Exelon Generation.

Order No. EA-12-049

RS-16-088

July 15, 2016

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Byron Station, Unit 2
Renewed Facility Operating License No. NPF-66
NRC Docket No. STN 50-455

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

References:

1. NRC Order Number EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements For Mitigation Strategies For Beyond-Design-Basis External Events," dated March 12, 2012
2. NRC Interim Staff Guidance JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," Revision 0, dated August 29, 2012
3. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0, dated August 2012
4. Exelon Generation Company, LLC's Initial Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated October 25, 2012
5. Exelon Generation Company, LLC Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated February 28, 2013 (RS-13-018)
6. Exelon Generation Company, LLC First Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated August 28, 2013 (RS-13-115)
7. Exelon Generation Company, LLC Second Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated February 28, 2014 (RS-14-008)

8. Exelon Generation Company, LLC Third Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated August 28, 2014 (RS-14-206)
9. Exelon Generation Company, LLC Fourth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated February 27, 2015 (RS-15-017)
10. Exelon Generation Company, LLC Fifth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated August 28, 2015 (RS-15-209)
11. Exelon Generation Company, LLC Sixth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated February 26, 2016, Byron Station, Unit 2 (RS-16-021)
12. NRC letter to Exelon Generation Company, LLC, Byron Station, Units 1 and 2 – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049, (Mitigation Strategies) (TAC Nos. MF0893 and MF0894), dated December 17, 2013
13. NRC Letter, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated March 12, 2012
14. Exelon Generation Company, LLC letter to USNRC, Response to March 12, 2012, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, Enclosure 5, Recommendation 9.3, Emergency Preparedness – Staffing, Requested Information Items 1, 2, and 6 - Phase 2 Staffing Assessment, dated May 29, 2014 (RS-14-119)
15. NRC letter to Exelon Generation Company, LLC, Byron Station, Unit Nos. 1 and 2 – Report for the Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Pool Instrumentation Related to Orders EA-12-049 and EA-12-051 (TAC Nos. MF0893, MF0894, MF0872, and MF0873), dated December 17, 2014

On March 12, 2012, the Nuclear Regulatory Commission ("NRC" or "Commission") issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements For Mitigation Strategies For Beyond-Design-Basis External Events," (Reference 1) to Exelon Generation Company, LLC (EGC). Reference 1 was immediately effective and directed EGC 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.

Reference 1 required submission of an initial status report 60 days following issuance of the final interim staff guidance (Reference 2) and an Overall Integrated Plan (OIP) pursuant to Section IV, Condition C. Reference 2 endorsed industry guidance document NEI 12-06, Revision 0 (Reference 3) with clarifications and exceptions identified in Reference 2. Reference 4 provided the EGC initial status report regarding mitigation strategies. Reference 5 provided the Byron Station, Unit 2 OIP.

Reference 1 required submission of a status report at six-month intervals following submittal of the OIP. References 6, 7, 8, 9, 10, and 11 provided the first, second, third, fourth, fifth, and sixth six-month status reports, respectively, pursuant to Section IV, Condition C.2, of Reference 1 for Byron Station, Unit 2.

The purpose of this letter is to provide the report of full compliance with the March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements For Mitigation Strategies For Beyond-Design-Basis External Events (Order Number EA-12-049) (Reference 1) pursuant to Section IV, Condition C.3 of the Order for Byron Station, Unit 2.

Byron Station, Unit 2 has developed, implemented, and will maintain the 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 in response to Order EA-12-049. The information provided herein documents full compliance for Byron Station, Unit 2 with Reference 1.

OIP open items have been addressed and closed as documented in References 6, 7, 8, 9, 10, and 11, and are considered complete pending NRC closure. EGC's response to the NRC Interim Staff Evaluation (ISE) open and confirmatory items identified in Reference 12 have been addressed and closed as documented in References 7, 8, 9, 10, and 11, and are considered closed as documented in Reference 15. EGC's response to the NRC ISE confirmatory items identified as open in Reference 15 are addressed below, and are considered complete pending NRC closure. EGC's response to the NRC audit questions and additional audit open items have been addressed and closed as documented in References 10, 11, and 15, and are considered complete pending NRC closure. The following tables provide completion references for each OIP open item and NRC ISE open or confirmatory item, and NRC Audit Report open item.

Overall Integrated Plan Open Items

Key Site assumptions (p.4)	Primary and secondary storage locations have not been selected yet; once locations are finalized implementation strategies and routes will be assessed for hazard impact.	Reference 9
Sequence of events (p.5)	The final timeline will be time validated once detailed designs are completed and procedures are developed.	Reference 11
Identify how strategies will be deployed (p.7)	Identification of storage area and creation of the administrative program.	Reference 9
Programmatic controls (p.8)	Develop an administrative program for FLEX responsibilities, and testing & maintenance.	Reference 10
National SAFER Response Center plan (p.9)	Development of Byron Station's playbook.	Reference 9
Key Reactor Parameters (p. multiple)	Identify additional parameters that are needed in order to support key actions	Reference 9

	identified in the plant procedures/guidance or to indicate imminent or actual core damage.	
Deployment Conceptual Design (p. multiple)	Develop the storage structure conceptual design.	Reference 9
Maintain RCS Inventory Control, Phase 2 (p.23)	A calculation will be required for the timing of the boration and quantity required.	References 10 and 11
Maintain Containment, Phase 1 (p.31)	Additional calculations will be performed to evaluate containment response.	References 9 and 11
Maintain Spent Fuel Pool Cooling, Phase 1 (p.39)	Procedure development for Initial Spent fuel pool make-up with gravity drain from the RWST.	Reference 9
Maintain Spent Fuel Pool Cooling, Phase 1 (p.39)	Initial calculations were used to determine the fuel pool timelines. Formal calculations will be performed to validate this information during development of the spent fuel pool cooling strategy detailed design.	Reference 9
Maintain Spent Fuel Pool Cooling, Phase 1, (p.39 and p.42)	Evaluation of the spent fuel pool area for steam and condensation will be performed and used to determine if vent path strategy is needed.	Reference 9
Safety Functions Support, Phase 2 (p.51)	Habitability conditions will be evaluated and a strategy will be developed to maintain Main Control Room.	Reference 9
Safety Functions Support, Phase 2 (p.51)	Critical ventilation assets may be required to support DDAF pumps, station battery rooms, miscellaneous electric equipment rooms, and fuel handling building personnel habitability and/or component survivability. Specific analyses of these rooms will be performed.	Reference 9

Interim Staff Evaluation Open Items

Item No. 3.2.1.8.A	Reference 11

Interim Staff Evaluation Confirmatory Items

Item No. 3.1.1.1.A	Reference 9
Item No. 3.1.1.3.A	Reference 9

Item No. 3.1.1.4.A	Reference 8
Item No. 3.1.5.1.A	Reference 9 and updated with this submittal as provided below
Item No. 3.1.5.3.A	Reference 9 and updated with this submittal as provided below
Item No. 3.2.1.A	Reference 9
Item No. 3.2.1.1.A	Reference 9
Item No. 3.2.1.1.B	Reference 9
Item No. 3.2.1.1.C	Reference 9
Item No. 3.2.1.1.D	Reference 9
Item No. 3.2.1.2.B	References 10 and 11
Item No. 3.2.1.2.E	Reference 8
Item No. 3.2.1.3.A	References 9 and 10
Item No. 3.2.1.4.A	Reference 10
Item No. 3.2.1.4.B	Reference 9
Item No. 3.2.1.5.A	Reference 8
Item No. 3.2.1.6.A	Reference 11
Item No. 3.2.1.6.B	Reference 9
Item No. 3.2.1.9.A	Reference 9
Item No. 3.2.2.A	Reference 9
Item No. 3.2.3.A	References 9 and 10
Item No. 3.2.3.B	Reference 9
Item No. 3.2.4.1.A	Reference 9
Item No. 3.2.4.2.A	Reference 9
Item No. 3.2.4.2.B	Reference 9
Item No. 3.2.4.3.A	Reference 9
Item No. 3.2.4.4.A	References 10 and 11
Item No. 3.2.4.6.A	Reference 8
Item No. 3.2.4.7.A	References 10 and 11
Item No. 3.2.4.8.A	Reference 9
Item No. 3.2.4.9.A	Reference 9
Item No. 3.2.4.10.A	Reference 9

NRC Audit Report Open Items

Audit Open Item	Completion Response Reference
AQ-27	Reference 10
SE # 10	Reference 10
SE # 12	Reference 11
SE # 13	Reference 10

The table below documents the revision to the previously completed response to the items listed above. As stated above, EGC considers these items to be complete for Byron Station, Unit 2.

Item	Description	Status
ISE Confirmatory Item No. 3.1.5.1.A Protection of Equipment (High Temperature) - Confirm FLEX storage structure will maintain FLEX equipment at a temperature range to ensure its likely function when called upon.	The FLEX storage building's ventilation systems are designed as required by code and to maintain the FLEX equipment in a ready state. The maximum building temperature will be controlled by forced ventilation. Temperature information from Byron's UFSAR indicates the site extreme high temperature is a maximum of 103°F. The FLEX low pressure pump was designed to be able to operate with an outside air temperature of 110°F. The FLEX medium head and high head pump purchase specification requires a maximum operating air temperature of 110°F. The FLEX Generator purchase specification requires a maximum operating air temperature of 122°F.	Complete
ISE Confirmatory Item No. 3.1.5.3.A Deployment of Equipment (High Temperature) - Confirm that the effects of high temperature on FLEX equipment have been evaluated in the locations they are intended to operate.	FLEX equipment has been purchased with appropriate temperature specifications to ensure it will function in the extreme temperature conditions applicable to the site. Temperature information from Byron's UFSAR indicates the site extreme high temperature is a maximum of 103°F. The FLEX low pressure pump was designed to be able to operate with an outside air temperature of 110°F. The FLEX medium head and high head pump purchase specification requires a maximum operating air temperature of 110°F. The FLEX Generator purchase specification requires a maximum operating air temperature of 122°F. FLEX equipment primary staging locations are located outside of buildings and therefore require no additional cooling.	Complete

MILESTONE SCHEDULE – ITEMS COMPLETE

Milestone	Completion Date
Submit 60 Day Status Report	October 25, 2012
Submit Overall Integrated Plan	February 28, 2013
Contract with National SAFER Response Center	October 15, 2014
Submit 6 Month Updates:	
Update 1	August 28, 2013
Update 2	February 28, 2014
Update 3	August 28, 2014
Update 4	February 27, 2015
Update 5	August 28, 2015
Update 6	February 26, 2016
Modification Development:	
Phases 1 and 2 modifications	October 2, 2015
National SAFER Response Center Operational	October 15, 2014
Procedure Development:	
Strategy procedures	September 24, 2015
Validate Procedures (NEI 12-06, Sect. 11.4.3)	September 24, 2015
Maintenance procedures	September 24, 2015
Staffing analysis	May 29, 2014
Modification Implementation	
Phases 1 and 2 modifications	October 2, 2015
Storage plan and construction	October 20, 2014
FLEX equipment acquisition	October 20 2014
Training completion	August 21, 2015
Unit 2 implementation date	May 16, 2016

ORDER EA-12-049 COMPLIANCE ELEMENTS SUMMARY

The elements identified below for Byron Station, Unit 2 as well as the site OIP response submittal (Reference 5), the 6-Month Status Reports (References 6, 7, 8, 9, 10, and 11), and any additional docketed correspondence, demonstrate compliance with Order EA-12-049.

Strategies - Complete

Byron Station, Unit 2 strategies are in compliance with Order EA-12-049. There are no strategy related Open Items, Confirmatory Items, or Audit Questions/Audit Report Open Items. The Byron Station, Units 1 and 2, Final Integrated Plan for mitigating strategies is provided in the enclosure to this letter.

Modifications - Complete

The modifications required to support the FLEX strategies for Byron Station, Unit 2 have been fully implemented in accordance with the station design control process.

Equipment – Procured and Maintenance & Testing – Complete

The equipment required to implement the FLEX strategies for Byron Station, Unit 2 has been procured in accordance with NEI 12-06, Sections 11.1 and 11.2, received at Byron Station, Unit 2, initially tested/performance verified as identified in NEI 12-06, Section 11.5, and is available for use.

Maintenance and testing will be conducted through the use of the Byron Station, Unit 2 Preventative Maintenance program such that equipment reliability is achieved.

Protected Storage – Complete

The storage facilities required to implement the FLEX strategies for Byron Station, Unit 2 have been completed and provide protection from the applicable site hazards. The equipment required to implement the FLEX strategies for Byron Station, Unit 2 is stored in its protected configuration.

Procedures – Complete

FLEX Support Guidelines (FSGs) for Byron Station, Unit 2 have been developed and integrated with existing procedures. The FSGs and affected existing procedures have been verified and are available for use in accordance with the site procedure control program.

Training – Complete

Training for Byron Station, Unit 2 has been completed in accordance with an accepted training process as recommended in NEI 12-06, Section 11.6.

Staffing – Complete

The Phase 2 staffing study for Byron Station has been completed in accordance with 10CFR50.54(f), "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force review of Insights from the Fukushima Dai-ichi Accident," Recommendation 9.3, dated March 12, 2012 (Reference 13), as documented in Reference 14.

National SAFER Response Center – Complete

EGC has established a contract with Pooled Equipment Inventory Company (PEICo) and has joined the Strategic Alliance for FLEX Emergency Response (SAFER) Team Equipment Committee for off-site facility coordination. It has been confirmed that PEICo is ready to support Byron Station, Unit 2 with Phase 3 equipment stored in the National SAFER Response Centers in accordance with the site specific SAFER Response Plan.

Validation – Complete

EGC has completed performance of validation in accordance with industry developed guidance to assure required tasks, manual actions and decisions for FLEX strategies are feasible and may be executed within the constraints identified in the Overall Integrated Plan (OIP) for Order EA-12-049.

FLEX Program Document - Established

The Byron Station, Unit 2 FLEX Program Document has been developed in accordance with the requirements of NEI 12-06.

This letter contains no new regulatory commitments. If you have any questions regarding this report, please contact David P. Helker at 610-765-5525.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 15th day of July 2016.

Respectfully submitted,

Glen T. Kaegi

Glen T. Kaegi
Director - Licensing & Regulatory Affairs
Exelon Generation Company, LLC

Enclosure:

Byron Station Units 1 and 2 Final Integrated Plan Document – Mitigation Strategies for a Beyond-Design-Basis Event (NRC Order EA-12-049)

cc: Director, Office of Nuclear Reactor Regulation
NRC Regional Administrator - Region III
NRC Senior Resident Inspector – Byron Station
NRC Project Manager, NRR – Byron Station
Mr. John D. Hughey, NRR/JLD/JOMB, NRC
Illinois Emergency Management Agency - Division of Nuclear Safety

Enclosure

Byron Station Units 1 and 2

Final Integrated Plan Document – Mitigation Strategies for a Beyond-Design-Basis External Event (NRC Order EA-12-049)

(100 pages)

Exelon Generation®

Byron Station
Units 1 & 2

Final Integrated Plan Document

Mitigation Strategies for a Beyond-Design-Basis External Event

(NRC Order EA-12-049)

JULY 2016

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1. Background

On March 11, 2011, an earthquake-induced tsunami caused Beyond-Design-Basis (BDB) flooding at the Fukushima Dai-ichi Nuclear Power Station in Japan. The flooding caused by the tsunami rendered 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 & 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.

Nuclear Regulatory Commission (NRC) Order EA-12-049, Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (BDBEE) (Reference 1), requires a three-phase approach for mitigating beyond-design-basis external events. The initial phase requires the use of installed equipment and resources to maintain or restore core cooling, containment and spent fuel pool (SFP) cooling capabilities. The transition phase requires providing sufficient, portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from off site. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely.

These strategies must be capable of mitigating a simultaneous loss of all AC power and loss of normal access to the ultimate heat sink (LUHS) and have adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities following a beyond-design-basis external event. Reasonable protection must be provided for the associated equipment from external events. Such protection must demonstrate that there is adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities. The strategies must be implementable in all Modes.

NRC Interim Staff Guidance (ISG) JLD-ISG-2012-01, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, (Reference 4) provides guidance to assist nuclear power reactor applicants and licensees with the identification of measures needed to comply with the requirements to mitigate challenges to key safety functions contained in Order EA-12-049. This ISG endorses, with clarifications, the methodologies described in Nuclear Energy Institute (NEI) 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide. (Reference 2)

NEI 12-06 outlines the process to be used by individual licensees to define and implement site-specific diverse and flexible mitigation strategies that reduce the risks associated with beyond-design-basis conditions. NEI 12-06 requires that each plant establish the ability to cope with the baseline conditions for a simultaneous ELAP and loss of normal access to the UHS (LUHS) event and then evaluate the FLEX protection and deployment strategies in consideration of the challenges of the external hazards applicable to the site.

This final integrated plan provides the Byron Station Units 1 & 2 (Byron) approach to comply with Order EA-12-049 using the methods described in NRC JLD-ISG-2012-01. The Byron Final Integrated Plan is based on our design information and engineering analyses, completed modifications, developed guidelines, and procurement of material.

2. NRC Order EA-12-049 – Diverse and Flexible Mitigation Capability (FLEX)

The primary FLEX objective is to develop the capability for coping with a simultaneous ELAP and LUHS event for an indefinite period through a combination of installed plant equipment, portable onsite equipment, and offsite resources. The baseline assumptions have been established on the presumption that other than the loss of normal and alternate AC power sources, and normal access to the UHS, installed equipment that is designed to be robust with respect to design basis external events is assumed to be fully available. Installed equipment that is not robust is assumed to be unavailable. Permanent plant equipment, cooling and makeup water inventories, and fuel for FLEX equipment contained in systems or structures with designs that are robust with respect to seismic events, floods, high winds and associated missiles are available. Other equipment, such as portable AC power sources, portable back up DC power supplies, spare batteries, and equipment for Title 10 of the Code of Federal Regulations (10 CFR) Section 50.54(hh)(2), may be used provided it is reasonably protected from the applicable external hazards and has predetermined hookup strategies with appropriate procedures/guidance and the equipment is stored in a relative close vicinity of the site. Installed electrical distribution systems, including inverters and battery chargers, remain available provided they are protected consistent with current station design.

The FLEX strategy relies upon the following principles:

- Initially cope by relying on installed plant equipment (Phase 1)
- Transition from installed plant equipment to onsite FLEX equipment (Phase 2)
- Obtain additional capability and redundancy from offsite resources until power, water, and coolant injection systems are restored or commissioned. (Phase 3)
- Response actions will be prioritized based on available equipment, resources, and time constraints. The initial coping response actions can be performed by available site personnel post-event.

- Transition from installed plant equipment to onsite FLEX equipment may involve onsite, offsite, or recalled personnel as justified by evaluation.
- Strategies that have a time constraint to be successful are identified and a basis provided that the time can reasonably be met.

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

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

NRC Order EA-12-051, Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, (Reference 5) required licensees to install reliable SFP instrumentation with specific design features for monitoring SFP water level.

NEI 12-02, Industry Guidance for Compliance with NRC Order EA-12-051, "To modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," (Reference 11) provided guidance for compliance with Order EA-12-051. The NRC determined that, with the exceptions and clarifications provided in JLD-ISG-2012-03, Compliance with Order EA-12-05, Reliable Spent Fuel Pool Instrumentation, (Reference 6), conformance with the guidance in NEI 12-02 is an acceptable method for satisfying the requirements in Order EA-12-051.

2.1 General Elements - Assumptions

The assumptions used for the evaluations of a Byron ELAP/LUHS event and the development of FLEX strategies are stated below.

Boundary conditions consistent with NEI 12-06 (Reference 2) Section 3.2.1, General Criteria and Baseline Assumptions, are established to support development of FLEX strategies, as follows:

- The BDB external event occurs impacting both units at the site.
- Both reactors are initially operating at power, unless there are procedural requirements to shut down due to the impending event. The reactors have been operating at 100% power for the past 100 days.
- Each reactor is successfully shut down when required (i.e., all control rods inserted, no Anticipated Transient Without SCRAM (ATWS)). Steam release to maintain

decay heat removal upon shutdown functions normally, and reactor coolant system overpressure protection valves respond normally, if required by plant conditions, and reseat. The emergency cooling system initiates and operates normally, providing decay heat removal, thus obviating the need for further overpressure protection valve operation.

- Onsite staff is at site administrative minimum shift staffing levels.

- No independent, concurrent events, e.g., no active security threat.

- All personnel onsite are available to support site response.

- The reactor and supporting plant equipment are either operating within normal ranges for pressure, temperature and water level, or available to operate, at the time of the event consistent with the design and licensing basis.

The following plant initial conditions and assumptions are established for the purpose of defining FLEX strategies and are consistent with NEI 12-06 Section 3.2.1, General Criteria and Baseline Assumptions, for Byron:

- No specific initiating event is used. The initial condition is assumed to be a loss of offsite power (LOOP) with installed sources of emergency onsite AC power unavailable with no prospect for recovery.

- Cooling and makeup water inventories contained in systems or structures with designs that are robust with respect to seismic events, floods, and high winds and associated missiles are available. Permanent plant equipment that is contained in structures with designs that are robust with respect to seismic events, floods, and high winds and associated missiles, are available. The portion of the fire protection system that is robust with respect to seismic events, floods, and high winds and associated missiles is available as a water source.

- Normal access to the Ultimate Heat Sink (UHS) is lost, but the water inventory in the UHS remains available and robust piping connecting the UHS to plant systems remains intact. The motive force for UHS flow, i.e., pumps, is assumed to be lost with no prospect for recovery.

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

- Installed Class 1E electrical distribution systems, including inverters and battery chargers, remain available since they are protected.

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

- Reactor coolant inventory loss consists of unidentified and identified leakage at the upper limit of Technical Specifications and reactor coolant pump seal leak-off at normal rates at rated pressure (pressure dependent).

- For the spent fuel pool, the heat load is assumed to be the maximum design basis heat load. In addition, inventory loss from sloshing during a seismic event does not preclude access to the pool area.

Additionally, key assumptions associated with implementation of FLEX Strategies are as follows:

- Exceptions for the site security plan or other (license/site specific) requirements of 10 CFR's may be required.

- Site access is impeded for the first 6 hours, consistent with NEI 12-01, Guideline for Assessing Beyond-Design-Basis Accident Response Staffing and Communications Capabilities (Reference 10). Additional resources are assumed to begin arriving at hour 6 with limited site access up to 24 hours. By 24 hours and beyond, near-normal site access is restored allowing augmented resources to deliver supplies and personnel to the site.

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 have been incorporated into the unit emergency operating procedures in accordance with established Emergency Operating Procedure (EOP) change processes, and their impact to the design and license bases 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 event may place the plant in a condition where it cannot comply with certain Technical Specifications and/or with its Security Plan, and, as such, may warrant invocation of 10 CFR 50.54(x) and/or 10 CFR 73.55(p). This position is consistent with the previously documented Task Interface Agreement (TIA)

2004-04, "Acceptability of Proceduralized Departures from Technical Specification (TSs) Requirements at the Surry Power Station", (TAC Nos. MC42331 and MC4332), dated September 12, 2006 (Reference 9).

2.2 Strategies

NOTE: All strategies described below are the same for both Byron Station Units 1 & 2. Any differences and/or unit specific information is included where appropriate.

2.3 Reactor Core Cooling and Heat Removal

Reactor core cooling and heat removal strategy involves the removal of decay heat through the secondary side of the Nuclear Steam Supply System (NSSS) and maintain sufficient Reactor Coolant System (RCS) inventory to ensure the continuation of natural circulation in the primary side of the NSSS. The FLEX strategy for reactor core cooling and heat removal is to release steam from the Steam Generators (SGs) using Power Operated Relief Valves (PORVs) and the addition of a corresponding amount of Auxiliary Feedwater (AF) to the SGs via the Diesel Driven Auxiliary Feedwater (DDAF) pump. The AF system includes the Condensate Storage Tank (CST) as the primary initial water supply to the DDAF pump. However, the Essential Service Water (SX) System is the safety related backup supply. RCS cooldown, using this AF flow/SG steam release balance, will be initiated within the first 2 hours following a BDBEE that initiates an ELAP/LUHS event.

2.3.1. Phase 1 Strategy

Following the occurrence of an ELAP/LUHS event, the reactor will trip and the plant will initially stabilize at no-load RCS temperature and pressure conditions, with reactor decay heat removal via steam release to the atmosphere through the Main Steam Safety Valves (MSSVs) and/or the Steam Generator (SG) PORVs. Natural circulation of the RCS will develop to provide core cooling and the Diesel Driven Auxiliary Feedwater (DDAF) pump will provide flow from the Condensate Storage Tank (CST) to the SGs to makeup for steam release. Operators will respond to the ELAP/LUHS event in accordance with emergency operating procedures (EOPs) to confirm RCS, secondary system, and Containment conditions. A transition to 1/2BCA-0.0, Loss of All AC Power Unit 1/2, will be made upon the diagnosis of the total loss of AC power. This procedure directs isolation of RCS letdown pathways, verification of Containment isolation, reduction of DC loads on the station Class 1E batteries, and establishes electrical equipment alignment in preparation for eventual power restoration. The operators re-align AF flow to all Steam Generators, establish manual control of the safety-related, missile protected, seismically qualified SG PORVs, and initiate a rapid cooldown of the RCS to minimize inventory loss through the Reactor Coolant Pump (RCP) seals. 1/2BCA-0.0 also directs local manual control of AF flow to the SGs and manual control of the SG PORVs to control steam release and the RCS cooldown rate, as necessary.

Other actions and/or expected responses include:

- Verify Diesel Driven Auxiliary Feedwater (DDAF) pump is providing feedwater to the Steam Generators. The initial and preferred suction source will be the CST. In the event the CST is not available, actions will be taken to align the UHS, which is a safety-related water source, to the DDAF pump. Action will also be taken to align the alternate cooling water supply from the discharge of the Essential Service Water (SX) pump to the DDAF pump engine driven booster pump to ensure adequate cooling water supply is available for continued operation of the pump. Guidance is provided in 1/2BFSG-2, Alternate AFW/EFW Suction Source Unit 1/2. AF flow will peak at 373 gpm per pump and then remain less than 155 gpm after 16.75 hours into the event (Reference 36).

- Division 12/22 instrumentation will be maintained available by performing DC and AC Bus load shedding. Load shedding will be completed within sixty-five (65) minutes of event initiation. Load shedding is expected to extend 125V DC battery life to eight (8) hours (Reference 35).

- Safety Injection (SI) accumulator injection will provide the initial boration for reactivity control and RCS inventory addition.

- Reactor Coolant System temperature will be maintained at approximately 410°F by controlling SG pressure at approximately 260 psig in order to ensure maximum SI accumulator injection while preventing nitrogen injection.

2.3.2 Phase 2 Strategy

The Phase 2 FLEX Strategy for reactor core cooling and heat removal provides an indefinite supply of water for feeding the SGs using the installed DDAF pump. The medium pressure FLEX pump will be moved from the storage building to the deployment area near the RWST tunnel hatch. A Deep Well Water (WW) Pump will be powered from a FLEX Diesel Generator (FX DG) via a Bus Connection Device (BCD) in 480 volt ESF Bus 131Z or 132Z. Hoses will be routed from the FLEX connection for WW in the 0A Essential Service Water Cooling Tower

(SXCT) valve chamber to the medium pressure FLEX pump to provide a suction source and serve as a backup source of water to the SGs. The WW system discharge to the SXCT will maintain the SXCT inventory. The Deep Well Water will serve as the long term source of water to the SGs via the SXCT and DDAF pump or via the medium head FLEX pump.

Other actions and/or expected responses include:

- The medium pressure FLEX pump will be moved from the storage building to the deployment area near the RWST tunnel hatch.
- Hoses will be routed from the medium pressure FLEX pump to the primary SG connection in the B/C Main Steam Isolation Valve (MSIV) room to provide a backup source of feedwater to the SGs.
- Hoses will also be routed to connections in the Main Steam (MS) tunnel to allow feedwater to be provided to the A/D SGs. This will allow all four SGs to be used to provide symmetric cooling of the RCS and Reactor Coolant Pump (RCP) seals to maintain their integrity.
- An alternate connection for feedwater to the SGs will be available in the A/D MSIV room for use in the event the primary connection is not available or the MS tunnel is inaccessible.
- Connections will be made using standard FLEX connections.
- The medium pressure FLEX pump will be maintained in a standby condition as this is a backup to the DDAF pump. An alternate source of feedwater must be supplied within sixty-two (62) minutes for Unit 1 and forty-five (45) minutes for Unit 2 of a failure of the DDAF pump to prevent SG dryout assuming the 1/2C and 1/2D SG PORVs are isolated within five (5) minutes of the loss of feedwater (Reference 73).
- The DDAF pump will continue to operate and provide feedwater flow to all four (4) SGs.
- DDAF pump fuel oil level will be monitored and the tank refilled using the installed Diesel Oil (DO) transfer pumps that are powered from the FX DG.
- RCS temperature will be maintained at approximately 410°F by controlling SG pressure at approximately 260 psig.
- DDAF pump battery chargers will be energized from the FX DG.

- Division 12/22 instrumentation will be maintained available by performing DC and AC bus load shedding as well as providing power to the battery chargers from the FX DG. It is expected that power will be restored to the battery charger within 6 hours.
- In the event a battery charger cannot be energized, the DC bus may be cross-tied to the opposite unit provided its battery charger is energized.

2.3.3 Phase 3 Strategy

The Phase 3 strategy for Reactor Core Cooling and Heat Removal utilizes Phase 2 connections and includes additional equipment available from the National SAFER Response Center (NSRC) to provide backup as necessary. (Byron Station is a FLEX Phase 2 coping strategy site.)

- Water Purification skid from the NSRC will be used to treat site makeup water used for core cooling.
- Phase 3 equipment will also provide Operations and the TSC/ERO flexibility in addressing plant issues relating to the BDBEE.
- If any FLEX Equipment from the NSRC is required, the transition is provided in Attachment L of 1/2BFSG-13, Transition from FLEX Equipment.

2.3.4 Key Parameters:

- SG Pressure
- SG Level Narrow Range (NR)
- SG Level Wide Range (WR)
- RCS Pressure Wide Range (WR)
- RCS Cold Leg Temperature
- RCS Hot Leg Temperature
- Auxiliary Feedwater (AF) Flow
- Auxiliary Feedwater (AF) Suction pressure
- Condensate Storage Tank (CST) Level
- Core Exit Thermocouple (CETC)
- Reactor Vessel Level Indication System (RVLIS)
- Post Accident Neutron Monitor (PANM)
- DC Bus Voltage

Additionally, CETC, RVLIS, and PANM will be energized from the FX DG and Instrumentation will be maintained available from the FX DG or Cross-tie to the opposite unit DC Bus with an energized charger. The use of alternate indication for vital information is described in 1/2BFSG-7, Loss of Vital Instrumentation or Control Power.

2.3.5 Thermal Hydraulic Analyses

A cooldown and depressurization will be performed at a rate of 20°F/hr to 75°F/hr (max 100 °F/hr) to approximately 410°F (saturation for 260 psig) with manual/local operation of the Steam Generator (SG) Power Operated Relief Valves (PORVs). The target cooldown rate is 50°F/hr. SG feed will be controlled with local operation of the AF flow control (1/2AF005) valves. The cooldown will be initiated as soon as possible, resource permitting, but no later than 8 hours after event initiation.

In the event one or more Steam Generators are unavailable for the initial cooldown, asymmetric cooldown rate limits are established to prevent loop stagnation and allow for boron mixing of RCS loop(s). The cooldown rate limits for an asymmetric alignment during the first phase cooldown are 11°F/hr for Unit 1 and 25°F/hr for Unit 2 (Reference 21).

2.3.6 Reactor Coolant Pump Seals

Byron Station has installed the Westinghouse Reactor Coolant Pump (RCP) SHIELD® Passive Thermal Shutdown Seals (SDS) (Generation III) in all 4 RCPs on Unit 1 and Unit 2. The NRC has concluded that the use of the Westinghouse SHIELD® Passive Thermal SDS is acceptable for use in ELAP evaluation for Order EA-12-049 as documented in ADAMS Accession No. ML 14132A128. (Reference 49)

The qualification testing of the shutdown seal was performed at conditions based on a cold leg temperature of 571°F. The maximum shutdown seal temperature remains below the shutdown seal temperatures experienced during qualification testing. Following a loss of AC power, it is possible for the RCS cold leg temperature to exceed 571°F for short periods of time without the shutdown seal heating up beyond the temperatures experienced during qualification testing. This is due to the significant thermal inertia of the massive reactor coolant pump internals and pressure boundary. The evaluation documented in Westinghouse Letter LTR-CDA-15-11 concludes that even if the cold leg temperature is 581°F for the first 3000 seconds (50 minutes) following ELAP initiation, the maximum fluid temperature at the reactor coolant pump seal inlet remains below the temperatures experienced during shutdown seal qualification testing. Auxiliary Feedwater flow to the Steam Generators will be initiated at approximately 30 minutes into the ELAP event. Following the restoration of Auxiliary Feedwater flow to the Steam Generators and prior to initiating plant cooldown, cold leg temperature will be dictated by the Main Steam Safety Valves. Cold leg temperature will remain less than 571°F during this period based on the lowest Main Steam Safety Valve setting of 1175 psig adjusted for setting tolerance and lift setpoint testing uncertainty. (Reference 21)

2.3.7 Pumps

Each unit has one Diesel Driven Auxiliary Feedwater (DDAF) pump. It provides 100% of the required AF capacity to the four (4) Steam Generators, as assumed in the accident analysis. The pump is equipped with an independent recirculation line to prevent pump operation against a closed system. The DDAF pump is supported by a diesel engine, an independent battery system, an essential service water booster pump, and a fuel oil day tank. The diesel is a 16 cylinder engine which produces a nominal 1500 HP and is cooled by the Essential Service Water (SX) system. It has two sets of 100% capacity 24VDC batteries (nickel cadmium). One battery bank is required for starting duty and half of the other bank is used for control power. The fuel system consists of a 500 gallon Day Tank which is maintained with at least 420 gallons of fuel as required by Technical Specifications. Pump design capacity is 990 gpm at 1450 psig. This ensures at least 740 gpm total flow (160 gpm per Steam Generator plus 100 gpm recirculation flow) with all SGs intact. Normal suction is from the Condensate Storage Tank with the SX System as the safety-related backup.

A medium pressure FLEX pump will be used in the backup strategy for the DDAF pump. This pump may be use to supply a suction source to the DDAF or supply the SGs directly, following the initial cooldown. The pump rating is a nominal 500 psig at 300 gpm and is sized to provide adequate cooling water flow for reactor core cooling and heat removal.

2.4 RCS Inventory and Reactivity Control

RCS inventory and reactivity control strategy involves the removal of decay heat through the secondary side of the Nuclear Steam Supply System (NSSS) and maintain sufficient RCS inventory to ensure the continuation of natural circulation in the primary side of the NSSS. As the plant cools down and RCS inventory shrinks as expected, initial RCS inventory and boration addition will accomplished through the injection from the safety-related, passive Safety Injection Accumulators. Subsequent longer term inventory and boration makeup will accomplished through the use of a high pressure FLEX pump, connected from the borated Refueling Water Storage Tank (RWST) and a primary or alternate RCS injection connection.

2.4.1 Phase 1 Strategy

Following the occurrence of an ELAP/LUHS event, the reactor will trip and the plant will initially stabilize at no-load RCS temperature and pressure conditions, with reactor decay heat removal via steam release to the atmosphere through the Main Steam Safety Valves (MSSVs) and/or the SG PORVs. Natural circulation of the RCS will develop to provide core cooling and the Diesel Driven Auxiliary Feedwater (DDAF) pump will provide flow from the Condensate Storage Tank to the SGs to makeup for steam release. Operators will respond to the ELAP/LUHS event in accordance with Emergency Operating Procedures (EOPs) to confirm RCS, secondary system, and Containment conditions. A transition to 1/2BCA-0.0, Loss of All AC Power Unit 1/2, will be made upon the diagnosis of the total loss of AC power. This procedure directs isolation of RCS letdown pathways, verification of Containment isolation, reduction of DC loads on the station Class 1E batteries, and establishes electrical equipment alignment in preparation for eventual power restoration. The operators re-align Auxiliary Feedwater (AF) flow to all Steam Generators, establish manual control of the SG PORVs, and initiate a rapid cooldown of the RCS to minimize inventory loss through the Reactor Coolant Pump (RCP) seals. 1/2BCA-0.0 also directs local manual control of AF flow to the SGs and manual control of the SG PORVs to control steam release and the RCS cooldown rate, as necessary. Inventory and shutdown margin calculations require the addition of 6000 gallons of RWST water to the RCS to commence before 16 hours. The inventory portion is not required prior to the bounding time of 58 hours to prevent an end of single phase natural circulation and 186 hours until core uncover occurs (Reference 21).

Other actions and/or expected responses include:

- Division 12/22 instrumentation will be maintained available by performing DC and AC bus load shedding. Load shedding will be completed within sixty-five (65) minutes of event initiation. Load shedding is expected to extend 125V DC battery life to eight (8) hours.
- Reactor Coolant System (RCS) temperature will be maintained at approximately 410°F by controlling S/G pressure at approximately 260

psig in order to ensure maximum SI accumulator injection while preventing nitrogen injection.

- Byron Station has installed the Westinghouse reactor coolant pump (RCP) SHIELD® Passive Thermal Shutdown Seals (SDS) (Generation III) on Unit 1 and on Unit 2. Byron Station has Westinghouse RCP Model 93A. See Section 2.3.6 for further discussion.

- SI accumulator injection will provide the initial boration and RCS inventory addition.

- SI accumulators will be isolated by powering their discharge valves from the FLEX Diesel Generator (FX DG). In the event the SI accumulator isolation valves cannot be closed, venting of the cover gas to reduce pressure and prevent nitrogen injection will be performed.

- Core reactivity monitoring will be performed using the installed Division 12/22 Nuclear Instrumentation or the Post Accident Neutron Monitoring (PANM) instrumentation.

2.4.2 <u>Phase 2 Strategy</u>

The Phase 2 FLEX Strategy for RCS Inventory and Reactivity Control provides a reliable supply of borated water. The high pressure FLEX pump will be moved from the storage building to the deployment area near the RWST tunnel hatch. Hoses will be routed from the FLEX RWST connection in the RWST tunnel to provide a borated source of water to the high pressure FLEX pump. Hoses will be routed from the FLEX pump to installed FLEX primary (Chemical and Volume Control)(CV) or alternate (Safety Injection)(SI) RCS injection connections. A second RCS cooldown is initiated following isolation of the SI accumulators and the minimum RCS boration.

Other actions and/or expected responses include:

– Connections will be made using standard FLEX connections.

– The high pressure FLEX pump will be maintained in a standby condition and operated as required to provide RCS makeup and boration.

– RCS boration will be initiated in 16 hours to ensure subcritical conditions are maintained as documented in Westinghouse Calculations (Reference 41). A minimum volume of 6000 gallons of 2300 ppm borated water from the RWST will be injected.

- In the event one or more Steam Generators (SGs) are unavailable for the second cooldown, asymmetric cooldown rate limits will be 8°F/hr for Unit 1 and 20°F/hr for Unit 2 (Reference 22).

- Division 12/22 instrumentation will be maintained available by performing DC and AC bus load shedding as well as providing power to the battery chargers from the FX DG. It is expected that power will be restored to the battery charger within 6 hours.

- In the event a battery charger cannot be energized, the DC bus may be cross-tied to the opposite unit provided its battery charger is energized.

- Core reactivity monitoring will be performed using the installed Division 12/22 Nuclear Instrumentation or the Post Accident Neutron Monitoring (PANM) instrumentation.

2.4.3 Phase 3 Strategy

The Phase 3 strategy for RCS Inventory and Reactivity Control utilizes Phase 2 connections and includes additional equipment available from the National SAFER Response Center (NSRC) to provide backup as necessary. (Byron Station is a FLEX Phase 2 coping strategy site.)

- Water Purification skid from the NSRC will be used to treat site makeup water used for core cooling.

- Phase 3 equipment will also provide Operations and the TSC/ERO flexibility in addressing plant issues relating to the BDBEE.

- If any FLEX Equipment from the NSRC is required, the transition is provided in Attachment L of 1/2BFSG-13, Transition from FLEX Equipment.

2.4.4 Key Parameters

- SG Pressure
- SG Level Narrow Range (NR)
- SG Level Wide Range (WR)
- RCS Pressure Wide Range (WR)
- RCS Cold Leg Temperature
- RCS Hot Leg Temperature

- Containment Pressure
- Pressurizer Level
- Refueling Water Storage (RWST) Tank Level
- Safety Injection (SI) Accumulator Level
- Core Exit Thermocouple (CETC)
- Reactor Vessel Level Indication System (RVLIS)
- Post Accident Neutron Monitor (PANM)
- DC Bus Voltage

Additionally, CETC, RVLIS, and PANM will be energized from the FX DG and Instrumentation will be maintained available from the FX DG or Cross-tie to the opposite unit DC Bus with an energized charger. The use of alternate indication for vital information is described in 1/2BFSG-7, Loss of Vital Instrumentation or Control Power.

2.4.5 Thermal Hydraulics

A cooldown and depressurization will be performed at a rate of 20°F/hr to 75°F/hr (max 100 °F/hr) to approximately 410°F (saturation for 260 psig) with manual/local operation of the Steam Generator (SG) Power Operated Relief Valves (PORVs). The target cooldown rate is 50°F/hr. SG feed will be controlled with local operation of the Auxiliary Feedwater (AF) flow control (1/2AF005) valves. The cooldown will be initiated as soon as possible, resource permitting, but no later than 8 hours after event initiation.

In the event one or more Steam Generators (SGs) are unavailable for the initial cooldown, asymmetric cooldown rate limits are established to prevent loop stagnation and allow for boron mixing of RCS loop(s). The cooldown rate limits for an asymmetric alignment during the first phase cooldown are 11°F/hr for Unit 1 and 25°F/hr for Unit 2 (Reference 21).

2.4.6 Pumps

Each unit has one Diesel Driven Auxiliary Feedwater (DDAF) pump. It provides 100% of the required AF capacity to the four (4) Steam Generators, as assumed in the accident analysis. The pump is equipped with an independent recirculation line to prevent pump operation against a closed system. The DDAF pump is supported by a diesel engine, an independent battery system, an essential service water booster pump, and a fuel oil day tank. The diesel is a 16 cylinder engine which produces a nominal 1500 HP and is cooled by the Essential Service Water (SX) system. It has two sets of 100% capacity 24VDC batteries (nickel cadmium). One battery bank is required for starting duty and half of the other bank is used for control power. The fuel system consists of a 500 gallon Day Tank which is maintained with at least 420 gallons of fuel as required by Technical Specifications. Pump design capacity is 990 gpm at 1450 psig. This ensures at least 740 gpm total flow (160 gpm per Steam Generator plus 100 gpm recirculation flow) with all SGs intact. Normal suction is from the Condensate Storage Tank with the SX System as the safety-related backup.

A high pressure FLEX pump will be used in the Phase 2 strategy. It will be used as need to provide RCS makeup and boration. The pump rating is a nominal 1550 psig at 40 gpm and is sized to provide the service required for RCS inventory and reactivity control.

2.5 Containment Integrity

With an extended loss of all alternating current power (ELAP) initiated while either Byron unit is in Modes 1-4, Containment cooling for that unit is also lost for an extended period of time. Therefore, Containment temperature and pressure will slowly increase. With the installation of the Westinghouse Reactor Coolant Pump (RCP) SHIELD® Passive Thermal Shutdown Seals (SDS) (Generation III), the amount of leakage into containment will be reduced, resulting in additional margin to reaching design basis temperature and pressure (Reference 22). As part of the Containment Integrity Strategy, Containment status will be monitored by the Main Control Room operators. Containment temperature and pressure design limits are not expected to be approached.

2.5.1 Phase 1 Strategy

Following the occurrence of an ELAP/LUHS event, the reactor will trip and the plant will initially stabilize at no-load Reactor Coolant System (RCS) temperature and pressure conditions. Operators will respond to the ELAP/LUHS event in accordance with emergency operating procedures (EOPs) to confirm RCS, secondary system, and Containment conditions. A transition to 1/2BCA-0.0, Loss of All AC Power Unit 1/2, will be made upon the diagnosis of the total loss of AC power. Among the actions directed by this procedure is verification of Containment isolation.

Other actions and/or expected responses include:

- Monitor containment status.

- Division 12/22 instrumentation will be maintained available by performing DC and AC bus load shedding as well as providing power to the battery chargers from the FLEX Diesel Generator (FX DG). It is expected that power will be restored to the battery charger within 6 hours (Reference 73).
- In the event a battery charger cannot be energized, the DC bus may be cross-tied to the opposite unit provided its battery charger is energized.

2.5.2 Phase 2 Strategy

The Phase 2 coping strategy is to continue monitoring Containment temperature and pressure using installed instrumentation.

Other actions and/or expected responses include:

- Monitor containment status.
- Division 12/22 instrumentation will be maintained available by performing DC and AC bus load shedding as well as providing power to the battery chargers from the FX DG. It is expected that power will be restored to the battery charger within 6 hours (Reference 73).

2.5.3 Phase 3 Strategy

The Phase 3 strategy for Containment Integrity utilizes Phase 2 connections and includes additional equipment available from the National SAFER Response Center (NSRC) to provide backup as necessary. (Byron Station is a FLEX Phase 2 coping strategy site.)

- Phase 3 equipment will also provide Operations and the TSC/ERO flexibility in addressing plant issues relating to the BDBEE.
- If any FLEX Equipment from the NSRC is required, the transition is provided in Attachment L of 1/2BFSG-13, Transition from FLEX Equipment.

2.5.4 Key Parameters

- SG Pressure
- SG Level Narrow Range (NR)
- SG Level Wide Range (WR)

- RCS Pressure Wide Range (WR)
- RCS Cold Leg Temperature
- RCS Hot Leg Temperature
- Containment Pressure
- Containment Temperature
- Core Exit Thermocouple (CETC)
- Reactor Vessel Level Indication System (RVLIS)
- Post Accident Neutron Monitor (PANM)
- DC Bus Voltage

Additionally, CETC, RVLIS, and PANM will be energized from the FX DG and Instrumentation will be maintained available from the FLEX DG or Cross-tie to the opposite unit DC Bus with an energized charger. The use of alternate indication for vital information is described in 1/2BFSG-7, Loss of Vital Instrumentation or Control Power.

2.6 Spent Fuel Pool Cooling

The Byron Station Spent Fuel Pool (SFP) is a common pool designed for both Unit 1 and Unit 2. The basic FLEX strategy for maintaining SFP cooling is to monitor SFP level and provide sufficient makeup water to the SFP to maintain the normal SFP level. Byron has installed new spent fuel pool level monitoring systems to meet NRC order EA 12-051 requirement (Reference 5).

2.6.1 Phase 1 Strategy

The coping strategy for spent fuel pool cooling is to monitor spent fuel pool level using the instrumentation installed as required by NRC Order EA-12-051 (Reference 5)

Other actions and/or expected responses include:

- SFP level will be monitored using Spent Fuel Pool Level Instrumentation – 0LI-FC001B and 0LI-FC002B. The instrumentation will be powered from the FLEX diesel generator (FX DG). It also contains an Uninterruptible Power Supply (UPS) that will provide power to the instrumentation for seventy-two (72) hours.
- Power will be supplied from the FX DG to the 0A Refueling Water Purification Pump to provide the primary method for SFP cooling and makeup. The RWST will be the source of water.

- Hoses for alternate SFP makeup will be routed from the medium head FLEX pump through the Fuel Handling Building (FHB) from the trackway door to the SFP via monitor guns. Deep Well Water (WW) will be the alternate source of SFP makeup via the hoses routed from the WW system to the medium head FLEX pump. Actions are directed through 0BFSG-11, Alternate SFP Makeup and Cooling Unit 0.

- FHB FLEX setup activities requiring entry into the FHB will be performed prior to reaching an adverse environment in the area.

- A Spent Fuel Pool vent path will be provided by opening the Fuel Handling Building trackway roll-up door. The site has manual actions within the Fuel Handling Building, which include aligning the alternate SFP make-up flow path. The site will perform these manual actions prior to the onset of SFP boiling and prior to reaching an adverse environment in the area. The actions are directed by 0BFSG-5, Initial Assessment and FLEX Equipment Strategy.

- For all SFP heat loads, procedure guidance directs the FHB vent path and alternate FLEX SFP makeup hose placement to assure safe access and task completion.

2.6.2 Phase 2 Strategy

The Phase 2 strategy is to initiate SFP makeup on demand using the installed 0A Refueling Water Purification Pump powered from the FLEX DG. The Deep Well Water System will be the alternate source of SFP makeup via the hoses routed from the WW system to the medium head FLEX pump. This SFP makeup will utilize the medium pressure FLEX pump via hoses routed through the FHB to the SFP.

Other actions and/or expected responses include:

– The medium pressure FLEX pump will be moved from the storage building to the deployment area near the RWST tunnel hatch.

– Restore/maintain SFP level using the installed RWST purification pump powered from the FLEX DG.

– SFP level will be monitored using Spent Fuel Pool Level Instrumentation. The instrumentation will be powered from the FLEX DG. It also contains a UPS that will provide power to the instrumentation for seventy-two (72) hours.

- Maintain the SFP level as needed.

2.6.3 Phase 3 Strategy

The Phase 3 strategy for RCS Inventory and Reactivity Control utilizes Phase 2 connections and includes additional equipment available from the National SAFER Response Center (NSRC) to provide backup as necessary. (Byron Station is a FLEX Phase 2 coping strategy site.)

Phase 3 equipment will also provide Operations and the TSC/ERO flexibility in addressing plant issues relating to the BDBEE.

In case any FLEX Equipment from the NSRC is required, the transition is provided in Attachment L of 1/2BFSG-13, Transition from FLEX Equipment.

2.6.4 Key Parameters

- Spent Fuel Pool Level Instrumentation

Additionally, Spent Fuel Pool Level Indication will be energized from the FLEX DG and Instrumentation will be maintained available from the FLEX DG or Cross-tie to the opposite unit DC Bus with an energized charger. The use of alternate indication for vital information is described in 1/2BFSG-7, Loss of Vital Instrumentation or Control Power.

2.6.5 Thermal Hydraulic Analyses

The worst case SFP Heat Load during non-outage conditions is 32.5 Mbtu/hr. Loss of Spent Fuel Pool cooling with this heat load results in a time to boil of 10.94 hours and 90.98 hours to the top of active fuel. 1/2BCA 0.0, Loss of All AC Unit 1/2, directs spent fuel pool make-up at 420' elevations which will occur 24.8 hours into the event. The equipment line-up for initiating SFP make-up needs to be completed prior to the SFP Boil time of 10.94 hours into the event to ensure on demand availability of adequate cooling of the spent fuel is maintained.

The worst case SFP heat load during an outage is 62.9 Mbtu/hr. Loss of SFP cooling with this heat load results in a time to boil of 2.72 hours and 43.96 hours to the top of active fuel. With the entire core being located in the SFP, manpower resources normally allocated to aligning core cooling along with the Operations outage shift manpower can be allocated to aligning SFP make-up. 1/2BCA 0.0, Loss of All AC Unit 1/2, directs spent fuel pool make-up at 420' elevations which will occur 9.8 hours into the event. The equipment line-up for initiating SFP make-up needs to be completed prior to the SFP Boil time of 2.72 hours into the event to ensure on demand availability of adequate cooling of the spent fuel is maintained. (Reference 18)

2.6.6 Pumps

The 0A Refueling Water Purification pump will be used for the primary method for Spent Fuel Pool cooling and makeup. The pump rating is a nominal 150 psig at 100 gpm and will provide the service required for SFP makeup.

A medium FLEX pump will be used in the backup strategy for SFP makeup. This pump will use the Deep Well Water System as its suction source. The pump rating is a nominal 500 psig at 300 gpm and is sized to provide adequate water flow for spent fuel pool cooling.

2.6.7 Program Requirements

This section addresses program requirements for SFP instrumentation contained in NEI 12-02 (Reference 11). To support the requirements, Operations and Instrument Maintenance procedures include the following:

- 0BOL FX2, LCOAR Spent Fuel Pool (SFP) Level Instrumentation, has been implemented to track availability and required actions for Spent Fuel Pool Level Instrumentation.
- 0BOSR FX-M1, Unit 0 Spent Fuel Pool Level Instrumentation Monthly Surveillance, has been implemented to prove functionality of the level instrumentation.
- BIP 2500-181, Calibration of Guided Wave Radar Spent Fuel Level Instruments, provides instructions to calibrate the Spent Fuel Pool Level Instrumentation System (SFPLIS), loops 0FC-001 and 0FC-002.

Refer to CC-AA-118, Diverse and Flexible Coping Strategies (FLEX) and Spent Fuel Pool Instrumentation Program Document for quality assurance requirements.

2.7 Shutdown and Refueling Mode

Byron Station is complying with the Nuclear Energy Institute position paper entitled, “Shutdown/Refueling Modes," dated September 18, 2013, addressing mitigation strategies in shutdown and refueling modes (Reference 12). This position paper has been endorsed by the NRC staff (Reference 47). Further clarification has been provided in an internal position paper (See Attachment 10). Byron Station will incorporate the supplemental Guidance provided in the NEI position paper titled, "Shutdown/Refueling Modes" to enhance the shutdown risk process and procedures. For planned outages and early in an unplanned outage, an outage risk profile is developed (Reference 76). This risk assessment is updated on a daily basis, and as changes are made to the outage schedule. Contingency actions are developed for high risk evolutions and the time needed for such evolutions is minimized. These Contingency Plans consider time to core boil/damage, decay heat loads, time to implement the contingency plan, and use of installed or temporary equipment. Contingency Plans are distributed to the appropriate work groups and briefed, as appropriate. During the outage, additional resources are available on site, and during the high risk evolutions individuals are assigned specific response actions (e.g., response team assigned to close the containment equipment hatch). The risk assessment accounts for, among other things, environmental conditions and the condition of the grid.

In order to effectively manage risk and maintain safety during outages, Byron Station develops contingencies to address the precautions and response actions for a loss of cooling, among other Key Safety Functions. These contingencies not only direct actions to minimize the likelihood of a challenge to a key safety function, such as loss of cooling, but also direct the actions to be taken to respond to such an events. For example, the initial response for a loss of cooling could be to perform a gravity drain from the RWST to the RCS using installed plant equipment to maintain core cooling. Should a contingency plan used to support shutdown risk identify the need for FLEX equipment, consideration will be given to pre-staging the equipment to a location that will not become inaccessible due to external hazards. The N+1 equipment will be used as the pre-staged equipment, such that the N set of equipment remains protected from external hazards and remains available (Reference 76).

When in Cold Shutdown and Refueling, many variables exist which impact the ability to cool the core. In the event of an ELAP during these Modes, installed plant systems cannot be relied upon to cool the core, thus transition to Phase 2 will begin immediately. All efforts will be made to expeditiously provide core cooling and minimize heat-up and repressurization. Byron Station has programs in place (References 76 and 77) to determine the time to boil for all conditions during shutdown periods. This time will be used to determine the time required to complete transition to Phase 2.

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 may occur quite rapidly. A procedure for each unit is in place to provide guidance for addressing a Loss of all AC Power while on Shutdown cooling (See Attachment 4).

Missile barriers have been placed outside of the 1/2B and 1/2C Main Steam Safety Valve (MSSV) rooms to protect the local controls for 1/2B and 1/2C Main Steam PORV's. This assures that the 1/2B and 1/2C Main Steam PORV's remain available as a steam release path for cooldown. In Modes 1-3, this allows for symmetric cooling of the RCP seals during the cooldown following an ELAP. In lower modes, the availability of these PORV's allows for RCS heat removal to keep the core cooled and remove energy that would otherwise have to be released to the Containment. These barriers must remain in place for the FLEX strategy to work. These barriers can only be removed when the 1/2B and 1/2C Main Steam PORV's are no longer required to be available.

Deploying and implementation of portable FLEX pumps and equipment to supply injection flow must commence immediately from the time direction is provided in the Site Emergency Procedures and/or Abnormal Procedures. This should be plausible because more personnel are on site during outages to provide the necessary resources. Strategies for makeup water include deploying of a FLEX pump to take suction from the RWST and /or Deep Well Water as described in the Phase 2 Core Cooling section. Guidance has been provided to ensure that sufficient area is available for deployment and that haul paths remain accessible without interference from outage equipment during refueling outages.

2.8 Characterization of External Hazards

The applicable extreme external hazards for Byron are seismic, external flooding, high winds, ice, snow, and extreme cold, and extreme high temperatures.

2.8.1 Seismic Assessment

The original investigation of historical seismic activity in the Byron Station region determined a design safe shutdown earthquake (SSE) which is defined as the occurrence of a Modified Mercalli Intensity of VIII originating at the bedrock-soil interface at the site. Per Section 2.5 of the Updated Final Safety Analysis Report (UFSAR), Byron Station determined the corresponding ground surface acceleration to be 0.21 g for the postulated Safe Shutdown Earthquake (Reference 68).

The combination of the relatively shallow amount of soil from the ground surface to the limestone shelf below, between 5' and 15' under the surface, coupled with the lack of ground water in this layer, makes liquefaction a non-issue at Byron Station.

For FLEX strategies, the earthquake is assumed to occur without warning and results in damage to non-seismic designed structures and equipment. Non-seismic structures and equipment may fail in a manner that would seemingly challenge accomplishment of FLEX-related activities (i.e., normal access to plant equipment, functionality of non-seismic plant equipment, deployment of BDB equipment, and restoration of normal plant services, etc.). The ability to clear haul routes, along with the diverse FLEX strategies, facilitates Byron Station success should a BDB seismic event occur.

2.8.2 External Flooding Assessment

Byron Station is located in northern Illinois, 3.7 miles south-southwest of the city of Byron, and 2.2 miles east of the Rock River, in Ogle County. Byron Station UFSAR, Revision 16, addresses additional flooding mechanisms that are neither critical nor bounding for Byron. External Flooding of the Byron Station site is not applicable per NEI 12-06, since Byron is considered a "Dry Site" per Byron UFSAR. The plant grade elevation is at 869.0 feet, and the grade floors of the safety related building are at elevation 870.0 feet. The site is not subject to significant river or tsunami type flooding based on site elevation relative to Rock River elevation.

The Probable Maximum Flood (PMF) along the Rock River does not affect the site, since the maximum water surface elevation is 708.3 feet, a minimum of 160.7 feet below the plant grade. This was reviewed as conservative when using the selected Manning n-values for the Rock River HEC-RAS hydraulic model (Reference 67). A review of dam failures resulted in no challenge to the Byron Station Site. This was based on the use of the NRC-endorsed simplified dam failure methodology by combining all upstream dams into one hypothetical dam and included a sensitivity analysis.

The Probable Maximum Precipitation (PMP) falling on the plant area was considered in the analysis of local intense precipitation on the plant site. Per Byron Station UFSAR, Section 2.4.2.3, Effects of Local Intense Precipitation, the maximum water level is elevation 870.9 feet at the plant site due to PMP. The required flood re-analysis found the maximum flood level to be 870.80 feet in the vicinity of the power block and 870.7 feet in the immediate station area and is bound by the design basis flood elevation (Reference 80). Generally, Byron Station grade elevation is 869 feet. To prevent water due to PMP from entering areas where essential equipment/systems are located, reinforced concrete curbs or steel barriers are provided. The FLEX Storage Robust Building (FSRB) is constructed above the flood level to an elevation of 872 feet (Reference 18). The FLEX strategy can be successfully implemented in the event of Local Intense Precipitation.

For the Natural Draft Cooling Tower (NDCT), the onsite dam failure analysis assumes that the PMP only falls within its flume and basin, and that no rainfall occurs outside the basin onto the rest of the site. The NDCT basin is contained by a non-seismic perimeter concrete structure and does not have a natural contributory drainage area. The surrounding grade is 873" and the top of the flume is 875'. Existing topography does not direct runoff to the NDCT basin. For analysis, a basin failure outflow for the NDCT was developed with Local Intense Precipitation water surface elevation. It resulted in no adverse effect on the FLEX strategies (Reference 67).

The Main Steam Safety Valve (MSSV) Rooms have a steel flood barrier to prevent external flooding from affecting essential equipment in the MSSV Rooms. The flood barriers in the MSSV Rooms and the Refueling Water Storage Tank (RWST) Hatch have a top elevation of 871 feet which provides 0.2 feet of margin, or 2.5 inches, from the updated BDBEE analysis (Reference 80).

For contingency makeup to the Essential Service Water Cooling Tower (SXCT), which serves as the Ultimate heat Sink (UHS), the FLEX connections to repower the Deep Well Water (WW) pumps are located in the SXCT Switchgear Rooms. The floor elevation of the SXCT Switchgear Rooms at Byron is 874'-6" which is 3.5 feet above the expected flood level from external flooding. The WW mechanical FLEX connections are in the SXCT Valve Rooms. Entrances to these rooms are above flood projections, requiring a step up, above flood level, before you step down into the room.

Byron has flood doors associated with the Diesel Oil (DO) Storage Tank Rooms below the 401' elevation. Therefore, the DO Transfer Pumps are protected from external and internal flooding. The DO FLEX connections in the 1/2B Emergency Diesel Generator Rooms are at the 402' elevation. This is slightly above the expected flood level. The 401' level of the Turbine building is utilized to access the 1/2B Emergency Diesel Generators Rooms, but flooding is not expected since external water would cascade to the lower elevations of the turbine building as opposed to pooling on the 401' elevation (Reference 80).

2.8.3 High Wind Hazard Assessment

NEI 12-06 (Reference 2) identifies Byron Station in a region (89° 16' W x 42° 4' N) which would not experience severe winds from hurricanes. However, NEI 12-06 identified Byron in Region 1 and is susceptible to tornado winds of 200 mph. Per Byron UFSAR Section 2.3.1.2.2, the predominant tornado path is southwest to northeast. Byron Station has a strongly constructed FLEX Storage Robust Building (FSRB) designed to meet the Design Basis UFSAR Wind Speed requirement of 360 mph. It can withstand tornado-generated missiles. This FSRB is the storage facility for the N and N+1 equipment. An adjacent commercial building, constructed to American Society of Civil Engineers (ASCE) 7-10 standards, houses non-strategic, support equipment (Reference 19). An F1 tornado has a maximum speed of 110 mph and 85% of all tornados are F0 or F1. Therefore, only 15 % of the tornados in the Byron area are expected to have winds speeds that will exceed the commercial building qualified wind speed. (Reference 80)

The buildings are oriented at the far north of the Site property, outside the protected area. The doors of the robust building face north such that debris would tend to be directed away from the equipment doors, given the predominant direction of tornados (southwest to northeast). The commercial building (non-robust) is located to the west of the robust building. Debris would tend to impact the west side of the robust building or be carried away to the northeast. Because the N set of equipment is stored in the robust building, that can withstand the high winds and tornadic threat, the "axis of separation" of storage buildings is not required.

Byron has equipment for moving storm debris. This equipment consists of a large, heavy duty, special equipped truck (e.g., Ford F-750) with a plow, and two loaders (e.g., New Holland T5.105) to push debris away from areas required to deploy FLEX equipment. The truck and loaders are staged in the robust building capable of moving portable pumps and generators needed for deployment, as well as fuel for deployed equipment.

Byron Station has existing procedures for addressing high wind situations. These procedures direct operators to check various plant equipment and assess the plant for damage. Plant administrative procedures exist for addressing the elimination of potential tornado-generated missiles within the area of the Main and Auxiliary power transformers (Reference 75). The Byron FLEX Implementation procedure (Reference 73) provides locations for staging equipment delivered from offsite through the Strategic Alliance for FLEX Emergency Response (SAFER) response procedure (Reference 74).

The Unit 1 and Unit 2 B/C Main Steam Safety Valve (MSSV) rooms are exposed to the environment facing west, in the line of fire from high wind hazards. Permanently installed Power Operated Relief Valve (PORV) manual hand pumps, needed as an alternate control method for Reactor Coolant System (RCS) cooldown, are located in these rooms. To provide reasonable protection of these hand pumps, large concrete blocks have been placed in front of the 1/2 B/C MSSV room doors. These blocks protect the PORV operators from design basis horizontal missiles. The blocks also limit the amount of possible large debris build-up in front of the doors, since the blocks are placed approximately four (4) feet from the entrance (Reference 20). The 1/2 A/D MSSV rooms are considered protected from horizontal missiles due to their orientation.

2.8.4 Ice, Snow and Extreme Cold Assessment

For Byron Station, per UFSAR Section 2.3.1.2.3, Heavy Snow and Severe Glaze Storms, severe winter storms consisting of six inches of snow or more will occur on average five times per year. The possibility of freezing rain or sleet, resulting in a glaze, will occur on average two times per year. Per NEI 12-06, Byron Station could receive 25 inches of snow over three days and therefore, identifies Byron Station with an Ice Severity Level 5, catastrophic destruction to power lines and/or existence of extreme amounts of ice. The design basis snow and ice load on structures, per the UFSAR, is 104 psf. Low temperatures less than or equal to 0°F occur about 16 times per year, with an extreme low temperature of (–) 22° F.

The Byron Ultimate Heat Sink (UHS) does not experience frazzle ice or blockage of the intake due to low temperatures. The UHS will continue to have a heat input from the Diesel Driven Auxiliary Feedwater (DDAF) pump during Phase 1 of a BDBEE. During Phase 2, if a FLEX Pump is utilized, a connection has been provided directly from the Deep Well Water (WW) Pumps that can supply the FLEX pumps. The Deep Well water (subterranean) supply is not susceptible to freezing.

The FLEX Storage Robust Building will house the dedicated FLEX Equipment. That Building has been designed and built to conform to NEI 12-06 standards, including Sections 5.3.1, 7.3.1, and 8.3.1, for storage considerations based on all hazards applicable to Byron Station. The interior temperature of the building is designed to maintain between 40°F and 100°F (Reference: CBI Calc 151871-C-M-00001). The building is designed to withstand the snow loading as required per NEI 12-06. The commercial building for the Support equipment is designed to ASCE 7-10 standards which include design for snow and ice (Reference 19).

FLEX Pumps were procured with operational specification for ambient temperatures as low as a nominal (–) 20° F. FLEX hoses were procured with similar operational specification. FLEX AC Generators were procured with operational specification for ambient temperatures as low as a nominal (–) 25°F and capable of operating in rain, snow, and sleet (Reference 80). The procured, large FLEX Truck is equipped with a plow for snow removal to clear a path for deployment. In addition, the Byron FLEX Plan (Reference 73 and Attachment 6) provides a diagram for FLEX equipment deployment locations and snow removal paths from FLEX Buildings to deployment location. Any downed power lines affecting the primary route will be assessed and de-energized, as necessary, or a secondary route will be used (Attachment 10).

The site FLEX strategy has been evaluated for potential freezing due to loss of heat trace or other heat sources. Susceptible equipment includes RWST, temporary hoses, and pumps deployed outside. An evaluation of tanks and hose freezing during an ELAP was completed to determine effects of freezing on this equipment. The FLEX temporary hoses, routed outside, will be protected from freezing by maintaining positive flow or by draining when not in use. Additional sections of FLEX hose are also available as replacements in the event a section of hose freezes. (Reference 38)

2.8.5 Extreme High Temperature Assessment

For Byron Station, per UFSAR Section 2.3.1.1, General Climate, the annual average temperature in the Byron area as represented by Rockford Data is 48.1°F, with an extreme high of 103°F. Maximum temperatures equal or exceeding 90°F is about 13 times per year.

Extreme high temperatures are not expected to impact the utilization of onsite or offsite resources, or the ability of personnel to implement the required FLEX strategies. Provisions have been made to hydrate personnel working in extreme high temperatures.

The FLEX equipment is qualified to operate in extreme conditions, including high temperatures. FLEX Pumps were procured with operational specification for ambient temperatures as high as a nominal 110°F. FLEX hoses were procured with similar operational specification. FLEX Diesel Generators were procured with operational specification for ambient temperatures as high as a nominal 122°F (Reference 19).

The interior temperature of the FLEX Robust Storage building is designed to maintain between 40°F and 100°F. Operators perform weekly rounds to ensure climate control is operating properly.

2.9 Habitability

Habitability will be evaluated in Section 2.10.2 in conjunction with the ventilation support function.

2.10 Support Functions

2.10.1 Electric Power

The primary electrical strategy will be to power Bus 132X/232X by running temporary cables using a downhill deployment method from Division 12/22 switchgear rooms to a portable FLEX Diesel Generator (FX DG) staged at the affected unit's turbine building trackway. Connection of the temporary cables is accomplished using a Bus Connection Device (BCD) that will be racked in to Bus 132X/232X. Among the loads, the FX DG will power include:

- DDAF pump battery chargers
- Train B diesel oil fuel transfer pumps
- Safety Injection accumulator isolation valves
- Main Control Room (MCR) lighting
- Lights and ventilation for DDAF pumps and valve operating areas
- SFP level instrumentation
- Alternate SFP cooling (0A Refueling Water Purification Pump)
- PANM
- CETCs/RVLIS
- Division 12/22 Battery Charger and associated Battery Room Exhaust Fans

The alternate electrical strategy will be implemented in the event Bus 132X/232X is unavailable. Temporary cables will be routed from the patch panel to provide power directly to Motor Control Centers (MCCs) to provide power to needed equipment. An FX DG will be tied into the opposite unit's Bus 132X/232X with a Bus Connection Device to energize the opposite unit's Division 12/22 Battery Charger and allow powering the unit's DC Bus through DC breaker crosstie.

The primary and alternate electrical supply strategies were put together under the loading premise that one unit would be implementing the primary strategy while the opposite unit would be implementing the alternate strategy. Byron calculation BYR13-180, Revision 1, and its supporting documents, supplies the basis for electrical equipment sizing (cables, breakers, portable generators, etc.) that support these strategies.

Byron Station has four FX DGs. These four FX DGs will have the same capacity, and any one of them can supply any of the busses. As required, one of the four is considered a spare (N+1) unit. The FX DGs have sufficient capacity to power their associated busses. Loads associated with Busses 132X and 232X are also documented in Byron Calculation BYR13-180. The Unit 1 primary strategy calls for a loading of 190.4KW at 314.3 Amps. The Unit 1 alternate strategy calls for a loading of 82.4KW at 115.6 Amps. The Unit 2 primary strategy calls for a loading of 190.5KW at 314.5 Amps. The Unit 2 alternate strategy calls for a loading of 82.5KW at 115.8 Amps.

The Bus 131Z and 132Z loads consist of the Deep Well Water (WW) Pumps, which supply contingency makeup to the Essential Service Water Cooling Tower (SXCT). One pump is connected to each bus. Each WW Pump is a 93.25KW (125HP) load that draws 145 Amps.

Each FX DG has a nominal rating of 350KW/428KVA. Each FX DG has sufficient capacity to deliver the bounding load current, with consideration of all load drops, including margin. Each FX DG has sufficient motor starting volt-amp capacity to start the largest required motor (Deep Well Water Pump). The standby rating of each diesel generator is adequate for energizing a 1000KVA transformer. Each FX DG has the capability of adjusting the output +/- from a nominal 480V (456V – 504V). Therefore, the capability of the FX Diesel Generators supports the strategies.

Load shedding and battery conservation are described in 1/2BFSG-4, ELAP DC BUS Load Shed/Management. The alternate DC electrical strategy will be to cross-tie DC Busses to one with an energized battery charger.

FX DG alignment to supply 480V AC power to Bus132X/232X is described in 1/2BFSG-5, Initial Assessment and FLEX Equipment Staging Unit 1/2.

The use of alternate indication for vital information is described in 1/2BFSG-7, Loss of Vital Instrumentation or Control Power.

Figure 2, Byron FLEX Electrical Strategy, provides a basic block diagram of the electrical strategy.

2.10.2 Ventilation and Equipment Cooling

Alternate Main Control Room (MCR) ventilation is described in 0BFSG-51, Alternate MCR Ventilation. MCCs 133V2/233V2 will be powered from a FLEX Diesel Generator via the patch panel in the Auxiliary Building. When energized, they will be used to provide power to the MCR and Miscellaneous Electrical Equipment Room (MEER) alternate ventilation.

As a result of the loss of ventilation, the following calculations were performed to ensure the loss of ventilation would not significantly affect equipment operation:

- The Diesel Driven Auxiliary Feedwater Pump Room Temperature Analysis during and ELAP Event shows room temperature is maintained within acceptable limits and supplemental room cooling is not required. Procedure guidance for the setup of alternate cooling was developed to provide additional options to the operators and is controlled by 0BFSG-5, Initial Assessment and FLEX Equipment Staging Unit 0. (Reference 27)

- MEER and Battery Room Conditions following ELAP shows Battery Room can reach 2% hydrogen concentration within 2.52 hours of re-energizing the battery changer. Hydrogen generation begins when the battery chargers are re-energized. When power is re-established to the battery charger, power is also returned to the battery room vent fan. Operation of the battery room vent fan will prevent hydrogen generation from becoming a concern. 1/2BFSG-5, Initial Assessment and FLEX Equipment Staging Unit 1/2, provides operators with the necessary guidance to establish forced ventilation within the Battery Room. Additionally, this calculation shows the MEER room will require forced ventilation to preserve component availability within 8 hours of re-energizing the battery changers. 0BFSG-5, Initial Assessment and FLEX Equipment Staging Unit 0, provides operators with the necessary guidance to establish alternate ventilation. This calculation also assumes a Battery Room maximum temperature of 138°F and a minimum temperature of 60°F during an ELAP event. The temperature effects on the battery capacity were incorporated into this calculation. (Reference 30),

- The Main Control Room and Auxiliary Electric Equipment Room (AEER) heat up and Ventilation during an ELAP shows the Unit 2 AEER portion of the MCR boundary reaching temperature limits first within approximately 5.15 hours. 0BFSG-51, Alternate MCR Ventilation Unit 0, provides operators the necessary guidance to establish alternate ventilation for the

MCR, the Unit 1 AEER, and the Unit 2 AEER. Local manual actions will be occurring in multiple areas of the plant to execute the FLEX strategy. (Reference 29) The action will provide for control of the plant equipment as well as connecting and controlling FLEX equipment. Local manual actions will be occurring in:

- MSSV rooms (PORV's)
- MSIV tunnel
- DDAF pump room
- Main Control Room (including Unit 1 and Unit 2 AEER)
- MEER /Battery room
- Fuel Handling Building
- DDAF pump discharge valves (AF005s)

- Habitability conditions within the MCR and other areas of the plant will be maintained with a tool box approach (Attachment 10) limiting the impact of high temperatures with methods such as supplemental cooling, personnel rotation, and/or availability of fluids.

- Local PORV operation is accomplished adjacent to an outside door, which can be opened to provide a cooler staging area for the operators. Sound power phone headsets are provided to ensure communications are acceptable and available outside the rooms. Entry would only be required to make small adjustments in the PORV position. DDAF pump room initial actions will be aligning the suction source and alternate SX cooling. Ongoing manual actions include filling day tank (valve operation), monitoring pump performance and setting up temporary ventilation. Continuous occupancy is not required.

MEER/Battery room initial action include DC load shedding and verifying aligning the battery charger to the DC Bus. Ongoing actions include area/equipment checks and temporary ventilation setup. Continuous occupancy is not required.

Main Control Room initial actions include Emergency Procedure and plant operations. Ongoing actions will require continuous occupancy. The AEER does not have initial operator actions. Execution of 1/2BFSG-7, Loss of Vital Instrumentation or Control Power Unit 1/2 would require entry for alternate instrument readings, but continuous occupancy is not required. Temporary ventilation will be setup to provide cooling in both the MCR and AEER.

The Spent Fuel Pool area initial actions include setting up temporary hoses and spray nozzles. These actions are performed prior to the onset of SFP boiling. Occupancy after this initial setup in not required.

Main Steam Isolation Valve (MSIV) tunnel initial actions include routing a temporary hose between the A/D and B/C Main Steam Safety Valve (MSSV) rooms. This area is the supply air for the MSSV rooms. Natural ventilation will draw air from the turbine building, through the tunnel and out the MSSV rooms. Continuous occupancy is not required.

The Diesel Drive Auxiliary Feedwater pump discharge valves will need to be throttled periodically to control Steam Generator level. The valves are located on the 364 elevation of the auxiliary building. This area is relatively cool and does not contain components that will generate significant heat.

2.10.3 Lighting

Appendix R lights are available in many locations within the plant, including the DDAF pump room, AF005 valve area, Main Control Room, Auxiliary Building, and Containment Penetration areas. These lights are not robust, but may provide general area lighting that will assist the operators in execution of the site FLEX strategy. Flashlights are available to Operators and will be used to illuminate specific areas or components, as needed. Temporary lighting is established in the following areas by 0BFSG-5, Initial Equipment and FLEX Equipment Staging Unit 0:

- Main Control Room
- DDAF pump rooms
- AF005 flow control valve operating areas
- FLEX equipment deployment areas near the RWST tunnel hatches

MCCs 132X2 and 232X2 will be powered from a FLEX Diesel Generator. When energized, MCR lighting is restored as one of the vital loads.

2.10.4 Communication

Onsite communications will be performed using either the installed sound powered headset system or the 900 Mhz radios in the talk around mode. If the Security diesel generator is in operation then the normal onsite telephone and radio system will be functional. Additional hand-held radios for use on talk around, with batteries, are staged in the Robust FLEX Storage Building.

The design of the NARS Communication upgrade for Byron is one (1), installed dish, permanently mounted, that provides primary satellite communication for the MCR. As backup emergency communication in BDBEE, two trailer mounted satellite communications system are staged in the Robust FLEX building. One of the trailer satellite systems is designated for MCR backup use and the other for TSC & OSC. Each trailer has its own small portable diesel generator unit (e.g., Yanmar®) for emergency power. Each is rated at 5500W, able to carry the small expected load. The trailers are compact and can be deployed via any small vehicle with a trailer hitch. The trailers have automatically deploying dish, satellite communications terminal box, remote satellite terminals as well as necessary cable and miscellaneous items to establish communications from a remote satellite deployment location. (References 20 and 21)

Three (3) satellite phones (e.g., Iridium®) and three (3) Bull Horns are available for the Shift Manager/Site Emergency Director in the Main Control Room area.

Battery chargers for portable communications equipment will be powered from a portable diesel generator or the FLEX DG.

2.10.5 Fueling Portable Equipment

The Byron FLEX Response Strategy is to ensure all of the Phase 2 and Phase 3 equipment can continue to operate for the indefinite coping time required. The fuel credited is the fuel stored in the 1/2B DG Fuel Oil Storage Tanks. Byron installed a modification in the 1/2B Diesel Oil System allowing the transfer of the fuel into a refuel vehicle for refuel operations from a repowered B DG Fuel Oil Transfer Pump. Fuel Consumption and Refuel Strategy is contained in Attachment 9, Fuel Consumption and Refuel Strategy.

Equipment that has been purchased will operate on the same type of fuel, Ultra Low Sulfur (ULS) diesel fuel. The strategy is contained in the Byron Station Procedure 0BFSG-50, FLEX Support Equipment Operation Unit 0. All fuel onsite meets the ULS requirements and the future orders of fuel will meet the same requirements.

The outside fuel oil storage tanks, 125,000, and 50,000 gallon tanks, although not in the strategy, if available, can be utilized in the refuel strategies.

Filling portable diesel fuel tanks is described in 0BFSG-50, FLEX Support Equipment Operation Unit 0. This procedure will be used to fill the fuel tank installed on the F-750 (or equivalent) which will then be used to fill tanks on the portable FLEX equipment.

National SAFER Resource Center resources, in the form of additional tanks and fuel transfer pumps, may also be used for fueling FLEX equipment.

2.10.6 Other

0BFSG-5, Initial Assessment and FLEX Equipment Staging Unit 0, establishes a rest and recovery area. This is coordinated with Security and will be dependent upon the event. Supplies include:

- Water
- Personal hygiene supplies
- Sleeping bags
- Cots

2.11 Water Sources

2.11.1 Water Sources – Secondary

The 500,000 gallon Condensate Storage Tank (CST) provides a non-safety grade source of water to the Steam Generators for removing decay and sensible heat from the Reactor Coolant System (RCS). The CST provides a passive flow of water, by gravity, to the Auxiliary Feedwater (AF) System (LCO 3.7.5) which feeds the Steam Generators. The steam produced is released to the atmosphere by the Main Steam Safety Valves (MSSVs) or the Steam Generator Power Operated Relief Valves when the condenser is not available. The AF pumps normally operate with recirculation to the CST. The specified LCO level assures the required useable volume of approximately 212,000 gallons is met.

If the CST is not available, AF can be supplied by the Essential Service Water (SX) System. The SX System provides a safety related, Seismic Category I backup to the CST. The SX System is automatically aligned to provide AF based on system conditions and pump start signals. For analysis purposes, the Ultimate Heat Sink cooling tower basins (2) are assumed to be maintained at a nominal 60% level, which corresponds to approximately 306,000 gallons of water in each basin. Calculations have shown that this quantity, combined with expected operator actions, provide adequate suction supply to the DDAF pumps. (Reference 36)

The intake area and screens for the SX system are designed for a maximum flow of 52,000 gpm under design basis conditions. In an ELAP, the flow rate is a maximum of 3,800 gpm. This is 7.3% of the design basis flow which significantly reduces the intake velocity into the intake area and screens as well as providing significant margin for screen clogging. (Attachment 10)

The normal makeup to the towers is provided by the non-safety related, non-engineered safety feature, Circulating Water (CW) System. Two safety related diesel-driven makeup pumps, which take suction from the Rock River, can provide makeup to each tower basin. For a BDBEE, both the CW System and Rock River makeup sources are considered not available. However, there are two Deep Well Water (WW) pumps. Each is dedicated to one of the two SXCT basins. They are powered from an engineered safety feature bus associated with each tower and are capable of providing make up to either SX basin. The tower basins communicate at approximately 64% basin level. With normal electrical supply unavailable, backup power is provided as a part of the DBEE strategies.

The deep well design features preclude debris entrainment into the suction of the ELAP pump. The WW pump has a concrete casement covering the well plus ASTM A53 Grade B steel casing (3/8 inch thick) through the soil and dolomite strata into the sandstone. Individual lengths of well casing were welded together when installed. The annular spaces between the bore holes and the well casings were grouted with concrete grout from the bottom upward in order to seat the casings into the bedrock and to provide seals preventing the movement of soil or surface contaminants into the wells. (Attachment 10)

These water sources have a wide range of associated chemical compositions. Therefore, extended periods of operation with addition of these various water sources to the SGs will have an impact on their material. Use of the available clean water sources, condenser and CST, are limited only by their quantity. The water supply from the SX system, with makeup from the WW pumps, is essentially unlimited by quantity, but is limited in quality. Calculations have shown that Unit 1 Steam Generators (SG) heat transfer capabilities will be reduced by 3.5% (Unit 2 by 5.8%) through the first 72 hours when using SX system as the water supply. Additionally, based on calculated heat removal requirements over this time, the SGs could lose 67% of their heat transfer capabilities and still meet the heat removal requirement over the first 72 hours, with adequate subsequent margin. (Reference 39) This assures acceptable and adequate site water sources until the delivery and deployment of the Phase 3 NSRC water treatment equipment.

The use of these sources is discussed in the appropriate strategies.

2.11.2 Water Sources – Primary Side

The Safety Injection Accumulators (4 per unit) will provide the initial source of borated water for reactivity control and RCS inventory makeup. The SI Accumulators are passive components, since no operator or control action are required for them to perform their function. Each SI Accumulator contains a volume of 7106 (+/- 111) gallons of water with a boron concentration of 2300 (+/- 100) ppm, and a pressurized nitrogen cover gas of 624.5 (+/- 22.5) psig. The gas is the motive force for RCS addition. This internal tank pressure is sufficient to discharge each borated accumulator contents into their respective cold leg of the RCS, as RCS pressure decreases below the accumulator pressure.

The Refueling Water Storage Tank (RWST) supplies borated water to the Chemical and Volume Control System (CVCS) during abnormal operating conditions, to the refueling pool during refueling, and to the ECCS and Containment Spray system during accident conditions. Each operating unit has their dedicated RWST. Each RWST contains a minimum of 395,000 of useable water volume. This volume is maintained at a boron concentration of 2400 (+/- 100) ppm and at a temperature between 35°F and 100°F. Calculations have shown that in the most demanding scenario of usage, each RWST alone will provide at least 33.6 hours of borated water. If an alternate water supply is provided to the SFP, a single RWST is not depleted until 1060 hours. (Reference 37)

The use of these sources is discussed in the appropriate strategies.

2.11.3 Water Sources – Spent Fuel Pool (SFP)

The Refueling Water Storage Tank (RWST) supplies borated water to the Chemical and Volume Control System (CVCS) during abnormal operating conditions, to the refueling pool during refueling, and to the ECCS and Containment Spray system during accident conditions. Each operating unit has their dedicated RWST. Each RWST contains a minimum of 395,000 of useable water volume. This volume is maintained at a boron concentration of 2400 (+/- 100) ppm and at a temperature between 35°F and 100°F.

Deep Well Water from subterranean aquafers provides an unlimited quantity of available water for SFP makeup.

The use of these sources is discussed in the appropriate strategies.

2.12 Sequence of Events

Attachment 8 presents the Sequence of Events Timeline for an ELAP/LUHS event at Byron Station.

The validation of FLEX strategies and procedures has been performed using a series of simulator scenarios, plant walk-downs, and table-top discussions. The process used was similar to the one that was used for the validation of the Emergency Operating Procedures (EOP) as described in AD-BY-101-1003, EOP Maintenance Program Guideline. The validation process included Phase 1 and Phase 2 strategies. Since Phase 3 strategies utilize the same connection with NSRC components, the validation was applicable/bounding to Phase 3 strategies.

The FLEX related procedures were walked down for accuracy and will be walked down at least once every five (5) years to ensure the ability to perform the strategy remains unchanged. Among the items to be considered in the walkdown are: 1) current configuration of the plant, 2) location and legibility of labels, and 3) viability of the referenced procedures credited in this site specific Final Integrated Plan (FIP).

Snow plans, which adequately address FLEX deployment travel routes, have been validated and will be validated at least once every five (5) years.

Assessments will be performed in accordance with LS-AA-126-1005, Check-In Self Assessments, at least once every five (5) years. The assessment should focus on the ability to implement the FLEX strategies.

2.13 Equipment Storage

2.13.1 Identification of FLEX Equipment

Portable FLEX equipment shall have unique plant equipment numbers. If a unique plant equipment number does not exist, then the major equipment is clearly labeled with a noun name and designated as FLEX equipment.

FLEX storage areas is marked as FLEX or Emergency Response Storage Areas.

Non-control room equipment that requires manipulation or verification as part of a FLEX mitigation strategy are clearly identified by plant labelling.

Infrequently operated or difficult to locate components are clearly identified by one of the following methods:

- The plant label has FLEX (FX) equipment listed on it.

- The plant label will be color coded or contain orange reflective tape so Operations personnel can easily identify it as FLEX/FSG or Emergency Response Equipment.

2.13.2 Onsite

There are two storage building to support FLEX strategies. The FLEX Storage Robust Building houses the "N" and "N+1" FLEX equipment, and is designed to withstand design basis wind, tornado, and seismic hazards as outlined in NEI 12-06. An adjacent commercial building, constructed to ASCE 7-10 standards, houses non-strategic, support equipment. The commercial building will hold site equipment as well as support supplies not required by the NEI 12-06 FLEX Strategies. Both buildings will be located outside the protected area north of the main parking lot. In addition, the site strategy will have several strategic temporary hoses and electrical cables staged within robust structures in the plant. (Reference 19)

The onsite storage location is capable of supporting the site deployment time line.

Deployment paths:

- Deployment paths are reviewed on a monthly basis to ensure they are maintained available, are in a condition to allow transport of FLEX equipment, and are not blocked.
- When two deployment path options are available, temporarily blocking one path to support plant operations is acceptable. Compensatory actions may be considered depending upon the duration of the blockage.
- When only one deployment path is available, temporarily blocking this path to support plant operations is acceptable. Compensatory actions should be considered depending upon the duration of the blockage.
- Deployment paths and staging areas are contained in the snow removal plan. These areas will be maintained as a priority after site safety concerns are addressed.
- 0BOSR XFT-A5, Unit 0 Freezing Temperature Equipment Protection Non-protected Area Buildings Surveillance, provides directions for checking the functionality of the building heaters prior to the onset of freezing weather.
- Portable FLEX pumps and generators are stored to maintain compliance with EN-AA-103-0003, Spill Prevention.

Equipment storage in the FLEX building:

- Equipment is secured during a seismic event to preclude seismic interaction that could cause damage to the equipment. Equipment is secured using a minimum of 4 tie-down points per piece of equipment. For situations where less than 4 tie-down points are used for a piece of equipment, engineering was consulted to ensure equipment was sufficiently restrained to preclude interaction with surrounding equipment.
- Storage cabinets are not tied down as they are located a sufficient distance from any piece of equipment such that if the cabinet were to fall over during a seismic event, it would not make contact with any equipment.
- Miscellaneous items are stored on shelves in the FLEX building. Equipment is located a sufficient distance away from shelves to ensure items stored on shelves will not contact equipment if they fall from the shelves during a seismic event.

FLEX pump, generator, tow vehicle and equipment usage:

- It is acceptable for portable FLEX pumps, generators, tow vehicles and support equipment to be used for emergency response activities in the Owner Controlled Area (OCA).
- The FLEX pumps, generators, tow vehicles, and support equipment shall be available to support FLEX strategies unless it is undergoing maintenance, testing, or in support of training, however the equipment must be able to be restored to an AVAILABLE condition without undue delays.
- FLEX pumps, generators, tow vehicles, and support equipment may <u>not</u> be moved from its storage location without authorization of Operations Shift Management.

FLEX keys:

- The FLEX building access key will be stored in at least two individual locations.
- FLEX equipment operation keys are stored in two separate locations. Where practical, one set of keys should be tethered to its respective FLEX equipment.

The following procedures will provide directions for the inspection of the onsite storage facilities and access routes following adverse conditions:

- 0BOA ENV-1, Adverse Weather Conditions, provides directions to inspect the onsite storage areas and pathways to the deployment area.
- 0BOA ENV-4, Earthquake, provides directions to inspect the onsite storage areas and pathways to the deployment areas.
- 0BOSR FP-14, B.5.B and FLEX Equipment Weekly Surveillance, performs an inspection of the storage buildings and equipment stored inside the buildings to ensure:
- All portable equipment is in a ready for deployment condition.
- During cold weather conditions (less than 30°F) the buildings are heated.
- Access to the portable equipment and deployment routes are in a condition that does not impede timely deployment.
- Support equipment storage cabinets are sealed to ensure required support equipment is available for use.

In-plant storage areas are established to ensure required equipment is available to support the FLEX strategies:

- Main Control Room alternate ventilation support equipment will be stored near the deployment areas described in 0BFSG-51, Alternate MCR Ventilation.
- Division 12/22 4KV ESF switchgear rooms to support alignment of the FLEX diesel generator to Bus 132X/232X.
- Main steam tunnel to support the ability to provide feedwater to all four (4) Steam Generators.
- Fuel Handling Building to support alternate Spent Fuel Pool makeup.
- Aux Building 383' elevation to support Auxiliary Feedwater and other Aux Building requirements.

In plant storage areas are uniquely identified to ensure equipment is available at all times to support the associated FLEX strategy.

2.13.3 Offsite

Byron Station relies on equipment stored offsite for Phase 3 of the FLEX mitigation strategy. Equipment may be provided from a National SAFER Response Center (NSRC). Another nuclear plant may also provide Phase 3 equipment, if response would be faster than from the NSRCs.

Temporary staging areas have been identified and details for their use in supporting Phase 3 equipment receipt, inspection and deployment to operating areas are provided in the SAFER Response Plan for Byron Station. (Reference 74)

2.14 Equipment Deployment

2.14.1 Onsite

Primary and alternate deployment routes for Phase 2 portable FLEX equipment are identified in Attachment 6.

Evaluation of deployment routes for suitability in supporting FLEX strategies is documented in EC 399165, FLEX Haul Path Liquefaction Evaluation.

Debris removal and onsite transport of Phase 2 FLEX portable equipment will be accomplished using one (1) F-750 (or equivalent) equipped with a plow and two (2) tractors equipped with buckets.

2.14.2 Offsite

Primary and alternate deployment routes for Phase 3 portable FLEX equipment are described in CC-BY-118-1002, SAFER Response Plan for Byron Station.

Staging areas for Phase 3 portable FLEX equipment are described in CC-BY-118-1002, SAFER Response Plan for Byron Station.

Memorandums of Understandings (MOU) for Whiteside County Airport and DeKalb Taylor Municipal Airport are VALIDATED annually to ensure they are in place, accurate, and renewed for the next annual period.

2.15 Portable FLEX Equipment and Commodities

Note: N+1 refers to the required amount of equipment required to satisfy the requirements of NEI 12-06, where N = the number of units on site and the +1 refers to an additional set.

Exelon has committed to the domestic nuclear industry to make their FLEX equipment available to other utilities that may need it during a BDBEE event. INPO is maintaining the Phase 2 FLEX equipment lists for all nuclear utilities in the U.S. If any changes are made to the inventory of the site's Phase 2 FLEX equipment (not including removing pieces of equipment for routine maintenance), INPO must be notified of such a change within 30 days. (Reference 73)

Attachment 2, FLEX Equipment List, provides a list of the portable equipment and commodities required to support the FLEX strategies.

All portable FLEX equipment and commodities will be uniquely identified to ensure availability to support the FLEX strategies.

FLEX equipment availability will be administratively controlled to ensure that the N equipment is available at all times, or appropriate contingency actions are taken until restored:

- 0BOL FX1, LCOAR FLEX Support Equipment, is in place to track the unavailability of portable Phase 2 equipment, connections, and the allowed unavailability period.

- 0BOSR FX-S1, Unit 0 FLEX Equipment Inventory Surveillance, is in place to track availability of equipment required to support Phase 2 strategies.

- 0BOSR FP-14, B.5.B and FLEX Equipment Weekly Surveillance, is in place to ensure FLEX equipment is maintained in a standby status.

Refer to CC-AA-118, Diverse and Flexible Coping Strategies (FLEX) and Spent Fuel Pool Instrumentation Program Document, for governance on equipment quality requirements.

2.16 Equipment Design

Refer to CC-AA-118, Diverse and Flexible Coping Strategies (FLEX) and Spent Fuel Pool Instrumentation Program Document, for governance on equipment design requirements.

Attachment 1, Basis Documentation Supporting FLEX Strategies, lists documentation that provides the detailed basis for each strategy including equipment design.

2.17 Programmatic Elements

2.17.1 Overall Program Document

Program Document CC-AA-118, Diverse and Flexible Coping Strategies (FLEX) and Spent Fuel Pool Instrumentation Program Document (Reference 72), provides Exelon Fleet governance and procedure guidelines to ensure readiness in the event of a Beyond-Design-Basis External Event.

Byron Station procedure CC-BY-118 (Reference 73) provides a description of the Site Implementation of Diverse and Flexible Coping Strategies (FLEX) and Spent

Fuel Pool Instrumentation Program. This procedure implements the Exelon Fleet program document CC-AA-118 by outlining Byron Station site-specific details. The key elements of this procedure include:

- Summary of the Byron Station FLEX strategies
- Validation of FLEX Strategies
- FLEX Equipment and Commodities design, control, and identification
- Maintenance and Testing Procedures, including Spent Fuel Pool Instrumentation
- Availability of Equipment and Connections
- FLEX Equipment Storage
- Deployment of FLEX Equipment
- Procedures and Guidelines
- Plant Configuration Control
- Staffing and Training to support FLEX Strategies
- Tracking of Commitments
- Snow removal routes

Existing design control procedures CC-AA-309-101, Engineering Technical Evaluations, has been revised to ensure that changes to the plant design, physical plant layout, roads, buildings, and miscellaneous structures will not adversely impact the approved FLEX strategies.

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

2.17.2 Procedural Guidance

The inability to predict actual plant conditions that require the use of BDB equipment makes it impossible to provide specific procedural guidance. As such, the Byron Station FLEX Strategy Guidelines (FSGs) provide guidance that can be employed for a variety of conditions. Clear criteria for entry into FSGs will ensure that FLEX strategies are used only as directed for BDB external event conditions, and are not used inappropriately in lieu of existing procedures. When

FLEX equipment is needed to supplement Emergency Operating Procedure (EOPs), Contingency Action Procedures (CAs), or Abnormal Operating Procedures (AOPs) strategies, the EOP, CA or AOP, as well as Severe Accident Mitigation Guidelines (SAMGs), or Extreme Damage Mitigation Guidelines (EDGMs), direct the entry into and exit from the appropriate FSG procedure.

FLEX Strategy guidelines have been developed in accordance with PWROG guidelines. FLEX Strategy Guidelines provide available, pre-planned FLEX strategies for accomplishing specific tasks in EOPs, CAs 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 1/2BCA 0.0, Loss of all AC Power Unit1/2 and 1/2BOA ELEC-8, Loss of All AC Power while on Shutdown Cooling Unit 1/2, to the extent necessary to include appropriate reference to FSGs and provide command and control for the ELAP.

FLEX Equipment guidelines have been created to support proper operation of specific equipment, i.e., High Head FLEX Pump operation guideline, FLEX diesel generator operation guideline. These guidelines are contained in the OP-BY-FX series of Byron Station procedures.

Changes to FSGs are controlled by Exelon fleet procedure AD-AA-101, Processing of Procedures and T&RMs (Reference 71). FSG changes will be reviewed and validated by the involved groups to the extent necessary to ensure the strategy remains feasible. Validation for existing FSGs have been accomplished in accordance with the guidelines provided in NEI APC14-17, FLEX Validation Process, issued July 18, 2014 (Reference 13).

2.17.3 Staffing

The Staffing requirements were assessed utilizing the methodology of NEI 12-01, Guideline for Assessing Beyond-Design-Basis Accident Response Staffing and Communications Capabilities, and an assessment of the capability of Byron on-shift staff and augmented Emergency Response Organization (ERO) to respond to a BDBEE.

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 units (all units are in operation at the time of the event)
- impeded access to the units by offsite 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.

Byron Operations, Security, Chemistry, Radiation Protection and FLEX project personnel conducted a table-top review of the on-shift response to the postulated BDBEE and extended loss of AC power for the Initial and Transition Phases using the FLEX mitigating strategies. Resources needed to perform initial event response actions were identified from the Emergency Operating Procedures (EOPs). 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 time motion analyses of NEI 10-05, Assessment of On-Shift Emergency Response Organization Staffing and Capabilities.

This Phase 2 Staffing Assessment concluded that the current minimum on-shift staffing as defined in the Emergency Response Plan for Byron, as augmented by site auxiliary personnel, is sufficient to support the implementation of the FLEX strategies on both units, as well as the required Emergency Plan actions, with no unacceptable collateral duties. The Phase 2 Staffing Assessment also identified the staffing necessary to support the Expanded Response Capability for the BDBEE as defined for the Phase 2 staffing assessment. This staffing will be provided by the current Byron site resources, supplemented by Exelon fleet resources, as necessary.

For habitability concerns, the operators will use the toolbox approach for safety gear required to enter the plant (Attachment 10).

A Phase 2 Staffing assessment was performed to verify and validate minimum staffing requirements to implement Phase 2 FLEX mitigation strategies with conclusions documented in RS-14-119, Response to NRC March 12, 2012

Request for Information Pursuant to 10 CFR 50.54(f), Enclosure 5, Recommendation 9.3, Emergency Preparedness – Staffing, Requested Information Items 1, 2, and 6 – Phase 2 Staffing Assessment (Reference 65).

Security personnel shall only be deployed to support FLEX procedure actions after all other available site personnel have been assigned to FLEX tasks. Security personnel would be relieved from duties associated with the implementation of mitigating strategies upon the earlier of two conditions:

- availability of other plant personnel
  - or-
- task completion

Once dismissed, security personnel may resume their normal duties, as necessary.

2.17.4 Training

Byron's Nuclear Training Program has been revised to assure personnel proficiency in the mitigation of BDB external events is adequate and maintained. These programs and controls were developed and have been implemented in accordance with the Systematic Approach to Training (SAT) Process. Refer to CC-AA-118, Diverse and Flexible Coping Strategies (FLEX) and Spent Fuel Pool Instrumentation Program Document for staffing and training requirements. Using the systematic approach to training (SAT), Operations and other appropriate personnel received initial and will receive continuing training on FLEX related procedures and strategies.

Personnel assigned to direct the execution of mitigation strategies for BDB external events have received the necessary training to ensure familiarity with the associated tasks, considering available job aids, instructions, and mitigating strategy time constraints. Upon SAFER equipment deployment and connection in an event, turnover and familiarization training on each piece of SAFER equipment will be provided to station operators by the SAFER deployment/operating staff.

Emergency Response Organization (ERO) members have completed NANTEL Basic FLEX Certification. New ERO members will complete NANTEL Basic FLEX Certification. ERO decision makers have completed NANTEL Generic Advanced FLEX Certification. New ERO Decision makers will complete NANTEL Generic Advanced FLEX Certification.

2.17.5 Availability, Maintenance and Testing

FLEX mitigation equipment is subject to initial acceptance testing and subsequent periodic maintenance and testing to verify proper function.

Portable FLEX equipment is maintained under the site's Preventative Maintenance (PM) program.

Operations perform periodic activities to ensure readiness of FLEX equipment and support equipment. This readiness includes equipment inventory, operability testing, flow testing, leakage testing, and inspections. Operations also maintain procedures which provide the actions to be taken during unavailability of FLEX equipment. (See Attachment 3)

Identified equipment deficiencies shall be entered into the corrective action program. Equipment deficiencies that would prevent FLEX equipment from performing the intended function shall be worked under the priority list in accordance with the work management process. Equipment that cannot perform its intended functions shall be declared Unavailable. Unavailability shall be tracked in accordance with 0BOL FX1, LCOAR FLEX Support Equipment.

Portable FLEX equipment availability and FLEX connections to permanent installed plant equipment complies with the requirements of CC-AA-118, Diverse and Flexible Coping Strategies (FLEX) and Spent Fuel Pool Instrumentation Program Document.

0BOL FX1, LCOAR FLEX Support Equipment, is in place to track the unavailability of portable Phase 2 equipment, connections, and the allowed unavailability period. For example, it provides the following guidance:

- If one portable FLEX diesel generator becomes unavailable, then immediately verify at least three remain available (site FLEX capacity - N) and restored the forth within 90 days or provide an alternate piece of equipment equal capacity within 90 days.
- If a portable FLEX diesel generator becomes unavailable such that the site FLEX capability (N) is not maintained, then initiate action within 24 hours to restore the site FLEX diesel generator capability (N) and provide an alternate piece of equipment with equal capacity within 72 hours.
- If one FLEX RWST Supply connection is unavailable, then immediately verify at least one remains available and restore the second RWST Supply connection within 90 days or provide an alternate piece of equipment with equal capacity within 90 days.

0BOSR FX-S1, Unit 0 FLEX Equipment Inventory Surveillance, will perform an inventory of FLEX equipment, connections, and support equipment. This procedure inventories the FLEX lockers in the plant, on the various FLEX equipment trailers, and in the FLEX buildings to ensure necessary equipment is available and in a condition to execute the FLEX strategies.

A partial or full inventory will be performed for equipment that has been moved from its storage location (e.g., maintenance, testing, or training) to ensure it has been returned to the proper storage location. Among the items included in this surveillance, but not limited to, are door chocks, flashlights headsets, insulated screwdrivers, and batteries.

2.18 Inspections

All FLEX equipment trailers, designated towing equipment, and buildings will be inspected and/or tested:

2.18.1 Monthly Inspections:

- Battery chargers plugged in and functional
- Door openings path is clear for access doors on trailers
- Access to the equipment is consistent with the OIP timeline and is not blocked
- External issues that could affect equipment availability are identified and appropriately scheduled to be corrected (e.g., building material condition, rodent problems, housekeeping issues, etc.)
- Battery electrolyte level is acceptable by verifying cell plates are covered (N/A for sealed batteries)
- Proper battery voltage with battery charger off
- Facility heating is working properly (during winter months)
- Access routes for FLEX equipment deployment are not obstructed including access to water sources

2.18.2 Quarterly Inspections:

- Fuel level satisfactory with no evidence of leakage
- Engine lube oil level satisfactory with no evidence of leakage
- Engine coolant level satisfactory with no evidence of leakage
- Tire pressure meets manufacturer recommendations

2.18.3 Semi-Annual Inspections:

- The physical inventory of all FLEX equipment is staged at various locations both in plant and at remote locations. This staging is checked. The inventory check shall include:
- Storage locations match procedural requirements
- Storage areas and equipment are marked as FLEX or FSG and/or Emergency Response Equipment
- Cabinets and boxes containing FLEX staged equipment are locked or sealed
- Proper quantity
- General condition of equipment ensures proper function
- FME covers installed per MA-AA-716-008, Foreign Material Exclusion Program
- Gaskets present as required
- Shelf or service life will not expire prior to next inventory check
- Calibration will not expire prior to next inventory check
- Housekeeping is acceptable
- Temporary power cord use is in accordance with SA-AA-129-2118, Management and Control of Temporary Power, including the use of Ground Fault Circuit Interrupter (GFCI) at the power source for all 120/240V AC receptacles
- Vendor recommended maintenance and testing will be performed on FLEX equipment, trailers, designated towing equipment, and FLEX buildings by following the designated PM service requirements per the Station PM program.

2.18.4 Annually Inspections:

- Vendor recommended preventive maintenance and testing will be performed on FLEX equipment, trailers, designated towing equipment, and FLEX building by following the designated PM service requirements per the Station PM program.
- Fuel stabilizer additive will be added or fuel will be sampled and replace as required.
- A functional check of access door(s) will be performed on trailers.

- Pressure hose and couplings will be checked for damage and degradation. Repack the hose so the folds are in a different location on the hose.
- Communication equipment specified in the OIP will be checked to ensure the correct devices are available, functional, and stored in the correct location.
- FLEX oscillating nozzle(s) will be operated or tested in accordance with vendor recommendations, including a physical check of the equipment for signs of corrosion or degradation. ENSURE movable parts will be verified for functionality through the required range of movement.

2.18.5 Every three (3) years Inspections:

Vendor recommended preventive maintenance and testing will be performed on FLEX equipment, trailers, designated towing equipment, and FLEX building by following the designated PM service requirements per the Station PM program.

If a pressure hose is new, then a five (5) year interval from the manufacturer hydrostatic test date on the pressure hose is acceptable prior to performing the first hydrostatic test. All subsequent testing shall be performed on a three (3) year interval.

Pressure hose testing or replacement must be performed with the specified interval (from the tested month) and is not permitted to be performed in grace.

- Hydrostatic testing of FLEX pressure hoses will be performed every three (3) years from the month of the last test OR replace the hose within five (5) years of the manufacturers tested month and year AND verify the hydrostatically tested date marked on the hose and is legible (e.g., typically MM/YY format).
- If a pressure hose is hydrostatically tested, the pressure hose will be tested to a minimum of the service pressure test marked on the hose.
- If Storz® fittings are utilized, then torque check the retaining coupling bolts to certify set at the appropriate value following hydrostatic test or replacement.

3. References

1. NRC Order Number EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012.
2. NEI 12-06 Rev. 0, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, dated August 2012.
3. Byron Station, Units 1 and 2, "Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 28, 2013 (RS-13-017).
4. NRC ISG JLD-ISG-2012-01, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, August 29, 2012.
5. NRC Order EA-12-051, Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, March 12, 2012.
6. NRC ISG JLD-ISG-2012-03 Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation, August 29, 2012.
7. NRC Screening and Prioritization Results Regarding Information Pursuant to 10 CFR 50.54(f) Regarding Seismic Hazard Re-Evaluations for Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, May 9, 2014.
8. NRC Final Determination of Licensee Seismic Probabilistic Risk Assessments under the Request for Information Pursuant to 10CFR 50.54(f) Regarding Recommendation 2.1 "Seismic" of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, October 27, 2015.
9. Task Interface Agreement (TIA) 2004-04, "Acceptability of Proceduralized Departures from Technical Specification (TSs) Requirements at the Surry Power Station", (TAC Nos. MC42331 and MC4332), September 12, 2006.
10. NEI 12-01, Guideline for Assessing Beyond-Design-Basis Accident Response Staffing and Communications Capabilities, Revision 0.
11. NEI 12-02, Industry Guidance for Compliance with NRC Order EA-12-051, "To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," Revision 1, August 2012.
12. NEI Position Paper: "Shutdown/Refueling Modes," dated September 18, 2013 (ML 13273A514).
13. NEI APC14-17, FLEX Validation Process, July 18, 2014.
14. NUREG 1.155, Station Blackout, August 1988.
15. ANS-5.1-1979 Decay Heat Standard.

16. Byron Station's First Six Month Status Report for the Implementation of FLEX, dated August 28, 2013.
17. Byron Station's Second Six Month Status Report for the Implementation of FLEX, dated February 28, 2014.
18. Byron Station's Third Six Month Status Report for the Implementation of FLEX, dated August 28, 2014.
19. Byron Station's Fourth Six Month Status Report for the Implementation of FLEX, dated February 27, 2015.
20. Byron Station's Fifth Six Month Status Report for the Implementation of FLEX, dated August 28, 2015.
21. Byron Station's Sixth Six Month Status Report for the Implementation of FLEX, dated January 26, 2016.
22. Byron Station Unit 2, Sixth Six Month Status Report for the Implementation of FLEX, dated February 26, 2016.
23. Byron Station, Units 1 and 2 – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigating Strategies) (TAC NOS. MF0895 AND MF0896), dated December 17, 2013.
24. BYR99-010/BRW-99-0017-I Rev. 2, Documentation of the Basis of the Emergency Operating Procedures (EOP) Setpoints, dated September 2014.
25. BYR13-026/BRW-13-0031-M Rev. 0, Transient Analysis of SX System Following Loss of A-C Power, dated May 2013.
26. BYR13-144/BRW-13-0160-M Rev. 0, FLEX Pump Sizing and Hydraulic Analysis, dated April 2014.
27. BYR13-234/BRW-13-0216-M Rev. 0, Auxiliary FW Pump Room Temperature Analysis during and ELAP Event, dated March 2014.
28. BYR13-235/BRW-13-0217-M Rev. 0, Containment Pressure and Temperature Response during an ELAP Event, dated September 2014.
29. BYR13-236/BRW-13-0218-M Rev. 0, Control Room and Auxiliary Electric Equipment Room heat up and Ventilation during an ELAP, dated June 2014.
30. BYR13-237/BRW-13-0219-M Rev. 0, MEER and Battery Room Conditions Flowing ELAP, dated June 2014.
31. BYR13-238 Rev. 0, B Auxiliary Feedwater Pump Battery Analysis During an External Loss of AC Power (ELAP) Event, dated September 2014.
32. BYR13-239/BRW-13-0221-M Rev. 1, RCS Boration Analysis during an ELAP Event, dated September 2015.
33. BYR13-240/BRW-13-0222-M Rev. 0, Spent Fuel Pool Boil Off Analysis during an ELAP Event, dated March 2014.
34. BYR14-046/BRW-14-0058-M Rev. 0, Containment Environment Following an Extended Loss of AC Power During Shutdown, dated September 2014.

35. BYR14-060/BRW-14-0080-E Rev. 0, Unit 1(2) 125 VDC Battery FLEX Coping Calculation – Common Calc – Beyond Design Basis, dated July 2014.

36. BYR14-119 Rev. 0, UHS Volume Analysis during an ELAP Event, dated September 2014.

37. BYR14-129 / BRW-14-0212-M Rev. 1, RWST Usage During FLEX Scenarios, dated February 2016.

38. BYR14-130/BRW-14-0211-M Rev. 0, Evaluation of Tank and Hose Freezing during an ELAP, dated September 2014.

39. BYR14-150 Rev. 1, Byron Units 1&2 FLEX Steam Generator Degraded Heat Transfer Analysis Through 72 hours, dated November 2014.

40. CN-LIS-15-34, Exelon Byron and Braidwood Stations Reactor Coolant System ELAP Inventory Control Analysis with SHIELD Reactor Coolant Pump Seal Packages.

41. CN-LIS-15-38, Calculation of Asymmetric Natural Circulation Cooldown Rate Limits for the Byron and Braidwood Units in Support of the FLEX Program.

42. CN-LIS-15-39, Exelon Byron and Braidwood Stations Reactor Coolant System ELAP Long-Term Subcriticality Analysis with Low-Leakage Reactor Coolant Pump Seal Packages.

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72. CC-AA-118, Diverse and Flexible Coping Strategies (FLEX) and Spent Fuel Pool Instrumentation Program Document, Revision 001.

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78. TQ-AA-1, Systematic Approach to Training Process Description, Revision 004.

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4. Acronyms

AC................Alternating Current
AEER...........Auxiliary Electrical Equipment Room
AF................Auxiliary Feedwater
BAST...........Boric Acid Storage Tank
BCA.............Byron Contingency Actions
BDB.............Beyond-Design-Basis
BDBEEs.......Beyond-Design-Basis External Events
BFSG...........Byron FLEX Support Guideline
BOA.............Byron Abnormal Operating Procedure
CC...............Component Cooling Water
CETC...........Core Exit Thermocouple
CST.............Condensate Storage Tank
CVCS...........Chemical Volume and Control System
CW..............Circulating Water
DC..............Direct Current
DG...............Diesel Generator
DO...............Diesel Oil
ELAP...........Extended Loss of Alternating Current (AC) Power
EOP.............Emergency Operating Procedure
ERO.............Emergency Response Organization
ESEP...........Expedited Seismic Evaluation Process
FHRR...........Flood Hazard Reevaluation Report
FC................Spent Fuel Pool Cooling System
FCV.............Flow Control Valve
FSG.............FLEX Support Guideline
FSRB...........FLEX Storage Robust Building
FX DG..........FLEX Diesel Generator
GMRS..........Ground Motion Response Spectrum
GTG.............Gas Turbine Generator
HHA.............Hierarchal Hazard Assessment
HCLPF.........High-Confidence-of-Low-Probability-of-Failure
Hz................Hertz
HVAC...........Heating, Ventilation, and Air Conditioning
IHS..............IPEEE HCLPF Spectrum
IPEEE..........Individual Plant Examination of External Events
ISFSI...........Independent Spent Fuel Storage Installation

ISG .... Interim Staff Guidance
LIP .... Local Intense Precipitation
LOOP........... Loss of Offsite Power
LPSI............. Low Pressure Safety Injection
LUHS........... Loss of Ultimate Heat Sink
MCC .... Motor Control Center
MCR .... Main Control Room
MEER .... Miscellaneous Electrical Equipment Room
MM............... Mechanical Maintenance
MOV .... Motor Operated Valve
MS .... Main Steam
MSL .... Mean Sea Level
MSSV .... Main Steam Safety Valve
NDCT........... Natural Draft Cooling Tower
N_2................. Nitrogen
NSRC .... National SAFER Response Center
NRC............. Nuclear Regulatory Commission
OP .... Operating Procedure
PA................ Protected Area
pcm.............. Per Cent Millirho (ρ)
PMF............. Probable Maximum Flood
PMP............. Probable Maximum Precipitation
PMSS .... Probable Maximum Storm Surge
PORV......... Power Operated Relief Valves
psi .... Pounds per square inch
PWST .... Primary Water Storage Tanks
RAI............... Request for Additional Information
RCFC......... Reactor Containment Fan Cooler
RCS............. Reactor Coolant System
RFC .... Refueling Cavity
RPS .... Reactor Protective System
RVLIS .... Reactor Vessel Level Indication System
RWST.......... Refueling Water Storage Tank
SAFER......... Strategic Alliance for FLEX Emergency Response
SAT.............. Systematic Approach to Training
SDC............. Shutdown Cooling
SDM............. Shutdown Margin
SFP.............. Spent Fuel Pool

SFPHTX ...... Spent Fuel Pool Heat Exchanger
SI .... Safety Injection System
SG .... Steam Generator
SSCs .... Structures, Systems and Components
SSE .... Safe Shutdown Earthquake
SX................ Essential Service Water System
SXCT .... Essential Service Water Cooling Tower
TS .... Technical Specifications
TSC .... Technical Support Center
UFSAR .... Updated Final Safety Analysis Report
UHS .... Ultimate Heat Sink
UPS .... Uninterruptable Power Supply
VDC .... Volts Direct Current