable pump drawing from a raw water source). Procedures/guidance should clearly specify the conditions when the operator is expected to resort to increasingly impure water sources."

Lake Ontario provides a raw water source that is of comparably high quality and low salinity. The JAF FLEX strategy is consistent with the positions stated in BWROG-TP-14-006 (Reference 3.39) and BWROG-TP-15-007 (Reference 3.50). The Phase 2 and Phase 3 RPV injection strategy pumps raw water with the DDFP (76P-1 or 76P-4) to the vessel through the RHR A or RHR B injection lines. The water level in the core and shroud will remain above the top of the fuel (Reference 3.34). DDFP 76P-1 takes suction downstream of the traveling screens. DDFP 76P-4 takes suction upstream of the traveling screens. The intake is through a long offshore tunnel well underwater in Lake Ontario (Reference 3.63, Table 4.1). During an ELAP/LUHS event, the flow velocities are extremely small, except near the suction to DDFP 76P-4, and the basin water is not well-mixed (Reference 3.49). Consequently, DDFP 76P-4 has inherent filtering by virtue of the fact that high density sediment will sink to the bottom and low density debris will float to the top of the inlet basin. Because there is not enough force at the bottom or surface to entrain high or low density debris, only suspended debris will be in the DDFP 76P-4 or 76P-1 flow streams, which go through the pump inlet strainers.

2.16 Shutdown and Refueling Analysis

JAF will follow the guidance provided by the Nuclear Energy Institute (NEI) position paper titled "Shutdown/Refueling Modes" (Reference 3.89) addressing mitigating strategies in shutdown and refueling modes. This position paper is dated September 18, 2013 and has been endorsed by the NRC staff (Reference 3.90) and incorporated into Exelon procedure EN-OU-108, Shutdown Safety Management Program. The approach for incorporation of this guidance is provided below.

In order to further reduce shutdown risk, the shutdown risk process and procedures have been enhanced through incorporation of the FLEX equipment. Consideration has been given in the shutdown risk assessment process to:

- Maintaining FLEX equipment necessary to support shutdown risk processes and procedures readily available, and
- How FLEX equipment could be deployed or pre-deployed/pre-staged to support maintaining or restoring the key safety functions in the event of a loss of shutdown cooling.

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

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

RPV Core Cooling:

The strategy for core cooling for Mode 4 is generally similar to those for Modes 1, 2, and 3. Should an ELAP occur during Mode 4 (i.e., cold shutdown), the water in the vessel will heat up due to the decay heat in the fuel assemblies. When the coolant temperature reaches 212°F (i.e., Mode 3, hot shutdown) the vessel will begin to pressurize. As steam is generated during the pressure rise, RCIC can be returned to service with suction from the CST to provide injection flow. When pressure rises to the SRV setpoints then pressure will be controlled by SRVs. See Sections 2.3.1 through 2.3.3 above for core cooling. It should be noted that the heatup from cold shutdown conditions through vessel pressurization will provide some amount of additional time to setup FLEX equipment for makeup and cooling.

During Mode 5, many variables impact the ability to cool the core. To accommodate the activities of vessel disassembly and refueling, water levels in the reactor vessel and the reactor cavity are often changed. The most limiting condition is the case in which the reactor head is removed and water level in the vessel is at or below the reactor vessel flange. If an ELAP/LUHS occurs during this condition then (depending on the time after shutdown) boiling in the core occurs quite rapidly. An analysis (Reference 3.64), determined that in Mode 5, with high water level in the pools but the core not yet off-loaded, that the time for boiling to begin is approximately 7.17 hours. However, if the BDBEE should occur at the most vulnerable time of the refueling outage, during initial RPV disassembly when water level is at the reactor vessel head flange, then time to boil is approximately 1.6 hours. And if no mitigating actions are performed, boiling will continue and level will be reduced to the top of active fuel in approximately 12.4 hours. Therefore, if a BDBEE occurs during Mode 5, Phase 2 actions for core cooling must be in place by approximately 12 hours to prevent fuel in the RPV from being uncovered. This timeline is still considered feasible because the required manual valve manipulations are fewer for this scenario, and there will be minimal house routing required.

The primary and alternate strategies for makeup water during a Mode 5 scenario are the same as for Modes 1, 2, and 3, Phase 2 as discussed above. The probability of a BDBEE occurring within the rather small time window wherein the head seals have been broken and the cavity has not had any significant flooding is very low.

SFP Core Cooling:

During Modes 4 and 5, depending on equipment status, vessel and pool levels, and degree of core offload, the SFP may begin to boil during Phase 1 of the event. The pool heat-up calculation (Reference 3.35) indicates the shortest time to boil in the SFP occurs at 5.5 days into the refueling outage upon the completion of a full core offload (not typically performed at JAF.) Even if the BDBEE were to occur at that time, the time to boil the SFP is 8.1 hours and the makeup flow rate is 60 gpm (well within the capabilities of the DDFPs). The referenced calculation determined a full core offload at 5.5 days after shutdown, results in a time to uncover the fuel of 65 hours. The outage risk plan requires prestaging of required FLEX hoses and adapters to expeditiously implement SFP cooling.

Containment Strategy

During Modes 4 and 5 Technical Specifications allow primary and secondary containment to be breached to provide opportunity for maintenance and testing.

The outage risk planning process is governed by fleet procedure EN-OU-108, Shutdown Safety Management Program (SSMP), which is consistent with the shutdown/refueling modes position (Reference 3.3, Section 3.2.1.13). The outage risk planning process will consider and determine the need for any specific FLEX equipment pre-staging or pre-deployment actions based on the risk to the safety functions at any given time in the refueling outage.

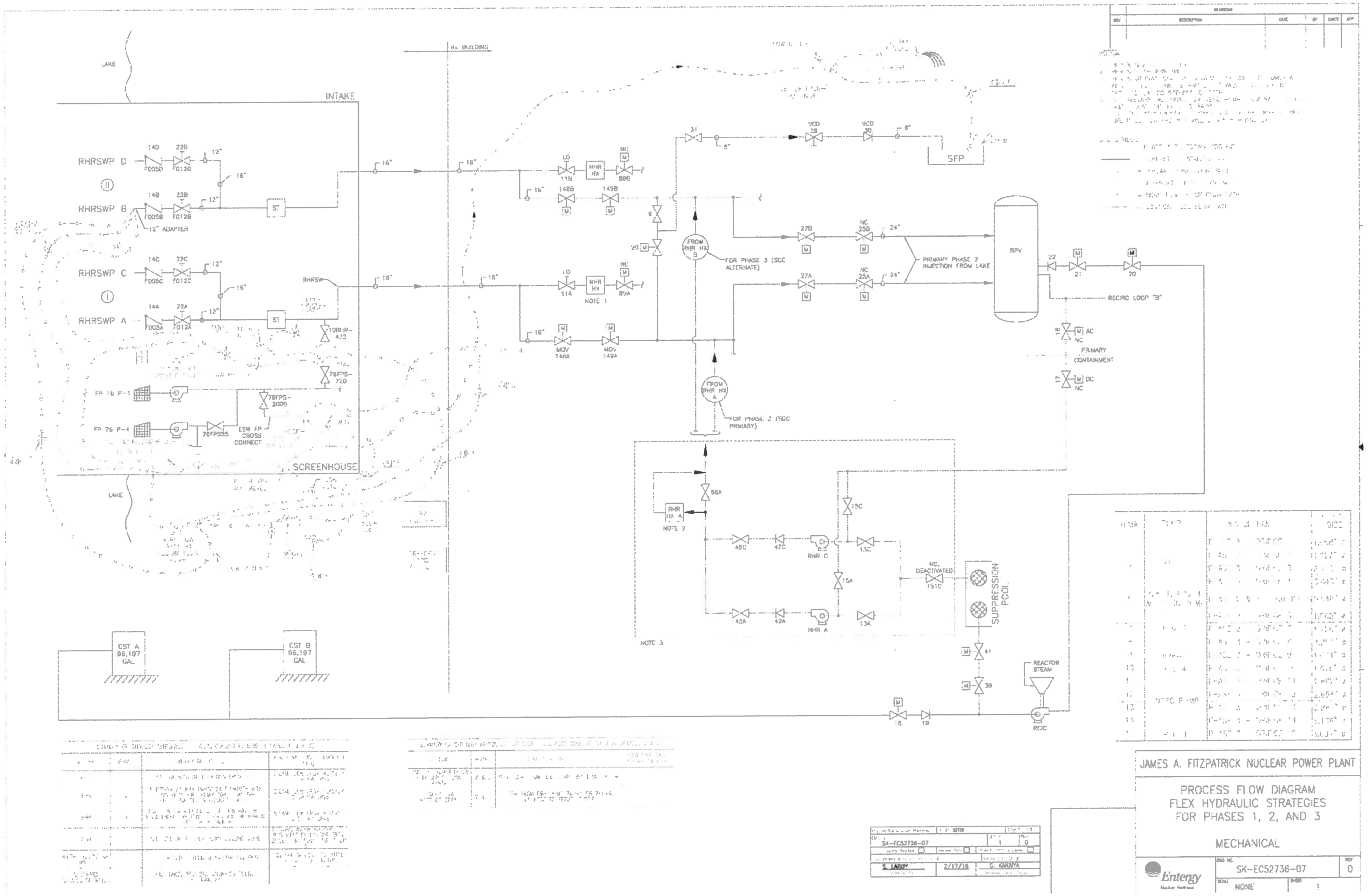

Figure 1: Phases 1, 2 and 3 FLEX Water Strategies

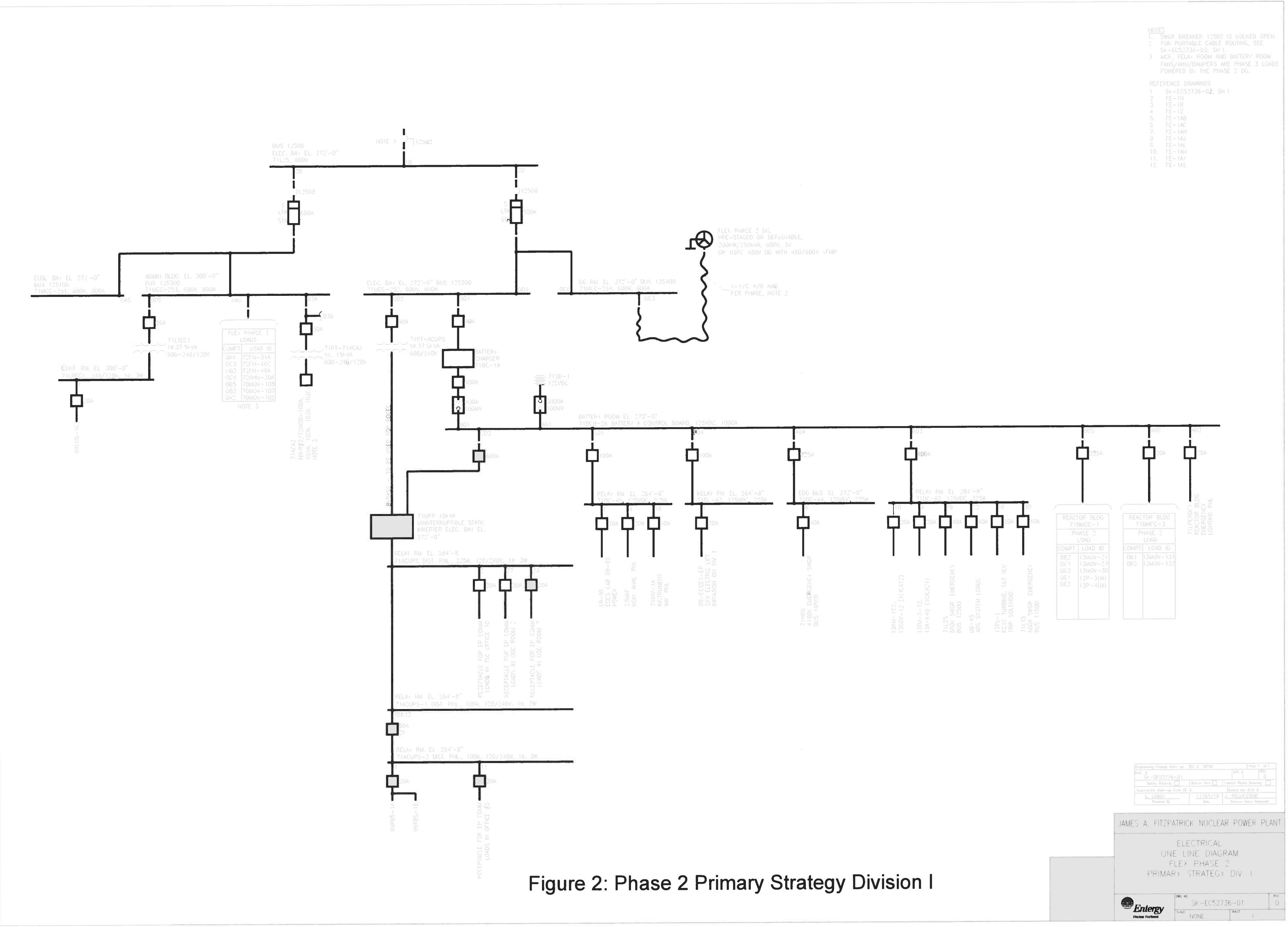

Figure 2: Phase 2 Primary Strategy Division I

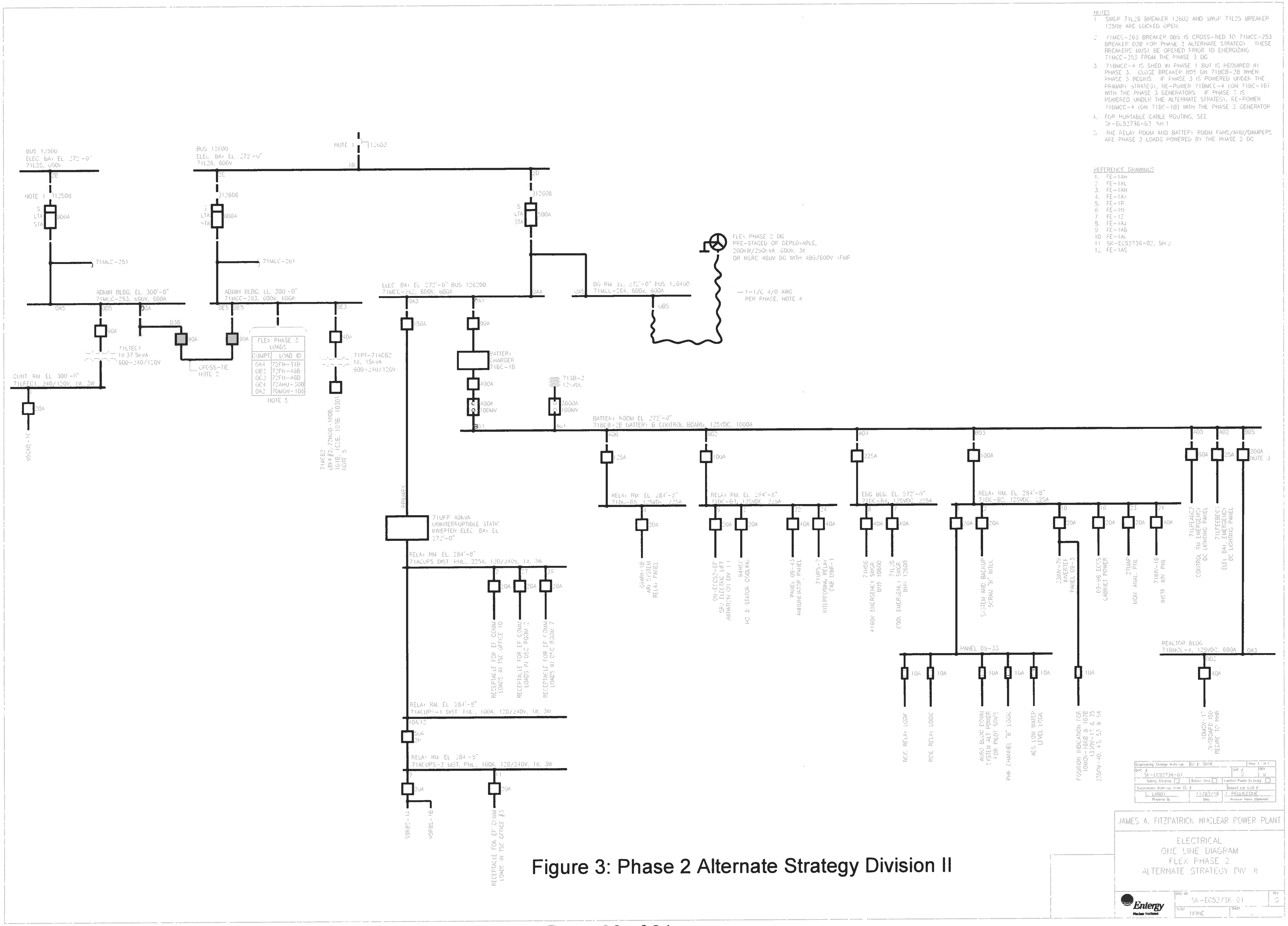

Figure 3: Phase 2 Alternate Strategy Division II

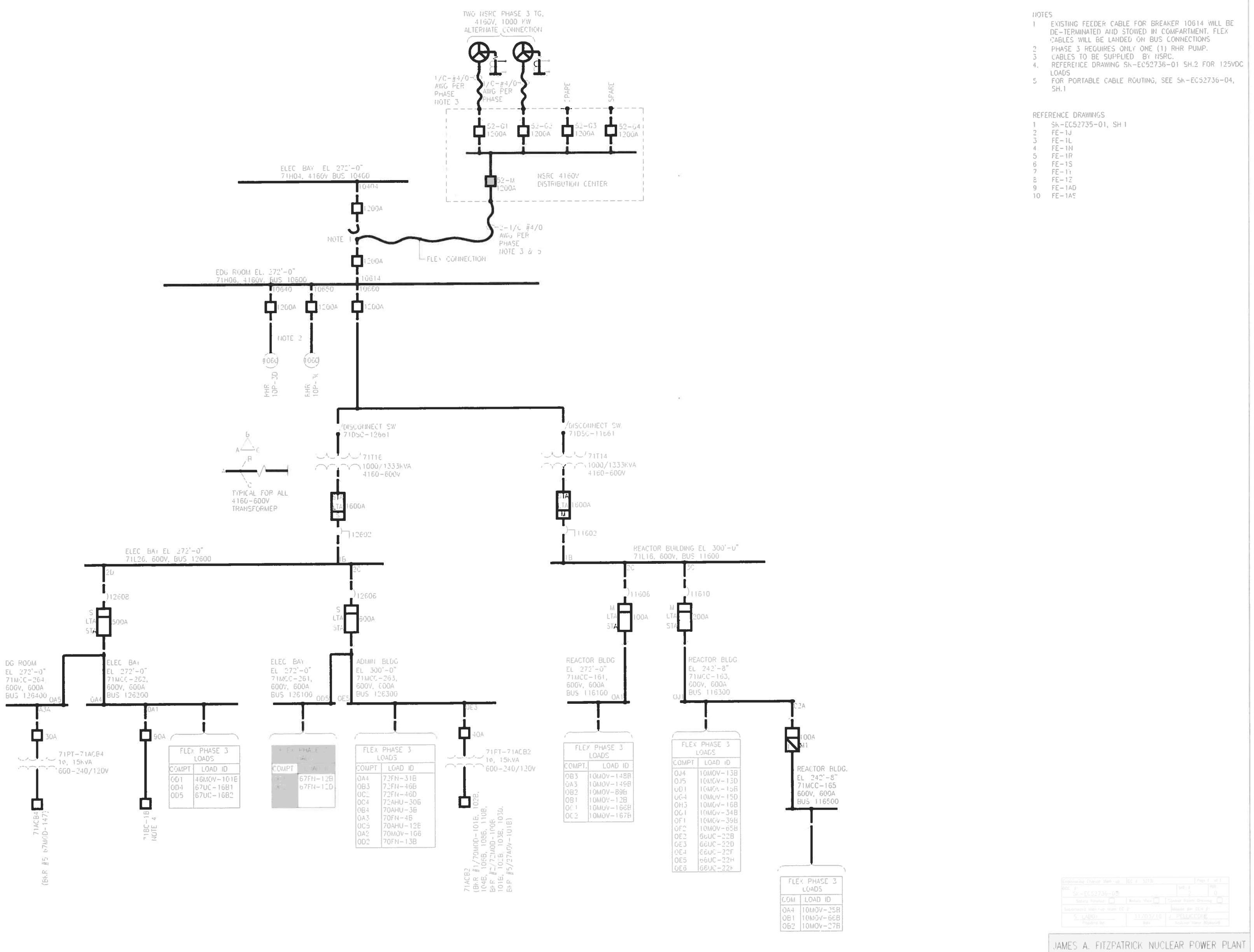

Figure 4: Phase 3 Primary Strategy Division II

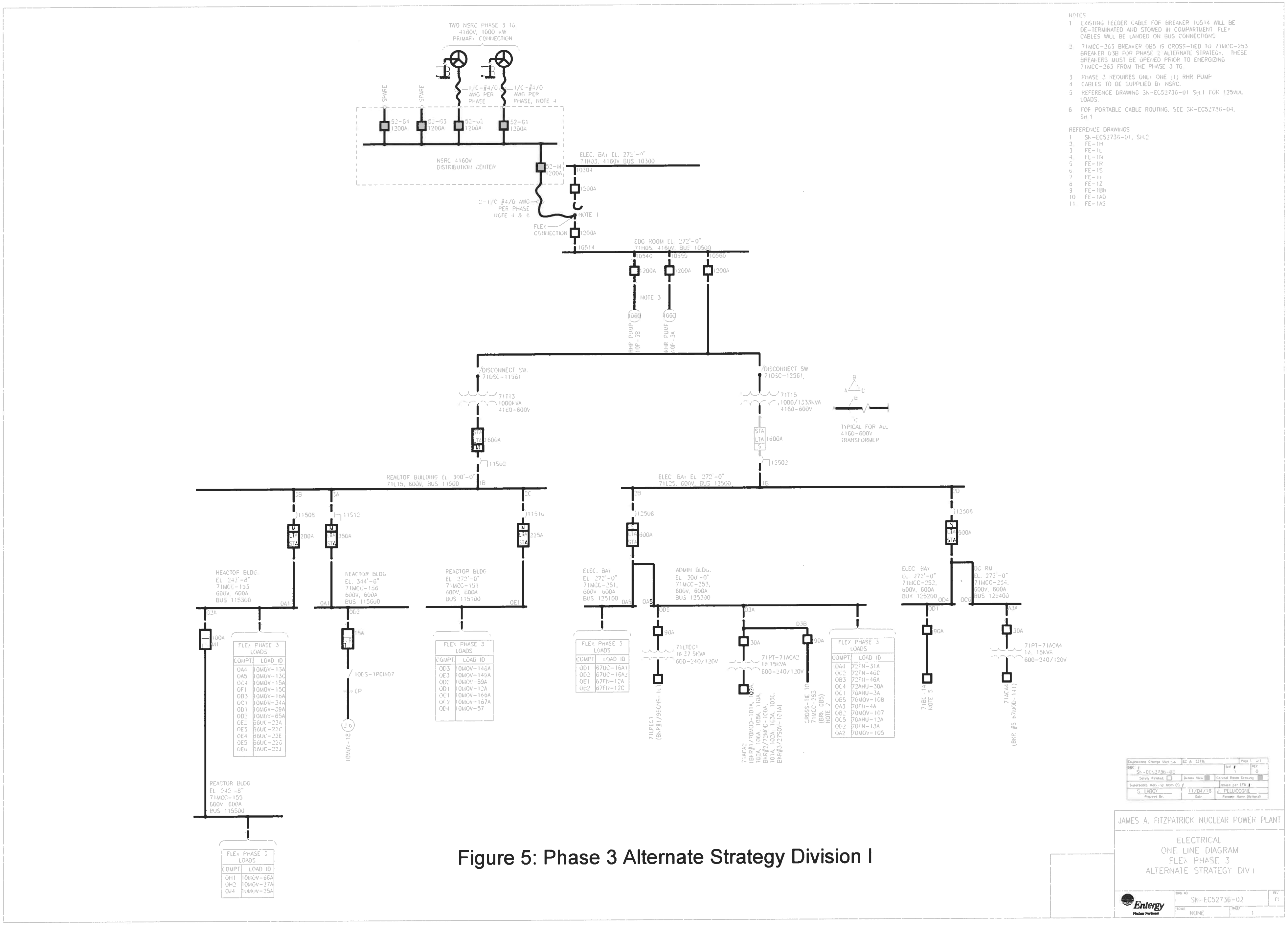

Figure 5: Phase 3 Alternate Strategy Division I

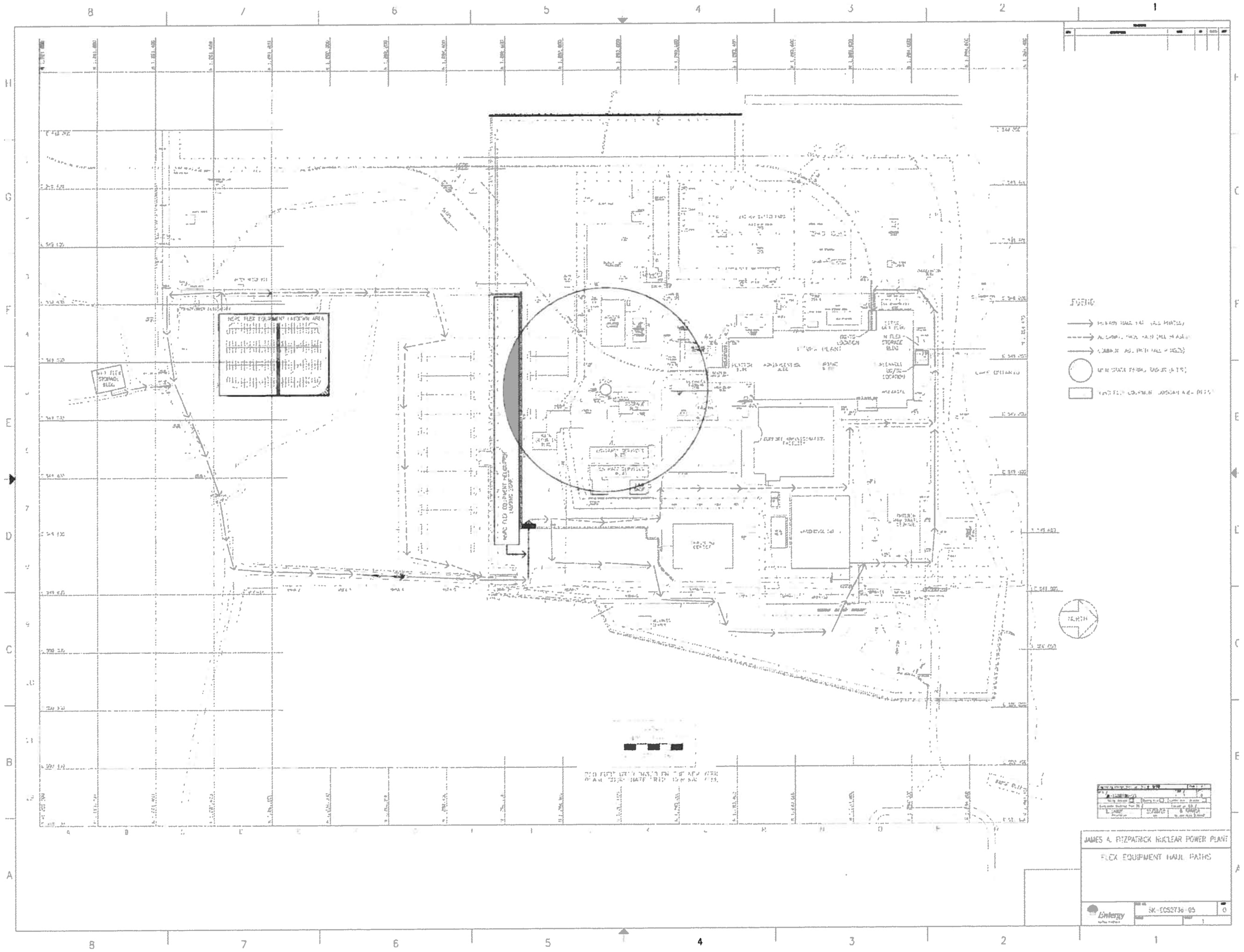

Figure 6: FLEX Equipment Deployment

2.17 Sequence of Events

Table 1 below presents a sequence of events (SOE) timeline for an ELAP/LUHS event at JAF. The timeline is based on JAF specific analysis. Validation (Reference 3.80) of each of the FLEX time sensitive actions has been completed in accordance with Appendix E of NEI 12-06 (Reference 3.3). A debris removal assessment based on site reviews of the equipment deployment routes and the locations of each of the two FESBs has been performed to determine a reasonable time needed to clear debris to allow FLEX equipment deployment to support the Phase 2 and beyond strategies. Debris removal equipment is stored in the "N+1" FESB.

Additional technical basis details regarding the identified time critical actions follow the table and are indexed by the table "Action Item" number.

Table 1
Sequence of Events

Action item	Elapsed Time	Action	Remarks / Applicability
	0	**Event Starts**	Plant @100% power
1	60 sec	RCIC/HPCI starts	Reactor Operators initiate or verify initiation of RPV water injection with steam driven high pressure pumps and enter SBO procedure
2	10 min	OPS manual control of SRVs to limit cycling	SRVs cycle on & off in safety-relief mode at their setpoints for 10 minutes. Conservative because operators trained to quickly take control.
3	30 min	Operate RCIC (continuous operation until CST depletion) Stop HPCI Complete SBO Battery Load Shed	Current SBO procedure AOP-49
4	1 hr	Defeat RCIC trips and interlocks Additional Load Shed	Current SBO procedure AOP-49

Table 1 Sequence of Events			
Action item	**Elapsed Time**	**Action**	**Remarks / Applicability**
		Open fire doors for RCIC & HPCI Rooms	
5	1 hr	Attempts to start EDGs unsuccessful. Enter ELAP Procedure	Entry into Extended Loss of ac Power (ELAP) provides guidance to operators for ELAP actions.
6	1 hr	Operators manually depressurize the RPV (during cooldown, reactor pressure is maintained between 600 – 400 psi).	Action required at approximately 1 hour, per MAAP analysis, to keep reactor pressure and temperature away from Unsafe Region of HCTL curve.
7	1 hr	Open RCIC Room door R-227-5 and prop open RCIC Room doors R-227-3 and R-227-4	Provide RCIC Room ventilation; Doors R-227-3 and R-227-4 have a fusible link that fails at 135F, at approximately 19 hours.
8	1.5 hrs	Complete FLEX dc Load Shed.	Load shed completed to assure 9.5 hours+ of battery life (per load shed calc)
9	2 hrs	Close 39IAS-25 and 39IAS-28	Necessary only if tornado event were to take out CAD Nitrogen Tanks.
10	2.5 hrs	Manual control of SRVs depressurize RPV (to approximately 200 – 400 psig)	Manual depressurization to 200 psig per the MAAP calculation.
11	5 hrs	Open RB doors R-369-1, R-369-2, R-272-1, and R-272-2	Provide ventilation for Refuel floor and other areas of RB
12	5.5 hrs	Open containment vent path	Containment vent path opened at 10 psig suppression chamber pressure to allow this path

Table 1
Sequence of Events

Action item	Elapsed Time	Action	Remarks / Applicability
13	5.7 hrs	Reactor Building Hose Runs and manual actions for elevations above El. 272'	The Reactor Building elevations about El. 272' reach a temperature of 120°F at a minimum of 5.7 hours. It is recommended that manual actions in those elevations be completed before this time.
14	8 hrs	FLEX DG power to Division I (or Division II) 125VDC Station Battery Charger	From Battery Time to Discharge analysis with dc load shed. 9.5 hrs for both Battery Divisions
15	10 hrs	Open 76FDR-HB-272-2, -3, -4, -5, -6	Ventilation for battery room and dc Equipment Room Heat up during extreme heat ambient conditions.
16	16 hrs	Defeat RCIC suction auto-swap to suppression pool from CST.	Time based on time to reach auto swap point of 59.9 inches CST level in OP-19 and average flowrate in MAAP calculation (2 hour margin provided).
16a	19 Hrs	First diesel refueling cycle for the FLEX DG	Time constraint based on fuel usage analysis.
17	22 hrs	Establish UHS (Lake Ontario) flow using DDFP direct to vessel injection	Total capacity of CSTs determines this time. Protected sections of the CSTs hold minimum 192,000 gallons
18	24 hrs	Establish flow to SFP via one of three identified methods	Flow not required until approximately 32.7 hours to stop boiling.
19	30 hrs	First diesel refueling cycle for Diesel Driven Fire Pump	Time constraint based on fuel usage analysis.
20	72 hr	Continue to operate the DDFP feeding the SFP and the Reactor from the UHS (Lake Ontario).	Continues until Phase 3 equipment is on site and recovery of RHR loop shutdown cooling established by

Table 1 Sequence of Events			
Action item	**Elapsed Time**	**Action**	**Remarks / Applicability**
			repowering an RHR pump and aligning the DDFP for RHRSW.
21	≥ 72 hrs	Deploy NSRC Generators	
22	≥ 72 hrs	Align DDFP for Shutdown Cooling (SDC) by placing one RHR pump in service	After NSRC generator is deployed
23	≥ 72 hrs	Deploy NSRC Air Compressor	

2.18 Programmatic Elements

2.18.1 Overall Program Document

The JAF Program Document (Reference 3.73) provides a description of the FLEX program for JAF. The key program elements provided in the Program Document include:

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

In addition, the Program Document includes a list of the engineering documents that provide the bases for the FLEX strategies. Process Changes have been made to ensure that proposed changes to the plant and the procedures that direct, implement, or interface with a FLEX strategy are screened in accordance with existing design control procedures to verify the change will not adversely impact the FLEX strategies (References 3.91 & 3.92).

Future changes to the FLEX strategies may be made without prior NRC approval provided 1) the revised FLEX strategies meet the requirements of NEI 12-06, or the change to the strategies and guidance implement an alternative approach approved by the NRC, provided that the bases of the NRC approval are applicable to the JAF's facility, or an evaluation demonstrates that the provisions of order EA-12-049 continue to be met, and 2) an engineering basis is documented that ensures that the change in FLEX strategies continues to ensure the key safety functions (core and SFP cooling, containment integrity) are met.

2.18.2 Procedural Guidance

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

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

Procedural interfaces have been incorporated into the station blackout procedure (Reference 3.25) to the extent necessary to include appropriate reference to FSGs and provide command and control for the ELAP.

FSG maintenance will be performed by Operations Department. In accordance with site administrative procedures, NEI 96-07, Revision 1, Guidelines for 10 CFR 50.59 Implementation, and NEI 97-04, Revision 1, Design Bases Program Guidelines, are to be used to evaluate changes to current procedures, including the FSG, to determine the need for prior NRC approval. However, per the guidance and examples provided in NEI 96-07, Rev. 1, changes to procedures (EOPs, AOPs, EDMGs, SAMGs, or FSGs) that perform actions in response events that exceed a site's design basis should screen out. Therefore, procedure steps which recognize the ELAP/LUHS has occurred and which direct actions to ensure core cooling, SFP cooling, or containment integrity should not require prior NRC approval notwithstanding that the changes still conform to NEI 12-06 Revision 4 guidance or an NRC approved alternative approach.

FSGs will be reviewed and validated by the involved groups to the extent necessary to ensure the strategy is feasible. Validation and verification process is based on the guidance of NEI 12-06, Appendix E.

2.18.3 Staffing

Using the methodology of (Nuclear Energy Institute) NEI 12-01, *Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities*, an assessment of the capability of the JAF on-shift staff and augmented Emergency Response Organization (ERO) to respond to a BDBEE has been performed. The results were provided to the NRC(Reference 3.75).

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

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

A team of subject matter experts from Operations, Radiation Protection, Chemistry, Training, Emergency Planning and FLEX Project Team personnel performed a tabletop the week of October 10, 2016. The participants reviewed the assumptions and applied procedural guidance, including applicable draft and approved FSGs for coping with a BDBEE using minimum on-shift staffing. Particular attention was given to the sequence and timing of each procedural step, its duration, and the on-shift individual performing the step to account for both the task and the estimated time to prepare for and perform the task.

The Phase 2 staffing assessment concluded that the current minimum on-shift staffing as defined in the JAF Emergency Plan is sufficient to support the implementation of the mitigating strategies (FLEX strategies) as well as the required Emergency Plan actions, with no unacceptable collateral tasks assigned to the on-shift personnel during the first 6 hours. The assessment also concluded that the on-shift staffing, with assistance from augmented staff, is capable of implementing the FLEX strategies necessary after the 6 hour period within the constraints. It was concluded that the Emergency response function would not be degraded or lost (Reference 3.75). In its letter (Reference 3.99) to JAF, NRC concludes that the licensee's Phase 2 staffing submittal adequately addresses the response strategies needed to respond to a BDBEE.

2.18.4 Training

The Exelon Nuclear Training Program has been revised to assure personnel proficiency in the mitigation of BDBEEs is adequate and maintained. These programs and controls were developed and have been implemented in accordance with the Systematic Approach to Training (SAT) Process (References 3.93 & 3.95).

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

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

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

2.18.5 Equipment List

The equipment stored and maintained at the JAF FLEX Storage areas necessary for the implementation of the FLEX strategies in response to a BDBEE at JAF is listed in Table 3. Table 3 identifies the quantity, applicable strategy, and capacity/rating for the major FLEX equipment components only, as well as, various clarifying notes. Details regarding fittings, tools, hose lengths, consumable supplies, etc. are not in Table 3.

2.18.6 Equipment Maintenance and Testing

Periodic testing and preventative maintenance of the BDB/FLEX equipment conforms to the guidance provided in INPO AP-913. A fleet procedure has been developed to address Preventative Maintenance (PM) using EPRI templates or manufacturer provided information/recommendations, equipment testing, and the unavailability of equipment.

EPRI has completed and has issued "Preventive Maintenance Basis for FLEX Equipment - Project Overview Report" (Reference 3.94). Preventative Maintenance Templates for the major FLEX equipment including the portable diesel generators have also been issued.

The PM Templates include activities such as:

- Periodic Static Inspections
- Fluid analysis
- Periodic operational verifications
- Periodic functional verifications with performance tests

PMs have been developed for both the “Standby” condition and the "Deployed" condition for the FLEX and Support Equipment.

The EPRI PM Templates for FLEX equipment conform to the guidance of NEI 12-06 providing assurance that stored or pre-staged FLEX equipment are being properly maintained and tested. EPRI Templates are used for equipment where applicable. However, in those cases where EPRI templates were not available, Preventative Maintenance

(PM) actions were developed based on manufacturer provided information/recommendations and JAF's Preventive Maintenance Program. Detailed information on FLEX and FLEX support equipment PM's is contained in FLEX program document EDSO-5 (Reference 3.73).

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

The unavailability of equipment and applicable connections that directly perform a FLEX mitigation strategy for core, containment, and SFP will be managed such that risk to mitigating strategy capability is minimized. Maintenance/risk guidance conforms to the guidance of NEI 12-06 as follows:

a. The controls for plant equipment that performs a FLEX function are provided by existing plant processes such as the Technical Specifications.

b. FLEX equipment may be non-functional for 90 days provided that the site FLEX capability (N) is available.

c. One of the connections to plant equipment required for FLEX strategies can be unavailable for 90 days provided the remaining connection remains available such that the site FLEX strategy is available.

d. If FLEX equipment or connections become unavailable such that the site FLEX capability (N) is not maintained, initiate actions within 24 hours to restore the site FLEX capability (N) and implement compensatory measures (e.g., use of alternate suitable equipment or supplemental personnel) within 7 days, or in advance of a forecast external event.

e. If the FLEX capability (N) is met but the equipment being relied on to meet the FLEX capability (N) is not all in its specified reasonable protection configuration for the N equipment, restore protection or implement compensatory actions (e.g., review hazard applicability under current conditions, achieve alternate protection or equipment separation, etc.) to justify a temporary reasonable protection configuration within 14 days or in advance of a forecast external event. Restore the specified reasonable protection configuration within 90 days

f. FLEX equipment may be pre-staged for up to 45 days to reduce the risk of maintenance or outage activities. For this pre-staged equipment, condition "e" above does not apply.

Work Management procedures will reflect AOT (Allowed Outage Times) as outlined above.

2.19 Alternate Approaches to NEI 12-06

The FLEX strategy designed and implemented at JAF conforms to NEI 12-06 Rev. 4 with no alternate approaches.

Table 2
Water Sources

Water sources and associated piping that fully meet ALL BDB external hazards, i.e., are FLEX qualified								
Water Sources	Usable Volume (Gallons)	Applicable Hazard					Time Based on Decay Heat	Cumulative Time Based on Decay Heat
		Satisfies Seismic	Satisfies Flooding	Satisfies High Winds	Satisfies Low Temp	Satisfies High Temp		
CST	192,000	Y	Y	Y (Note 1)	Y	Y	22 hours	22 hours
UHS (Lake Ontario) via DDFP	Not limiting	Y	Y	Y	Y	Y	Not Limited	Not Limited

(1) Limited by Tornado Missile protection height

Table 3
BWR FLEX Equipment Stored On-Site

	Use and (Potential / Flexibility) Diverse Uses					Performance Criteria
List FLEX Equipment	Core	Containment	SFP	Instrumentation	Accessibility	
One (1) Super Duty Pickup Trucks					X	Ford F350 or equal that can tow the diesel generators
One (1) Tractor for Debris Removal					X	John Deere Model JD811
Two (2) 600 VAC Generator	X	X		X		200 kW
Two (2) Plug-in Buckets	X	X		X		
One (1) Hose Trailer					X	Means to store and transport hoses and miscellaneous equipment
One (1) Cable Trailer					X	Means to store and transport cables and miscellaneous equipment
Two (2) Fuel Transfer Skids					X	For diesel driven fire pumps & Phase 2 diesel generators
One (1) Submersible Pumps[1]	X	X	X			36 ft @ 2500 GPM with 25 gpm @ 2800 psi hydraulic drive pressure

[1] To be used with NSRC Suction Lift Booster Pump hydraulic power unit listed in Table 4.

Table 4
BWR Off-Site FLEX Equipment From NSRC

Use and (Potential / Flexibility) Diverse Uses										Performance Criteria	
List of Off-Site Equipment	**Qty Req'd /Unit**	**Qty Provided / Unit**	**Power**	**Core Cool-ing**	**Cont. Cooling/ Integrity**	**SFP**	**Access**	**Instrumen-tation**	**RCS Inventory**		
Medium Voltage Generators (Generic)	1	2	Turbine	X	X	X		X	X	4160 VAC	2 MW
Low Voltage Generator (Generic)	0	1	Turbine	X	X	X		X		480 VAC	1000 kW
High Pressure Injection Pump (Generic)	0	1	Diesel							2000#	60 GPM
SG/RPV Makeup Pump (Generic)	0	1	Diesel							500#	500 GPM
Low Pressure / Medium Flow Pump (Generic)	1	1	Diesel	X	X	X				300#	2500 GPM
Low Pressure / High Flow (Dewatering) Pump (Generic)	0	1	Diesel	X	X	X				150#	5000 GPM
Lighting Tower (Generic)	0	3	Diesel				X				440,000 Lu
Diesel Fuel Transfer (Generic)	0	1	ac/dc	X	X	X	X	X			240 Gallons

Table 4
BWR Off-Site FLEX Equipment From NSRC

Use and (Potential / Flexibility) Diverse Uses										Performance Criteria	
List of Off-Site Equipment	Qty Req'd /Unit	Qty Provided / Unit	Power	Core Cool-ing	Cont. Cooling/ Integrity	SFP	Access	Instrumen-tation	RCS Inventory		
Fuel Air-Lift Containers (Generic)	0	1	N/A	X	X	X	X	X			500 Gallons
On-Site Diesel Transfer (Generic)	0	1	Diesel	X	X	X	X	X			60 GPM
Portable Diesel Fuel Tank and Attached Pumps (Generic)	0	1	ac/dc	X	X	X	X	X			264 Gallons 25 GPM
4160 VAC Distribution System (Generic)	0	1	4160 VAC	X	X	X		X			1200 AMP
Air Compressor (Non-Generic)	1	1	Diesel	X	X					150#	300 scfm
Suction Lift Booster[2]	1	1	Diesel/Hy draulic	X	X	X				36 ft	2500 GPM
480-600V Step-up Transformer	1	1		X	X	X		X		480 VAC/600 VAC	1375 KVA

[2] Only the hydraulic power unit portion of the pump skid will be use to supply hydraulic drive power to the submersible pump listed in Table 3. Performance criteria is based on hydraulic drive pressure of 2800 psi at 25 gpm.

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