Exelon Generation

Order No. EA-12-049

RS-18-037

May 9, 2018

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

LaSalle County Station, Unit 1
Renewed Facility Operating License No. NPF-11
NRC Docket No. 50-373

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-13-021)

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-13-121)

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-14-011)

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-14-209)

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-15-020)

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-15-211)

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 (RS-16-023)

12. Exelon Generation Company, LLC Seventh 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 26, 2016 (RS-16-146)

13. Exelon Generation Company, LLC Eighth 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, 2017 (RS-17-019)

14. Exelon Generation Company, LLC Ninth 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, 2017 (RS-17-094)

15. Exelon Generation Company, LLC Tenth 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, 2018 (RS-18-010)

16. NRC letter to Exelon Generation Company, LLC, LaSalle County Station, Units 1 and 2 – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049, (Mitigation Strategies) (TAC Nos. MF1121 and MF1122), dated February 21, 2014

17. 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

18. 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 September 25, 2014 (RS-14-187)

19. NRC letter to Exelon Generation Company, LLC, LaSalle County Station, Units 1 and 2 – Report for the Onsite Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Pool Instrumentation Related to Orders EA-12-049 and EA-12-051 (TAC Nos. MF1119, MF1120, MF1121, MF1122), dated March 23, 2015

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 LaSalle County Station, Unit 1 OIP.

Reference 1 required submission of a status report at six-month intervals following submittal of the OIP. References 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15 provided the first, second, third, fourth, fifth, sixth, seventh, eighth, ninth, and tenth six-month status reports, respectively, pursuant to Section IV, Condition C.2, of Reference 1 for LaSalle County Station, Unit 1.

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 LaSalle County Station, Unit 1.

LaSalle County Station, Unit 1 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 LaSalle County Station, Unit 1 with Reference 1.

OIP open items have been addressed and closed as documented in References 7, 14, and 15 and are considered complete pending NRC closure. EGC's response to the NRC Interim Staff Evaluation (ISE) open and confirmatory items identified in Reference 16 have been addressed and closed as documented in Reference 14 and are considered closed. EGC's response to the NRC ISE confirmatory item identified as open in Reference 19 is addressed in References 10 and 13, and is 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 and 13, 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 items.

Overall Integrated Plan Open Items

Section Reference	Overall Integrated Plan Open Item	Completion Response Reference
Sequence of Events (p.5)	The times to complete actions in the Events Timeline are based on operating judgment, conceptual designs, and current supporting analyses. The final timeline will be time validated once detailed designs are completed and procedures developed.	Reference 14
Sequence of Events (p.10)	Initial evaluations 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 14
Sequence of Events (p.10)	Analysis of deviations between Exelon's engineering analyses and the analyses contained in BWROG Document NEDC-33771P, "GEH Evaluation of FLEX Implementation Guidelines," and documentation of results on Att. IB, "NSSS Significant Reference Analysis Deviation Table." Planned to be completed and submitted with August 2013 Six Month Update.	Reference 7
Strategy Deployment (p.11)	Transportation routes will be developed from the equipment storage area to the FLEX staging areas. An administrative program will be developed to ensure pathways remain clear or compensatory actions will be implemented to ensure all strategies can be deployed during all modes of operation. Identification of storage areas and creation of the administrative program are open items.	Reference 14
Programmatic Controls (p.12)	An administrative program for FLEX to establish responsibilities, and testing & maintenance requirements will be implemented.	Reference 14
Core Cooling Phase 1 (p.17)	Additional work will be performed during detailed design development to ensure Suppression Pool temperature will support RCIC operation, in accordance with approved BWROG analysis, throughout the event.	Reference14

Section Reference	Overall Integrated Plan Open Item	Completion Response Reference
Fuel Pool Cooling Phase 1 (p.35)	Complete an evaluation of the spent fuel pool area for steam and condensation.	Reference 14
Safety Functions Support Phase 1 (p.44)	Evaluate the habitability conditions for the Main Control Room and develop a strategy to maintain habitability.	Reference 14
Safety Functions Support Phase 1 (p.44)	Evaluate the habitability conditions for the Auxiliary Electric Equipment Room (AEER) and develop a strategy to maintain habitability.	Reference 14
Safety Functions Support Phase 2 (p.48)	Develop a procedure to prop open battery room doors upon energizing the battery chargers to prevent a buildup of hydrogen in the battery rooms.	Reference 14
Maintain Core Cooling Phase 2 (p.23)	The Unit 1 FLEX connection to 1B FC EMU Piping is currently located in the Unit 1 Reactor Building '710 elevation. EC 618667 evaluations show if containment venting is utilized through the HCVS, radiation levels will be too high for entry into that area. The Unit 1 FLEX connection to 1B FC EMU Piping will be relocated to the Unit 1 Diesel Generator corridor (lower dose area). Since the Unit 1 FLEX connection to 1B FC EMU Piping will be located closer to the penetrations coming into the building, time validations are bounded by the original validation times.	Reference 15

Interim Staff Evaluation Open Items

Open Item	Completion Response Reference
Item No. 3.2.3.A	Reference 14

Interim Staff Evaluation Confirmatory Items

Confirmatory Item	Completion Response Reference
Item No. 3.1.1.2.A	Reference 14
Item No. 3.1.1.2.B	Reference 14
Item No. 3.1.1.4.A	Reference 14
Item No. 3.1.3.1.A	Reference 14
Item No. 3.2.1.1.A	Reference 14
Item No. 3.2.1.1.B	Reference 14
Item No. 3.2.1.1.C	Reference 14
Item No. 3.2.1.1.D	Reference 14
Item No. 3.2.1.1.E	Reference 14
Item No. 3.2.1.2.A	Reference 14
Item No. 3.2.1.3.A	Reference 14
Item No. 3.2.1.4.A	Reference 14
Item No. 3.2.1.4.B	Reference 14
Item No. 3.2.2.A	Reference 14
Item No. 3.2.4.1.A	Reference 14
Item No. 3.2.4.2.A	Reference 14
Item No. 3.2.4.4.A	Reference 14
Item No. 3.2.4.6.A	Reference 14
Item No. 3.2.4.7.A	Reference 14
Item No. 3.2.4.10.A	Reference 14
Item No. 3.4.A and 3.1.1.4.A	Reference 14

NRC Audit Report Open Items

Audit Open Item	Completion Response Reference
ISE CI 3.1.3.1.A	References 10 and 13

MILESTONE SCHEDULE – ITEMS COMPLETE

Milestone	Completion Date
Submit 60 Day Status Report	Oct 2012
Submit Overall Integrated Plan	Feb 2013
Contract with National SAFER Response Center	Nov 2012
Submit 6 Month Updates:	
Update 1	Aug 2013
Update 2	Feb 2014
Update 3	Aug 2014
Update 4	Feb 2015
Update 5	Aug 2015

Milestone	Completion Date
Update 6	Feb 2016
Update 7	Aug 2016
Update 8	Feb 2017
Update 9	Aug 2017
Update 10	Feb 2018
Modification Development:	
Phases 1 and 2 Modifications	Jan 2016
National SAFER Response Center Operational	Feb 2015
Procedure Development:	
Strategy Procedures	Mar 2018
Validate Procedures (NEI 12-06, Sect. 11.4.3)	Mar 2018
Maintenance Procedures	Mar 2018
Staffing Analysis	Oct 2014
Modification Implementation:	
Phases 1 and 2 Modifications	Mar 2018
Storage Plan and Construction	Feb 2015
FLEX Equipment Acquisition	Mar 2016
Training Completion	Mar 2018
Unit 1 Implementation Date	Mar 2018

ORDER EA-12-049 COMPLIANCE ELEMENTS SUMMARY

The elements identified below for LaSalle County Station, Unit 1 as well as the site OIP response submittal (Reference 5), the 6-Month Status Reports (References 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15), and any additional docketed correspondence, demonstrate compliance with Order EA-12-049.

Strategies - Complete

LaSalle County Station, Unit 1 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 LaSalle County 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 LaSalle County Station, Unit 1 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 LaSalle County Station, Unit 1 has been procured in accordance with NEI 12-06, Sections 11.1 and 11.2, and has been received at LaSalle County Station, Unit 1; and initially tested/performance verified as identified in NEI 12-06, Section 11.5, and is available for use.

Periodic maintenance and testing will be conducted through the use of the LaSalle County Station, Unit 1 Preventative Maintenance program such that equipment reliability is achieved.

Protected Storage – Complete

The storage facilities required to implement the FLEX strategies for LaSalle County Station, Unit 1 have been completed and provide protection from the applicable site hazards. The equipment required to implement the FLEX strategies for LaSalle County Station, Unit 1 is stored in its protected configuration.

Procedures – Complete

FLEX Support Guidelines (FSGs) for LaSalle County Station, Unit 1 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 LaSalle County Station, Unit 1 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 LaSalle County Station, Unit 1 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 17), as documented in Reference 18.

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 LaSalle County Station, Unit 1 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 the 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 LaSalle County Station, Unit 1 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 J. Distel at 610-765-5517.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 9th day of May 2018.

Respectfully submitted,

David M. Gullott
Manager - Licensing
Exelon Generation Company, LLC

Enclosure: LaSalle County 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 – LaSalle County Station
NRC Project Manager, NRR – LaSalle County Station
Mr. John P. Boska, NRR/JLD/JOMB, NRC
Illinois Emergency Management Agency – Division of Nuclear Safety

Enclosure

LaSalle County Station Units 1 and 2

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

(92 total pages)

LASALLE COUNTY NUCLEAR STATION

FINAL INTEGRATED PLAN DOCUMENT

MITIGATING STRATEGIES
NRC ORDER EA-12-049

May 2018

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1. Background

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

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

Based on NTTF Recommendation 4.2, the NRC issued Order EA-12-049 (Reference 1) on March 12, 2012 to implement mitigation strategies for Beyond-Design-Basis External Events (BDBEEs). The order provided the following requirements for strategies to mitigate BDBEEs:

1. Licensees shall develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and SFP cooling capabilities following a BDBEE.

2. These strategies must be capable of mitigating a simultaneous loss of all AC power and loss of normal access to the ultimate heat sink and have adequate capacity to address challenges to core cooling, containment and SFP cooling capabilities at all units on a site subject to the Order.

3. Licensees must provide reasonable protection 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 at all units on a site subject to the Order.

4. Licensees must be capable of implementing the strategies in all modes.

5. Full compliance shall include procedures, guidance, training, and acquisition, staging or installing of equipment needed for the strategies.

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

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

NRC Order EA-12-049 (Reference 1) required licensees of operating reactors to submit an overall integrated plan, including a description of how compliance with these requirements would be achieved by February 28, 2013. The Order also required licensees to complete implementation of the requirements no later than two refueling cycles after submittal of the overall integrated plan or December 31, 2016, whichever comes first.

The Nuclear Energy Institute (NEI) developed NEI 12-06 Revision 2 (Reference 2), which provides guidelines for nuclear stations to assess extreme external event hazards and implement the mitigation strategies specified in NRC Order EA-12-049. The NRC issued Interim Staff Guidance JLD-ISG-2012-01 Revision 1 (Reference 3), dated January 22, 2016, which endorsed NEI 12-06 Revision 2 with clarifications on determining baseline coping capability and equipment quality.

NRC Order EA-12-051 (Reference 4) required licensees to install reliable SFP instrumentation with specific design features for monitoring SFP water level.

NEI 12-02 (Reference 5) provided guidance for compliance with Order EA-12-051. The NRC determined that, with the exceptions and clarifications provided in JLD-ISG-2012-03 (Reference 6), conformance with the guidance in NEI 12-02 is an acceptable method for satisfying the requirements in Order EA-12-051.

NRC Order EA-13-109 (Reference 8) required licensees to install a severe accident capable hardened containment vent system for the Primary Containment wetwell to remove decay heat, vent the containment atmosphere, and control containment pressure to within acceptable limits.

NEI 13-02 (Reference 9) provided guidance to assist licensees with compliance with Order EA-13-109. The NRC issued Interim Staff Guidance JLD-ISG-2013-02 (Reference 10), dated November 14, 2013, which endorsed NEI 13-02 with exceptions and clarifications for installing a reliable hardened wetwell vent on Mark 1 and Mark 2 containment venting systems.

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

2.1 General Elements-Assumptions

The assumptions used for the evaluations of a LaSalle County Nuclear Station (LSCS) ELAP/LUHS event and the development of FLEX strategies are stated below.

Boundary conditions consistent with NEI 12-06 Rev. 2 Diverse and Flexible Coping (FLEX) Implementation Guide, 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 100 percent rated thermal power for at least 100 days or has just been shut down from such a power history as required by plant procedures in advance of the impending event.
- Each reactor is successfully shut down when required (i.e., all control rods inserted, no ATWS). Steam release to maintain decay heat removal upon shutdown functions normally, and reactor coolant system (RCS) 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.
- On-site staff is at site administrative minimum shift staffing levels.
- No independent, concurrent events, e.g., no active security threat.
- All personnel on-site 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 Rev. 2 Diverse and Flexible Coping (FLEX) Implementation Guide (Reference 2), for LSCS:

- No specific initiating event is used. The initial condition is assumed to be a loss of off-site power (LOOP) with installed sources of emergency on-site 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 portions 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 is lost, but the water inventory in the ultimate heat sink (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 all leakage, identified and unidentified, that flows to the drywell floor drain and equipment drain sumps. The total leakage rate limit is at 25 gpm per Technical Specifications.

- MAAP Analysis to Support Initial FLEX Strategy LS-MISC-017, Rev. 3 uses a RCS leakage value of 100 gpm at 1000 psig and is assumed to begin at t=30 minutes. The MAAP Analysis value of 100 gpm bounds the 25 gpm total tech spec leakage rate plus 18 gpm leakage from each Reactor Recirculation pump seal upon failure as stated in UFSAR section 15.9.3.5.

- 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 10CFR may be required.

- Site access is impeded for the first 6 hours, consistent with NEI 12-01 (Reference 7). Additional resources are available 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.

This plan defines strategies capable of mitigating a simultaneous loss of all alternating current (AC) power and loss of normal access to the ultimate heat sink resulting from a BDB event by providing adequate capability to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities for both units at LaSalle. 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.

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 BDB 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) "… departure from a licensed conditions or technical specification" and/or 10 CFR 73.55(p), "… suspension of security measures".

2.2 Strategies

The objective of the FLEX Strategies is to establish an indefinite coping capability in order to 1) prevent damage to the fuel in the reactor, 2) maintain the containment function and 3) maintain cooling and prevent damage to fuel in the SFP using installed equipment, on-site portable equipment, and pre-staged off-site resources.

This indefinite coping capability will address an extended loss of all AC power (ELAP) – loss of off-site power and emergency diesel generators, but not the loss of AC power to buses fed by station batteries through inverters – with a simultaneous loss of access to the ultimate heat sink (LUHS). This condition could arise following external events that are within the existing design basis with additional failures and conditions that could arise from a Beyond-Design-Basis external event.

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

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

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

The duration of each phase is specific to the installed and portable equipment utilized for the particular FLEX strategy employed to mitigate the plant condition.

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

The FLEX strategies are implemented by FSGs in conjunction with other site emergency procedures (LGA and LSAMG). LOA-FSG-011, Flex Beyond Design Basis External Event Guidance Attachment E, (Reference 62) provides a Flowchart of actions to be performed under ELAP for all FLEX events. The entry condition for LOA-FSG-011 Attachment E is from LOA-AP-101/201, Unit1/Unit2 AC Power Abnormal Procedure (Reference 64/67) when the expectation is that power will not be restored within the station's 4 hour Station Blackout (SBO) timeframe.

2.3 Reactor Core Cooling Strategy

The LSCS strategy for reactor core cooling and decay heat removal is controlled by using the Emergency Operating Procedures (EOPs) LGA-001, "RPV Control", LOA-FSG-003, "FLEX Water Strategy" and LOA-FSG-002, "FLEX Electrical Strategy".

In the event of a BDBEE, LGA-001 provides direction to use RCIC to provide RPV make-up while using ADS SRVs to control reactor pressure in the range of 150-250 psig.

Load shedding is performed per LOA-AP-101/201, U1/U2 AC Power Abnormal Procedure, to maintain divisional DC buses until the FLEX generator is available.

After 6 hours, the FLEX Portable Diesel Driven Pump (PDDP) is available for injection into the Suppression Pool or RPV when RCIC becomes unavailable. Within 8 hours, the FLEX generator is available to restore AC power on a limited basis to essential busses, the 250VDC battery charger, the Division I battery chargers and Division II battery chargers.

This configuration for water and AC power allows for the continued supply of both. The LOA-FSG-003, FLEX Water Strategy, provides primary, alternate, and in some cases contingency paths for make-up from the UHS to the RPV, suppression pool, and spent fuel pools.

2.3.1 Phase 1 Strategy

At the initiation of the event, the operators enter LaSalle General Abnormal (LGA) procedures (LaSalle site specific Emergency Operating Procedures) and LOA-AP-101/201, U1/U2 AC Power Abnormal procedure. Site specific FSGs are entered, as directed by LOA-AP-101/201, when there has been a loss of AC power and determination of no imminent return of AC power within the Station Black Out (SBO) timeframe of 4 hours. To extend the 125 VDC battery and 250 VDC battery coping times, load shedding actions are taken during Phase 1 (LOA-AP-101/201 Attachment K and Attachment N) and completed within 4.5 hours of the loss of all AC power. In addition, the operators take control of the Automatic Depressurization System (ADS) valves from the Auxiliary Electrical Equipment Room (AEER) within 20 minutes. Control of the ADS valves in the AEER ensures a safety related division 1 or division 2 bus and associated battery is used for ADS solenoid valve operation. Operators will line up a backup pneumatic nitrogen supply to the ADS SRVs (LOA-IN-101/201, Loss of Drywell N2 Supply) within 5 hours to enable continued ADS valve operation for RPV pressure control.

The FLEX Phase 1 strategy utilizes the RCIC system for initial RPV water level control. The RCIC pump can take suction from the condensate storage tank (CST) or from the Suppression Pool. The CSTs are not qualified for seismic and tornado/ high winds events. If the CST is unavailable, suction is transferred to the Suppression Pool. Only water from the Suppression Pool is credited in the FLEX Phase 1 strategy. The RCIC System operates independent of AC power. It is expected that RCIC would remain a viable source of injection if 125 VDC control power is available for system control and 250 VDC is available for the control of valves. Procedural guidance exists in LGA-RI-103/203, RPV Injection Using RCIC, when a Loss of DC is Imminent or Has Occurred to operate RCIC without DC power. This loss of DC power strategy is available but not required for the ELAP event. RCIC isolations are defeated (LGA-RI-101/201, RPV Injection Using RCIC Including Defeat of RCIC Isolations) to prevent a spurious signal from removing RCIC from service. A ventilation path will be established for RCIC within 11 hours using LOA-FSG-005, FLEX Ventilation.

Boiling Water Reactor Owners Group (BWROG) study BWROG-TP-14-018, evaluated RCIC performance at elevated temperatures. This study concluded that there is no loss of RCIC functionality below Suppression Pool suction temperatures of 250°F. Anticipatory venting of the containment will be initiated to maintain suppression chamber pressure less than or equal to 15 psig as directed from LGA-003, Primary Containment Control, such that peak Suppression Pool temperature remains below 250° F.

The Hardened Containment Ventilation System (HCVS), installed under NRC Order EA-13-109, will be used for the anticipatory venting.

RCIC will continue to be operated for as long as possible before transitioning to portable FLEX equipment.

Following stabilization of the plant after the event, a reactor cooldown is commenced at a rate not exceeding the 20°F/hour as directed from LOA-AP-101/201, U1/U2 AC Power Abnormal Procedure. The cooldown is halted and RPV pressure maintained in the range of 150 psig to 250 psig to preserve the steam supply to RCIC. If an ADS is required by the LGAs, RPV pressure is maintained in the 150 to 250 psig range by resetting the ADS logic and then continued manual operation of the ADS valves. When RCIC operation is no longer viable (transitioning to Phase 2 FLEX strategy), reactor pressure is further lowered so that the FLEX PDDP can inject.

Deployment and use of the portable FLEX PDDP is initiated using LOA-FSG-003, FLEX Water Strategy. Deployment of the portable FLEX Generators is initiated, using LOA-FSG-002, FLEX Electrical Strategy. The 480 VAC electrical system is aligned for repowering essential equipment during the event (LOA-FSG-002). Steps to provide RPV injection, Suppression Pool makeup, and SFP makeup using a FLEX Pump are initiated (LOA-FSG-003).

2.3.2 Phase 2 Strategy

Within 8 hours of event initiation (Reference Section 2.17, "Sequence of Events"), a portable FLEX Generator is providing power to the Unit's Division I and Division II safety related switchgear in the 480 VAC System (LOA-FSG-002), (see Figures 7, 8, 9, 10 and 11). The FLEX Generator will be located to the south of the Unit 1 Main Power Transformers (MPT) for Unit 1 and to the north of the Unit 2 MPTs for Unit 2 (see Figure 6). Temporary cables will be routed from the FLEX Generator to a connection panel that supplies selected Division I and Division II 480 VAC switchgear. When power is supplied to the selected switchgear, power is then available to the 250 VDC battery charger, Division I battery chargers and Division II battery chargers. Selected valves in one loop of RHR for each unit can be energized to assist with RHR injection and Suppression Pool makeup. Power can also be made available for other essential loads such as ventilation for the Main Control Room and battery rooms.

Within 6 hours of event initiation, the FLEX PDDP is available to supply makeup to the RPV and Suppression Pool (LOA-FSG-003, FLEX Water Supply Strategy). The FLEX PDDP will be deployed at the UHS. There are different paths (Primary and Alternate) available to support makeup water to the RPV and Suppression Pool as described below.

2.3.2.1 Primary FLEX RPV and Suppression Pool Make-Up Path

The PDDP Primary discharge path to the Unit 1 and Unit 2 Reactor Building will be by a combination of buried pipe and portable utility hose (see Figure 1 and Figure 2). The portable utility hose will enter into the Reactor Building through a 10” penetration installed in the Unit 1 Diesel Generator Corridor vestibule area for Unit 1 and into the Unit 2 DG Corridor to U2 Reactor Building air lock on Unit 2.

The Primary water supply connection will be on the ‘B’ Fuel Pool Cooling (FC) Emergency Makeup (EMU) Pump discharge pipe 1(2)FC030AF-6” on EL. 710’-6” inside the DG Corridor for Unit 1 and inside the Reactor Building for Unit 2. The tie-in will be made via a ‘T’ connection fitted with a Storz connection for the 6” FLEX portable utility hose. A locked-closed isolation valve (1(2)FC030AI) and throttling valve (1(2)FC030AN) [not locked-closed] is provided on this connection to the FC EMU piping. The connection to line 1(2)FC030AF-6” will allow for feed to the RPV, Suppression Pool and the SFP (see Figure 2). The Primary water flow path will include another ‘T’ connection and isolation valve (1(2)FC030AK) on the ‘B’ FC EMU Pump discharge piping on EL. 761' inside the Reactor Building. At this elevation, a 5" FLEX utility hose will be used to "jumper" over to Residual Heat Removal (RHR) containment spray line 1(2)RH72BB-10". The RHR connection includes a locked-closed isolation valve (1(2)E12-F480B), locked-closed throttling valve (1(2)E12-F481B), and a Storz connection for the 5" FLEX utility hose. This will be the path used to provide inventory makeup to the Reactor Pressure Vessel (RPV) and Suppression Pool (SP) (Figure 3 and Figure 4).

The RHR FLEX connection is located between the "B" RHR Drywell Spray valves (1(2)E12-F017B, Inboard Drywell Spray Valve and 1(2)E12-F016B, Outboard Drywell Spray Valve). RPV injection flow is achieved from the FLEX PDDP through the 1(2)E12-F016B and then through the "B" LPCI Injection valve 1(2)E12-F042B or "B" Shutdown Cooling Return Valve, 1(2)E12-F053B. Suppression Pool Makeup can be achieved through the 1(2)E12-F016B and then through "B" RHR Suppression Chamber Spray Valve, 1(2)E12-F027B or the "B" RHR Full Flow Test Valve, 1(2)E12-F024B (see Figure 3 and Figure 4)

2.3.2.2 Alternate FLEX RPV and Suppression Pool Make-Up Path

The alternate strategy is similar in nature to the primary strategy. For the supply of water, the FLEX PDDP provides flow from the UHS; however, the flow is injected by connecting to the "A" FC Emergency Make-up via the "A" RHR system.

The Alternate water supply connection will be on the 'A' Fuel Pool Cooling (FC) Emergency Makeup (EMU) Pump discharge pipe 1(2)FC30AD-6" on EL. 710'-6" inside the Reactor Building. The tie-in will be made via a 'T' connection fitted with a Storz connection for the 6" FLEX portable utility hose. A locked-closed isolation valve (1(2)FC030AJ) and throttling valve (1(2)FC030AO) [not locked-closed] is provided on this connection to the FC EMU piping. The connection to line 1(2)FC030AD-6" will allow for feed to the RPV, Suppression Pool and the SFP (see figure x). The Alternate water flow path will include another 'T' connection and isolation valve (1(2)FC030AL) on the 'A' FC EMU Pump discharge piping on EL. 761' inside the Reactor Building. At this elevation, a 5" FLEX utility hose will be used to "jumper" over to Residual Heat Removal (RHR) containment spray line 1(2)RH72BA-10". The RHR connection includes a locked-closed isolation valve (1(2)E12-F480A), locked-closed throttling valve (1(2)E12-F481A), and a Storz connection for the 5” FLEX utility hose. This will be the path used to provide inventory makeup to the Reactor Pressure Vessel (RPV) and Suppression Pool (SP).

The RHR FLEX connection is located between the “A” RHR Drywell Spray valves (1(2)E12-F017A, Inboard Drywell Spray Valve and 1(2)E12-F016A, Outboard Drywell Spray Valve). RPV injection flow is achieved from the FLEX PDDP through the 1(2)E12-F016A and then through the “B” LPCI Injection valve 1(2)E12-F042A or “B” Shutdown Cooling Return Valve, 1(2)E12-F053A. Suppression Pool Makeup can be achieved through the 1(2)E12-F016A and then through the “A” RHR Suppression Chamber Spray Valve, 1(2)E12-F027A or the “A” RHR Full Flow Test Valve, 1(2)E12-F024A (see Figure 3 and Figure 4).

2.3.3 Phase 3 Strategy

The Phase 3 strategy is to use the Phase 2 connections, both mechanical and electrical, but supply water using Phase 3 portable pumps and AC power using Phase 3 portable generators if necessary. The Phase 3 equipment will act as backup or redundant equipment to the Phase 2 portable equipment and is deployed from an off-site facility and delivered to LSCS. The off-site facility supplying this equipment is the National SAFER Response Center (NSRC) through executed contractual agreements with Pooled Equipment Inventory Company (PEICo). The NSRC will support initial portable FLEX equipment delivery to the site within 24 hours of a request for deployment per the LSCS SAFER Response Plan. The LSCS SAFER Response Plan defines the actions necessary to deliver pre-specified equipment to LSCS. Designated local staging areas have been selected to support deliveries of requested SAFER equipment from the NSRC to LSCS. Resources will be available, and sufficient, at the times required for Phase 3 implementation. Phase 3 implementation is outlined in CC-LA-118-1002, SAFER Response Plan for LSCS (Reference 73).

No plant modifications have been installed to support mitigating strategies for Phase 3. The connection of the majority of Phase 3 equipment can be made to connection points established for Phase 2 equipment and strategies. The remaining Phase 3 non-redundant equipment will be deployed as needed utilizing field established connections, without the reliance on plug and play type modifications.

2.3.4 Systems, Structures, Components

2.3.4.1 Reactor Core Isolation Cooling (RCIC)

The RCIC System consists of a steam turbine-driven pump designed to supply water from the Condensate Storage Tank (CST) or the Suppression Pool to the vessel. The steam supply to the turbine comes from the "B" main steam line between the reactor and inboard MSIV and exhausts to the suppression pool. The makeup water is delivered directly into the reactor vessel through the RCIC head spray line. Cooling water for the RCIC system turbine lube oil cooler and barometric condenser is supplied from the discharge of the pump.

All components necessary for initiating operation of the RCIC system are completely independent of auxiliary AC power, plant service air, and external cooling water systems, requiring only DC power from the station batteries (250 VDC and Div I 125 VDC).

The RCIC system automatically starts when reactor water level reaches the RPV Low-Low Water Level following an ELAP/LUHS event. The RCIC suction is initially from the CST and operates to inject makeup water to the RPV. The RCIC suction can be swapped to the Suppression Pool if the CST becomes unavailable. RCIC pump injection rate is controlled by auto or manual speed control of the RCIC turbine. The RCIC System can deliver 600 gpm to the reactor vessel.

EC 399297, RCIC Survivability Study (Reference 39) was performed to determine the temperature of the RCIC Pump Room impacting Woodward Governor operation during an ELAP and recommended actions to control RCIC room temperature. EC 399297 documents RCIC functionality for 13 hours and continued operation past 13 hours provided that supplemental actions to supply cool air to the room are taken. Portable ventilation is supplied to the RCIC room within 11 hours using LOA-FSG-005, Area Ventilation (Reference 58). Operation of the RCIC system provides make-up to the RPV to maintain water level during operation until RPV pressure is insufficient for system operation, at which time the FLEX Pump will be used for RPV level control.

2.3.4.2 Nuclear System Pressure Relief System

During an ELAP/LUHS event, the Steam Relief Valves (SRVs) automatically cycle to initially control reactor pressure until the Operations crew establishes manual control of the ADS SRVs from the AEER. During an ELAP, a controlled reactor depressurization is commenced at no greater than 20°F per hour. If RCIC is needed for RPV injection the cooldown is suspended and RPV pressure maintained at 150 psig to 250 psig by manual operation of the SRVs. SRV pneumatic motive force is from ADS bottle banks, emergency pressurization station, and then by a portable compressor per LOA-IN-101/201 (Reference 68). SRV solenoid operation is from Div 1 or Div 2 essential DC systems powered by the station safety related batteries.

2.3.4.3 Batteries

The safety related class 1E batteries and associated DC distribution systems are located within safety related structures designed to meet applicable design basis external hazards and will be used to initially power required key components (RCIC and SRVs) and key instrumentation. Load shedding of non-essential equipment provides an estimated total service time of at least 8 hours of operation.

2.3.4.4 RHR System

Each unit's RHR system consists of two independent loops ("B" and "A") for FLEX water injection. Each RHR (“B” or “A”) loop can provide FLEX water makeup to the RPV or to the Suppression Pool (SP). The RHR valves in the flow path to the RPV or the SP can be opened manually or electrically if power is available from the portable FLEX Generator. The "B" RHR piping for each unit can provide SFP makeup (requires installation of a spool piece) if the refuel floor cannot be accessed. The FLEX SFP makeup is via hoses connected from the FLEX Pump discharge to SFP Emergency Make-up piping and then to hoses routed on the Refuel Floor to the SFPs on each unit. The specific use of the RHR system depends on the FLEX Pump lineup chosen (LOA-FSG-003).

2.3.4.5 Pressure Suppression Pool/Chamber

The suppression pool is the heat sink for reactor vessel SRV discharges and RCIC turbine steam exhaust following a BDBEE. It is also the suction source for the RCIC pump for providing core cooling following a shutdown caused by the BDBEE. The design basis for the pressure suppression pool, which is contained in the pressure suppression chamber, is to initially serve as the heat sink for any postulated transient or accident condition in which the normal heat sink, main condenser, or Shutdown Cooling System is unavailable. The water level and temperature of the Suppression Pool are monitored in the main control room. The Division II Suppression Pool Water Wide Range Level instrument and the Division II Suppression Pool Water Temperature instrument are DC powered for continued reliability during an ELAP.

2.3.4.6 Ultimate Heat Sink

Six hours after the beginning of the event, transition from RCIC to FLEX equipment (Phase 2) for the Core Cooling Function is available by placing the FLEX PDDP in service. Suction from the UHS is established by two submersible hydraulically driven pumps which supply the PDDP (only one submersible pump is required to supply both units). These pumps are placed in the UHS downstream of the Ice Melt line discharge ensuring open water in winter months. The PDDP discharge is then routed through a 10" soft hose, into a hardened pipe which passes under fences and obstructions, additional 10" soft hose, a portable manifold, then 6" hose into the reactor building via the diesel generator corridor passages. The hoses are then connected to the "B" (primary) or "A" (alternate) Fuel Pool Cooling Emergency Make-Up system for ultimate injection into the RPV or Suppression Pool, via a 5" hose cross-tie to the RHR system.

2.3.4.7 Condensate Storage Tanks

Following a BDBEE, when reactor water level reaches the RPV Low-Low Water Level, RCIC automatically starts with suction from the CST and operates to inject makeup water to the Reactor Pressure Vessel (RPV). The RCIC pump will remain aligned to the CST as long as possible or until its 350,000 gallon supply is exhausted.

2.3.5 Key Parameters

The following key parameter instrumentation is provided to support the reactor core cooling and decay heat removal strategy.

- 1(2)E51-R602, RCIC Turbine Steam Inlet Pressure (Control Room), 0-1500 psig.
- 1(2)C61-R011, RPV Pressure (Remote Shutdown Panel), 0-1500 psig.
- 1(2)C61-R010, RPV Level (Remote Shutdown Panel), Wide Range, -150 to +60 inches

The above instrumentation is available prior to and after DC load shedding of the DC buses during ELAP response procedure implementation for up to 8 hours. Availability after 8 hours is dependent on actions to restore and maintain the Division I and Division II battery chargers with the portable FLEX Generator.

In the unlikely event that key parameter instrumentation is unavailable, alternate methods for obtaining the critical parameters locally are provided in procedure LOA-FSG-001, Loss of Vital Instrumentation (reference 54).

2.3.6 Thermal Hydraulic Analysis

At the initiation of the loss of all AC power event, the Main Steam Isolation Valves (MSIVs) will automatically close, feedwater is lost, and SRVs automatically cycle to control pressure. The inventory passing through the SRVs causes reactor water level to decrease. When reactor water level reaches the RPV Low-Low Water Level setpoint (approximately -50 inches), RCIC automatically starts with suction from the Condensate Storage Tanks (CSTs) and operates to inject makeup water to the reactor vessel (note that the CSTs are not seismically qualified and if damaged, RCIC will automatically transfer suction to the Suppression Pool on low CST tank level). This injection is sufficient to maintain reactor water level above TAF and to recover the reactor level to the normal band. MAAP4 computer code (Reference 33) was used to simulate the ELAP event for LSCS and is an acceptable method for establishing a timeline which meets the intent of NRC Order EA-12-049. The MAAP analysis documented in LS-MISC-017 (Reference 33) included multiple scenarios to show the FLEX strategies are acceptable. Case 4f in LS-MISC-017 is used to evaluate plant response with RCIC taking suction from the Suppression Pool with the HCVS used to maintain containment pressure less than 15 psig.

The LSCS FLEX strategy is to start a cooldown at 20°F/hr 20 minutes from the start of the event and to depressurize/cool down to approximately 150 to 250 psig. LS-MISC-017 shows RPV level will be restored and maintained to -30” to +50” (LGA-001 Level band) as long as RCIC remains available.

2.3.7 FLEX Pumps and Water Supply

2.3.7.1 FLEX Pump

Consistent with NEI 12-06, Appendix C, RPV injection capability is provided using FLEX Pumps (PDDP) via a primary or alternate connection. The FLEX PDDP is a trailer-mounted, diesel engine driven centrifugal pump that is stored in a robust FLEX Building (Building 22). The PDDP has 2 submersible hydraulically driven pumps that are placed into the UHS to provide suction head to the FLEX PDDP. Each PDDP is sized to provide 150 psi head at 4000 gpm, and the submersible pumps are sized to provide 32 ft lift at 4000 gpm. The head lift from the submersible pumps will be sufficient to provide the required flow to the PDDP. One PDDP and one submersible hydraulically driven pump can supply the required FLEX flow for both units.

Calculation L-003961 (Reference 35) was performed to verify the capability of the FLEX PDDP and piping/hose system to adequately deliver RPV make-up flow of 600 gpm, Suppression Pool make-up flow of 100 gpm and SFP make-up flow of 250 gpm for each unit with 10% margin.

2.3.7.2 Water Supply

The FLEX water supply is from the LaSalle Ultimate Heat Sink. The UHS consists of the volume of water remaining in the LaSalle cooling lake following a dike failure. This water has a depth of approximately 5 feet and a top water elevation of approximately 690 feet. This corresponds to a surface area of approximately 81 acres and a volume of approximately 341 acre-feet (assumes Tech Spec limit of 1.5 feet of sediment) (Reference 81).

2.3.8 Electrical Analysis

Class 1E batteries and associated DC distribution systems are located within safety-related structures and provide power to required key instrumentation and applicable DC components for FLEX (RCIC and SRV solenoids). The critical instruments fed from the battery system include reactor water level, reactor pressure, drywell pressure, suppression pool temperature, and suppression pool level. The Class 1E battery duty cycles for LSCS were calculated in calculation L-003447 (Reference 30) for the Division I and Division II 125 VDC batteries and in calculation L-003448 for the stations 250 VDC batteries. These calculations show a battery life of 8 hours or greater (EC 391795 Reference 38) with initial and deep load shed actions taken per LOA-AP-101(201), Unit 1(2) AC Power Abnormal (Reference 67), Attachment K and N (deep load shed completed at 4.5 hours from the initiating event for Unit 1 Div I and 5.5 hours for Unit 1 Div II, Unit 2 Div I, Unit 2 Div II). LSCS has one Division I and one Division II Class 1E battery per unit that are utilized as part of the Phase 1 and 2 FLEX strategies. The FLEX strategies ensure the Division I and Division II safety related battery chargers are energized before the battery coping time is exceeded. The expected deployment time for the portable FLEX Generators (one for each Unit) to supply the battery chargers is six (6) hours.

For FLEX Phase 2, the strategy to maintain the station's safety-related DC buses and other essential loads requires the use of one portable diesel FLEX Generator for each unit to re-power selected safety related 480 VAC load centers (switchgear) using portable cables that are connected to a FLEX 480 VAC connection panel installed on each unit. The Portable FLEX Generators are trailer-mounted diesel-powered units rated at 500 kW (full load current of 752 amps), 480 VAC, 3-phase, 60Hz, with an integral 500-gallon fuel tank. Each unit has a trailer for the portable cables to be used with the portable FLEX Generator. Two portable FLEX Generators and the two cable trailers are located within the Robust FLEX Storage Building 22. The primary cable trailer holds two sets of portable cables (a N set and the N+1 set). The other cable trailer (Plus 1 Cable Trailer) holds the other N set of portable cables. The third FLEX Generator (satisfies the N+1 requirement) is in Building 24 (commercial grade). Per EC 396062 (U1, Reference 42) and EC 396069 (U2, Reference 41) the portable FLEX Generators are capable of supplying FLEX Phase 2 required electrical loads.

2.4 Containment Integrity

An ELAP causes a loss of containment cooling. In addition, leakage from the recirculation pump seals, SRV discharge to the Suppression Pool, and RCIC turbine exhaust to the Suppression Pool will add heat to the containment. The loss of cooling and heat addition will cause containment temperature and pressure to increase.

RPV pressure will be reduced to 250 to 150 psig with SRVs and maintained in that band to support RCIC operation. It is expected that RCIC would remain a viable source of injection if 125 VDC power is available for system control, 250 VDC is available for valve operation, RPV pressure is above 150 psig or greater, and Suppression Pool temperature is maintained below the range 250°F. Boiling Water Reactor Owners Group (BWROG) study BWROG-TP-14-018 evaluated RCIC performance at elevated temperatures. This study concluded that there is no loss of RCIC functionality below Suppression Pool suction temperatures of 250°F. RCIC will continue to be operated as long as possible before transitioning to portable FLEX equipment. Anticipatory venting of the containment will be initiated to remove decay heat and prevent Suppression Pool temperature from exceeding 250°F. A FLEX Pump will be available within 6 hours of the event to provide makeup to the Suppression Pool.

The MAAP analysis performed in support of the LaSalle FLEX strategies is documented in calculation LAS-MISC-017 Rev. 3.

Case 4f was the specific MAAP run selected to represent the FLEX strategies and timeline.

2.4.1 Phase I

During Phase 1, Primary Containment integrity is maintained by normal design features of the containment, such as the containment isolation valves. In accordance with NEI 12-06, the containment is assumed to be isolated following the event. LSCS EOP Support Procedure LGA-VQ-102(202), Unit 1(2) Emergency Containment Vent, (Reference 82) is used to maintain containment pressure within design limits. RCIC will automatically start and inject to the RPV on low-low RPV level following the ELAP event. RCIC will remove some decay heat energy from the RPV and pump water to the RPV with RCIC turbine exhaust returning to the Suppression Pool. The energy deposited to the containment is from radiative heat transfer of the RPV and connected piping, leakage from the reactor recirculation pump seals, SRV discharge to the Suppression Pool, RCIC turbine exhaust to the Suppression Pool, and RPV leakage other than the RR pump seals. RCIC will continue to operate to maintain RPV level above TAF while the containment continues to heat up and pressurize. The Suppression Chamber is vented via the Hardened

Containment Vent System (HCVS) to remove decay heat from the containment and to prevent Suppression Pool temperature from exceeding 250°F. With RCIC as the only injection source, the HCVS is used to maintain Suppression Chamber pressure less than 15 psig to support continued operation of RCIC for core cooling.

During Phase 1, the containment is controlled following the guidance of LGA-003, Primary Containment Control (Reference 83), although actions are limited due to the ELAP condition.

2.4.2 Phase 2

In Phase 2, containment integrity is maintained by normal design features of the containment and by venting the Suppression Chamber using the HCVS. Suppression Pool temperature will be limited by controlling Suppression Pool pressure below 15 psig if RCIC is the only injection source. Containment venting will prevent approaching containment pressure limits as indicated by MAAP analysis (LS-MISC-017, Reference 33). Monitoring of Drywell pressure, Suppression Chamber pressure and Suppression Pool temperature will be available in the Control Room via installed plant instrumentation powered by the safety related batteries. These batteries are maintained in Phase 2 by deployment of portable FLEX Diesel Generators.

With HCVS venting of the Suppression Chamber, Suppression Pool temperature slowly rises and reaches a peak temperature of 239°F using LS-MISC-017 case 4f. Therefore, RCIC survivability is not threatened. FLEX Pumps will be ready for injection to the RPV via the RHR system and for Suppression Pool makeup at 6 hours from event onset. The various FLEX Pump lineups are discussed in Section 2.9.1.

2.4.3 Phase 3

Necessary actions to reduce Containment temperature and pressure and to ensure continued functionality of the key parameters will utilize existing plant systems restored by off-site equipment and resources during Phase 3. The Containment temperature and pressure will be monitored and, if necessary, the Primary Containment will be vented using existing procedures and systems.

2.4.4 Structures, Systems, Components

2.4.4.1 Hardened Containment Vent System

The Hardened Containment Vent System (HCVS) is designed (Reference 53) and installed to meet the operational requirements of NRC Order EA-13-109. HCVS Argon purge and the HCVS Nitrogen pneumatic supply is placed in service locally on 731' elevation in the Auxiliary Building at the Remote Operating Station (ROS) by opening the argon and nitrogen bottle valves and isolation valves. The HCVS rupture disc 1(2)PC302 is burst using argon. The HCVS nitrogen supply is used to operate containment isolation valves, 1(2)PC009A and 1(2)PC010A, to initiate containment venting via the hardened vent line. The HCVS system can be operated from either the Main Control Room on panel 0PM08J or from the ROS. Pneumatic supply to valves and DC power for instrumentation and controls are provided by nitrogen bottles and a HCVS battery located in the Auxiliary Building. Both can support system operation for at least 24 hours.

2.4.4.2 RHR System

The RHR System is utilized to provide Suppression Pool makeup when a FLEX Pump is in operation. The RHR System is discussed in Section 2.3.4.4.

2.4.5 Key Parameters

Instruments credited for the Containment FLEX Strategy are:

- 1(2)PR-CM029, Drywell Pressure (Control Room), 0 to 200 PSIG.
- 1(2)PI-CM056, Suppression Pool Pressure (Control Room), 0 to 60 PSIG.
- 1(2)LI-CM192, Suppression Pool Water Level (Control Room), 18 to + 14 feet.
- 1(2)TI-CM037, Suppression Pool Water Temperature (Control Room) 0 to 250° F

EC 396065 U1, (EC 396093 U2), (Reference 46) installed a 125VDC to 120VAC inverter to power the existing 120VAC to 24VDC power supply that feeds existing instrumentation:

- Drywell Chamber Pressure Transmitters – 1(2)PT-CM029 and 1(2)PI-CM029 at panel 1(2)H13-P601.
- Suppression Chamber Pressure Transmitters – 1(2)PT-CM056 and 1(2)PI-CM056 at 1(2)PM13J.

- Suppression Pool Level Transmitters – 1(2)LT-CM030 and 1(2)LI-CM192 at panel 1(2)H13-P601.

The inverters are fed from the unit specific Division II 125VDC system.

The Suppression Pool Water Temperature loop maintained its original DC power supply and was modified to meet Seismic Category I requirements.

2.4.6 Thermal-Hydraulic Analyses

MAAP4 computer code evaluations were used to simulate ELAP conditions for LSCS (LS-MISC-017). Several MAAP cases were run to analyze methods of containment heat removal, including containment venting strategies, to control containment heat up and pressurization. Using the FLEX strategies developed, the MAAP cases have shown that Primary Containment temperature and pressure will remain below containment design limits.

Case 4f is used for containment response and includes:

- RCIC automatically starts on low-low reactor water level and injects to the RPV from the Suppression Pool suction to recover RPV water level to -30” to +50”.
- Safety Relief Valves (SRV) are operated consistent with EOP guidance to reduce RPV pressure at a rate of no more than 20°F per hour to a band of 150 – 250 psig while RCIC is in service.
- Containment venting using the HCVS system occurs when Suppression Chamber pressure exceeds 12 psig.
- The HCVS is cycled to maintain Suppression Chamber pressure between 5 psig and 10 psig.
- Make-up to the Suppression Pool from the FLEX pump is begun when NPSH curve for RCIC is exceeded.
- The reactor coolant leakage is 100 gpm.

The early containment venting strategy is used while RCIC is injecting to extend the time that RCIC is available. Once RCIC is no longer available the HCVS is used to control primary containment pressure less than PCPL.

2.4.7 Flex Pump and Water Supplies

The FLEX Pump and water supplies for Suppression Pool make-up is described in Section 2.3.7 for Reactor Core Cooling.

2.4.8 Electrical Analysis

The electrical analysis for Containment Integrity is covered in Section 2.3.8 for Reactor Core Cooling. The same methodology and strategy applies to Containment Integrity.

2.5 Spent Fuel Pool Cooling/Inventory

The LSCS Spent Fuel Pool (SFP) is a wet spent-fuel storage facility located on the refueling floor in the Secondary Containment (Reactor Building). It provides specially designed underwater storage space for the reactor spent fuel assemblies which require shielding and cooling during storage and handling. The Unit 1 and Unit 2 SFPs are connected with a transfer canal. Normal makeup water source to the SFP is from the Condensate Transfer System. The basic FLEX strategy for maintaining SFP cooling is to monitor SFP level and provide makeup water to the SFP sufficient to maintain substantial radiation shielding for a person standing on the SFP operating deck and cooling for the spent fuel.

2.5.1 Phase 1 Strategy

The loss of all AC Power Sources causes a loss of forced circulation and heat removal for the SFP. At initial conditions, the spent fuel pool is assumed to be at 21’ 4” feet above the top of irradiated fuel assemblies seated in the SFP storage racks which is the minimum level per Technical Specifications (Reference 13). EC 392196, Spent Fuel Pool Uncovery Time for Outage and Online Scenarios (Reference 52), incorporates a review of Spent Fuel Pool time to boil and time to uncovery for an ELAP.

For the outage SFP uncovery evaluation, an ELAP is assumed to occur approximately 5 days after shutdown and a full core offload. Loss of SFP cooling with this heat load and an initial SFP temperature of 140°F results in a boil time to uncover the spent fuel as approximately 60 hours with a boil off rate of approximately 121 gpm. Therefore, completing the equipment line-up for initiating SFP makeup at 12 hours into the event ensures adequate cooling of the spent fuel is maintained by keeping the fuel covered.

For the online SFP uncovery evaluation a ½ core offload is used with a time after shutdown of approximately 14 days for the recently unloaded fuel. Loss of SFP cooling with this heat load and an initial SFP temperature of 140°F results in a boil time to uncover the spent fuel as approximately 123 hours with a boil off rate of approximately 59 gpm.

2.5.2 Phase 2 Strategy

SFP make-up flow would be supplied within 12 hours from the FLEX PDDP via the "B" (primary) or "A" (alternate) FC EMU piping up to the refuel floor and then by portable utility hoses to the Unit 1 and the Unit 2 SFPs as stated in LOA-FSG-003, FLEX Water Supply Strategy. Makeup would be controlled from the refuel floor to maintain level in the level band directed by LGA-002, Secondary Containment Control. The SFP Level band specified in LGA-002 is below the fuel pool ventilation ducts and sufficiently above the fuel to provide adequate cooling and radiation shielding. LOA-FSG-003 also provides methods to establish the required make-up flow without refuel floor access. After utility hoses are initially lined up on the refuel floor, controlling SFP make-up flow can be performed at the 710' elevation in the DG vestibule area via a gated wye directing SFP makeup to one FC EMU line and RPV/SP makeup to the other FC EMU line (Refer to Figure 2 and Figure 5 for SFP makeup flow paths). SFP make-up flow can then be turned on and off as necessary at the gated wye to maintain the proper SFP level. A SFP make-up flow path is also available using the "B" RHR piping that does not require access to the refuel floor (requires installation of a spool piece between the RHR system and SFP cooling system).

Providing make-up water within 12 hours ensures adequate radiological shielding and SFP cooling in an ELAP event.

2.5.3 Phase 3 Strategy

Phase 3 Strategy is to continue with the Phase 2 methodologies using the FLEX Pumps. Additional High Capacity Pumps will be available from the NSRC as a backup to the on-site FLEX Pumps.

2.5.4 Structures, Systems, and Components

2.5.4.1 SFP and SFP Cooling and Cleanup System

The SFP is designed to seismic Class I criteria and lined with stainless steel. Provisions are made for level detection to ensure the fuel in the spent fuel storage is covered with sufficient water for radiation shielding. Leakage detection instrumentation is also provided to ensure an adequate fuel pool water level is maintained during normal operations. The design of the spent fuel pool structure is such as to prevent inadvertent draining of the pool.

The SFP storage capacity shall not exceed 8064 fuel assemblies (3986 for Unit 1 and 4078 for Unit 2).

The design function of the SFP cooling portion of the system is to remove decay heat from spent fuel bundles after removal from the reactor, maintaining the SFP water temperature below a maximum design temperature of 140°F under all other conditions. SFP level is maintained by providing demineralized water from the Condensate Storage Tanks to maintain level 21’4” above the spent fuel storage racks as required.

2.5.4.2 RHR System

The “B” RHR System may provide SFP makeup depending on the FLEX PDDP alignment. To use the “B” RHR system for SFP make-up a spool piece must first be installed between the FC (SFP Cooling and Cleanup) system and “B” RHR.

SFP makeup is primarily from FLEX utility hoses directly from the FLEX Pump via FC EMU piping. The RHR System is discussed in Section 2.3.4.4.

2.5.4.3 Ventilation

During an ELAP/LUHS event normal Reactor Building ventilation and emergency ventilation system (Standby Gas Treatment System) will be non-functional. Since FLEX manual actions are performed on the Reactor Building elevation 843’ (spent fuel pool elevation) following an ELAP event, temperatures on Reactor Building elevation 843’ were evaluated in calculation L-003968 (Reference 28).

Case 2A of L-003968 shows refuel floor temperature stays below 140°F for the first 12 hours following an ELAP/LUHS event. Case 2A assumes no operator actions from LOA-FSG-005, Area Ventilation (Reference 58) are taken to mitigate temperature on the refuel floor. Actions to provide make-up water to the SFP are completed in the first 12 hours following the initiation of an ELAP event per LOA-FSG-011, FLEX BDBEE Guidance (Reference 64).

LOA-FSG-005, Area Ventilation, provides actions (e.g. opening doors, roof hatches, setting up portable fans) to mitigate area temperatures that could be realized because of an ELAP/LUHS event.

In addition to the ventilation actions from LOA-FSG-005, LaSalle uses the tool box approach (e.g. fire protection bunker gear with SCBA, ice vests, rotating personnel), to ensure worker safety for access to the RFF for FLEX SFP make-up actions.

2.5.5 Key Parameters

The key parameter for the SFP Make-up strategy is the SFP water level. EC 394010 (Reference 51) installed SFP wide range level instrumentation that has been installed in response to Order EA-12-051, Reliable Spent Fuel Pool Level Instrumentation. The instrumentation installed complies with the industry guidance provided by the Nuclear Energy Institute guidance document NEI 12-02 Revision 1.

LGA-002 directs the operators to monitor SFP level using the installed SFP wide range level instrumentation installed by EC 394010.

The purpose of the new system is to provide SFP wide range level monitoring to Operations during BDBEE. The SFPLI is a Westinghouse system that operates on Guided Wave Radar (GWR) sensor technology. The system is comprised of a level sensor, level transmitter and the electronics panel which contains a digital level indicator. Two independent primary and backup instrument channels are installed for SFP level indication. One channel is in the Unit 1 SFP and the other is in the Unit 2 SFP.

The devices are powered by unit specific Engineered Safeguard Feature (ESF) Motor Control Centers (MCCs), 135X-3 and 236X-3, with a backup battery which will provide power for up to 72 hours upon loss of AC power. The SFPLIs are identified as core FLEX loads re-energized with the portable FLEX generator per LOA-FSG-002, FLEX Electrical Strategy.

The SFPLI systems installed on Unit 1 and Unit 2 provide redundant measurements of the SFP level when pools are cross-tied from within 5 inches of the top of the fuel racks (El. 820' 5") to the high level setpoint (El. 842' 7 ¾") of the SFP. The displays are installed at a location that is habitable by operations personnel after a BDBEE.

- SFPLI 1LI-FC165 at Panel 1PLH13J (Primary) is in the AB at J-14.5 on 731' elevation.
- SFPLI 2LI-FC165 at Panel 2PLH13J (Backup) is in the AB at J-16 on 731' elevation.

2.5.6 Thermal-Hydraulic Analyses

For LSCS, the normal SFP water level at the event initiation is approximately 23' feet over the top of the spent fuel seated in the storage racks. Maintaining the SFP full of water at all times during the ELAP/ LUHS event is not required; the requirement is to maintain adequate water level to protect the stored spent fuel and limit exposure to personnel on-site and off-site. For the purposes of this strategy, the objective is to maintain the SFP level at least 10 feet above the spent fuel seated in the spent fuel racks. This is conservatively identified as Level 2 in NEI 12-02 Revision 1, Industry Guidance for Compliance with NRC Order EA-12-051, "To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation" and is specified as at least 10 feet above the fuel seated in the spent fuel racks.

An evaluation of Spent Fuel Pool scenarios was performed and documented in LaSalle EC 392196. Spent Fuel Pool (SFP) makeup is not a time constraint with the initial condition of Mode 1 at 100% power, since the worst case fuel pool heat load conditions only exist during a refueling outage. Under non-outage conditions, the maximum SFP heat load is 27.38 MBtu/hr. Loss of SFP cooling with this heat load and an initial SFP temperature of 140 degrees F results in a time to boil of 12.1 hours, and 123 hours to the top of irradiated fuel seated in the SFP fuel racks. Therefore, completing the equipment line-up for initiating SFP makeup at 12 hours into the event ensures adequate cooling of the spent fuel is maintained. The worst case SFP heat load during an outage is 56.03 MBtu/hr. Loss of SFP cooling with this heat load and an initial SFP temperature of 140 degrees F results in a time to boil of 5.86 hours, and 60.1 hours to the top of active fuel. With the entire core being in the SFP, manpower resources normally allocated to aligning core cooling along with the Operations outage shift manpower can be allocated to aligning SFP makeup which ensures the system alignment can be established within eight (8) hours. Initiation at eight (8) hours into the event ensures adequate cooling of the spent fuel is maintained.

2.5.7 Flex Pump and Water Supplies

The FLEX Pump and water supplies for Spent Fuel Pool Cooling/Inventory is described in Section 2.3.7 for Reactor Core Cooling.

2.5.8 Electrical Analysis

The SFP will be monitored by instrumentation installed in response to Order EA-12-051. The power for this equipment has backup battery capacity for 72 hours (Reference 51). Alternative power will be provided within 72 hours using the portable FLEX Generators.

Further electrical analysis for Spent Fuel Pool Cooling/Inventory is covered in Section 2.3.8 for Core Cooling. This same methodology and strategy applies to Spent Fuel Pool Cooling/Inventory.

2.6 Characterization of External Hazards

2.6.1 Seismic

Per the Updated Final Safety Analysis Report (UFSAR) Section 3.7 (Reference 1) the seismic criteria for LaSalle County Nuclear Station (LSCS) include two design basis earthquake spectra: Operating Basis Earthquake (OBE) and the Safe Shutdown Earthquake (SSE), The maximum horizontal ground acceleration at the free field foundation level, corresponding to above site response spectra, is 20% gravity for SSE and 10% gravity for OBE. These values constitute the design basis of LSCS. Per Reference 2, all sites will consider the seismic hazard.

As a result of the NRC request (Reference 89), LaSalle County Station (LSCS) performed a comparison between the plant Safe Shutdown Earthquake (SSE) used in the design of the plant structures, systems and components (SSCs) and the new Ground Motion Response Spectrum (GMRS). Based on this comparison, LSCS has determined that the GMRS is greater than the SSE but less than two times the SSE response spectrum (1-10Hz). Due to this increase, LSCS Mitigating Strategy Assessment (MSA) determines whether the FLEX strategies developed can be implemented for the reevaluated seismic hazard information, referred to in NEI 12-06 as the MSSHI (Reference 90).

LSCS Mitigating Strategies Assessment (MSA) Seismic evaluation for the impacts of the MSSHI (Reference 91) concluded that for all the components identified the MSA Path 4 have ^{C}10% capacities greater than the new GMRS demand.
The primary equipment haul paths and operator pathways and hose and cable routes, both outside and inside the buildings have no adverse seismic interaction potential. Outside, there is no equipment or structure that would block the path that cannot be moved with debris removal equipment or walked/driven around. Inside the buildings, the areas with FLEX equipment are interconnected by stairs and hallways that have enough space for operators to walk through. There is no equipment that would cause a complete pathway/route block, flood or fire such that the operators cannot successfully implement the FLEX Strategies.

At least a single path of equipment is available to successfully implement all three phases of LSCS FLEX Strategies considering the impacts of the MSSHI.

The result of the MSA Seismic evaluation for the impacts of the MSSHI confirm that the FLEX strategies for LaSalle County Station, Units 1 and 2 can be implemented as designed and no additional modifications or seismic evaluations are necessary.

2.6.2 External Flooding

The LSCS current design basis (CDB) characterizes the site as "floodproof" or "dry" and the External Flood Hazard is not applicable. Per the LaSalle Updated Final Safety Analysis Report (UFSAR) Section 2.4: Since there are no large bodies of water in the immediate vicinity of the site, surges, seiches, and tsunami floods are not relevant. A review of the literature has revealed no major dam failures affecting the surrounding region. Of the following flood events considered, Item 3 is the controlling event: (1) a postulated probable maximum flood (PMF) in the Illinois River, (2) a probable maximum precipitation (PMP) with antecedent standard project storm (SPS) on the cooling lake and its drainage area, and (3) a local PMP at the plant site. The station site is "floodproof" or "dry" with regard to a postulated PMF in the Illinois River, since the plant floor at elevation 710.5 feet MSL is 188 feet higher than the probable maximum flood plus wave runup elevation of 522.5 feet MSL obtained by superimposing the maximum (1%) wave characteristics of sustained 40-mph overland winds on the probable maximum water level. Safety-related structures at the plant site are similarly unaffected by wave runup due to winds coincident with a postulated probable maximum water level in the cooling lake. In the hydrologic design of the 2058-acre cooling lake, a standard project storm (SPS) is postulated to occur prior to the probable maximum precipitation (PMP), with three rainless days between them. The freeboard and riprap requirements for the peripheral dike are determined by superimposing significant wave characteristics of sustained 40-mph overland winds on the probable maximum water level in the lake. Wave runup elevation at the plant site is obtained by superimposing the maximum (1%) wave characteristics of sustained 40-mph overland winds on the probable maximum water level in the lake. Safety-related facilities at the plant site are unaffected by the probable maximum water level in the lake with coincident wind wave activity. A conservative estimate of the water surface elevation near the plant buildings due to local intense precipitation at the plant area would 710.3 feet. These elevations are below the plant grade elevation and would not cause flooding to the plant buildings. Therefore, the LSCS site is "floodproof" or "dry" and the External Flood Hazard is not applicable as the CDB was incorporated as the design input for all FLEX-related modifications.

However, the FLEX design basis floods do not completely bound the reevaluated flood (i.e. MSFHI) for LIP and Cooling Lake PMSS flooding. The LSCS FLEX design basis (DB) flood was set to be equivalent to the DB Local Intense Precipitation (LIP) event (localized Probable maximum precipitation event) and the DB Probable Maximum Storm Surge (PMSS) flooding in the Cooling Lake. As described in Reference 85) and affirmed by the NRC in Reference 86), the Mitigating Strategies Flood Hazard Information (MSFHI), submitted with the Flood Hazard Reevaluation Report (FHRR), showed that the DB and, by relationship, the FLEX DB, does not bound the MSFHI for both mechanisms. The Mitigating Strategies Assessment (MSA) was therefore required and evaluated the impact of the reevaluated flood hazard on FLEX strategy implementation as documented in Reference 87) and was affirmed by the NRC in Reference 88). The assessment concluded that the existing FLEX strategy can be successfully implemented and deployed as designed for LSCS's reevaluated flood hazard (i.e. MSFHI). For the LIP event, the assessment showed that storage and deployment of FLEX equipment is not adversely impacted and no additional actions or procedural changes were required. For the Storm Surge event, the reevaluated stillwater elevation is well below the elevation of the FLEX equipment and therefore will not impede the flex equipment functionality. Any additional wave runup effects will be minimal and will not impact FLEX deployment. The current FLEX strategy will not have to be modified for MSFHI. No other applicable flood causing mechanisms will affect the hauling routes of FLEX equipment. Therefore, the current FLEX strategies can be successfully deployed as designed for all applicable flood causing mechanisms and no further actions, including modifications to FLEX, are required.

2.6.3 Severe Storms with High Wind

LSCS is not susceptible to hurricanes due to location (Reference Figure 7-1 of NEI 12-06). Per NEI 12-06 Figure 7-2, LSCS is in Region I and will have winds exceeding 200 mph. From Sections 2.3.1.2.1 and 2.3.1.2.2 of the LSCS UFSAR, during the 1955-1967 period, the one-degree square containing the LSCS site had nine hailstorms producing ¾-inch hail or greater, 34 occurrences of 50-knot winds or greater, and 43 tornadoes. The maximum tornado wind speed is 300 mph (rotational) with a recurrence interval of 625 years. The design wind velocity for LSCS is 90 mph based on a 100-year recurrence.

2.6.4 Ice, Snow and Extreme Cold

NEI 12-06 Figure 8-2 shows LSCS in an Ice Severity Level 5 zone. The LSCS UFSAR Section 2.3.1.2.4 indicates that loading due to snow and ice loads from a winter PMP with a 100-year antecedent snowpack is less than 83.2 psf, which is the design roof loading for LSCS safety-related structures. UFSAR Section 2.3.1.1 states that the lowest recorded temperature at nearby Ottawa, IL, was -26 °F. Minimum temperatures extend below 0 °F several times each winter.

2.6.5 Extreme High Temperature

NEI 12-06 states that all sites must consider high temperatures. Extreme drought and high temperature events are slow meteorological evolutions. The highest recorded temperature at nearby Ottawa, IL, was 112 °F. Summer temperatures reach 90 °F or more nearly 20 times per year. (UFSAR Section 2.3.1.1)

2.7 Protection of Flex Equipment

NEI 12-06 Rev. 2 provides guidelines for robust structures to provide protection for the plant's FLEX equipment that may be needed to provide reactor and fuel pool cooling following a BDBEE. Two buildings were constructed to protect the LSCS FLEX N equipment. EC 397688 (Reference 43) directed the construction of a 60' x 90' protected building (Building 22) outside the power block and EC 397689 (Reference 44) directed the construction of a 30' x 40' protected building (Building 23) near the UHS.

A 50' x 60' commercial storage building (Building 24) was built (EC 397690, Reference 45) inside the PA to store FLEX equipment including some N+1 equipment (e.g. N+1 portable FLEX Generator).

EC 397688 provided the design documents to construct and provide power to a nominal 60'X90' Robust FLEX Storage Structure (Building 22) at LaSalle Station along with the design documentation for the roadway and apron to the Robust FLEX Storage Structure and all associated technical evaluations for the proposed activity. The Robust FLEX Storage Structure (Building 22) is used to protect and house FLEX equipment at LaSalle Station. In response to NRC Order EA-12-049 for implementation of Flexible Coping Strategies (FLEX) for external events beyond the original plant design basis (BDBEE), a 60'X90' Robust FLEX Storage Structure was installed outside of the plant's main power block (Building 22). The basic function of the 60'X90' Robust FLEX Storage Building (Building 22) is to protect and house the FLEX vehicles and equipment that will be needed for FLEX purposes. The structure is designed to meet the requirements specified in NEI 12-06 Revision 2 and any specific LaSalle Station requirements. External hazards that exceed the minimum requirements of typical local building codes but are specifically required by NEI-12-06 Revision 2 are: tornado, seismic, flood, wind, temperature, and snow/ice.

The 60' x 90' Robust FLEX Storage Structure (Building 22) is a stand-alone cast-in-place reinforced concrete structure with a floating slab supported on concrete strip footings resting on soil.

EC 397689 is similar in nature to EC 397688 and outlined the construction of the 30' x 40' FLEX building (Building 23) to the same standards as the 60' x 90' building (Building 22). In general, the 30' x 40' FLEX building near the UHS houses the N and N+1 PDDPs and support equipment, while the 60' x 90' FLEX building houses the vehicles, trailers, hoses, cables, and other support equipment necessary to carry out the FLEX response guidelines.

Equipment spacing is credited during a seismic event to preclude seismic interaction that could cause damage to the FLEX equipment. Where a specific piece of equipment could not be credited based on spacing, tie-downs are used. Tie-downs are used on all applicable equipment in the building as an additional barrier to seismic interaction.

Debris removal equipment such as the FLEX tractors are stored inside the 60'X90' Robust FLEX Storage Structure to be reasonably protected from external events such that the equipment will remain functional and deployable to clear obstructions from the pathway between the robust FLEX Building and its deployment location(s)

Deployments of the FLEX debris removal equipment from the robust FLEX Building are not dependent on off-site power. All actions required to access and deploy debris removal equipment and BDB/FLEX equipment can be accomplished manually.

As required by NEI 12-06 Revision 2, all FLEX N equipment credited for implementation of the FLEX strategies at LaSalle is either stored in a robust FLEX Building or in a plant structure that meets the station's design bases for Safe Shutdown Earthquake (SSE), specifically the LaSalle Reactor Building and Auxiliary Building.

2.8 Planned Deployment of Flex Equipment

2.8.1 Haul Paths and Accessibility

Pre-determined haul paths have been identified and documented in LaSalle FLEX procedures. Figure 1 shows the primary and alternate haul paths from the Robust FLEX Storage Building 22 to the various deployment locations for the water supply strategy. The FLEX PDDP pumps, and support equipment, are stored in Robust FLEX Storage Building 23 on the north shore of the UHS. A battery powered trailer moving device (Tugger) is used to move the FLEX PDDP Pumps from the building to the pad near the water where they are deployed. The Tuggers are located in Robust FLEX Storage Building 22.

The hauling of the portable FLEX Generators is along the primary haul path for the FLEX water strategy and then staging of the portable FLEX Generators is to the south of the Unit 1 Main Power Transformers (MPTs) for Unit 1 and to the north of the Unit 2 MPTs for Unit 2. The deployment of the FLEX generators is described in LOA-FSG-002, FLEX Electrical Strategy.

These haul paths are checked monthly for possible obstructions (LOS-FSG-M1, FLEX Monthly Equipment Surveillance) and following a BDBEE in procedure LOA-FSG-012, FLEX Deployment Path Debris Removal. Debris removal equipment is stored inside the Robust FLEX Storage Building 22 to be protected from external hazards such that the equipment remains functional and deployable to clear obstructions from the pathway between the Robust FLEX Storage Building 22 and the deployment location(s). Debris removal equipment includes the FLEX Tractors and FLEX F-750 Truck. FLEX debris removal hand tools are also available.

The equipment is stored in the FLEX storage buildings in a manner to facilitate the deployment sequence.

Deployment paths and staging areas are contained in the snow removal plan. These areas are maintained as a priority after site safety concerns are addressed.

Phase 3 of the FLEX strategies involves the receipt of equipment from offsite sources including the NSRC with various commodities such as fuel and supplies. Transportation of these deliveries will be through airlift or via ground transportation utilizing the SAFER Response Plan for LSCS (Reference 73). Debris removal for the pathway between SAFER Response Plan staging and from the various plant access routes may be required based on conditions present.

2.9 Deployment Strategies

Direction to implement FLEX Strategy Guidelines (LOA-FSGs) stems from LOA-FSG-011 Attachment B1, FLEX Suggested Non-Severe Accident Choreography or Attachment B2, FLEX Suggested Severe Accident Choreography (Reference 64).

FLEX PDDP and hose deployment (section 2.9.1) and portable FLEX Generator and cable deployment (section 2.9.2) is discussed below.

2.9.1 FLEX PDDP Deployment

2.9.1.1 Primary FLEX PDDP Deployment Strategy

FLEX water supply is via a Portable Diesel Driven Pump (PDDP) stored near the Ultimate Heat Sink (UHS). There are two such pumps in Robust FLEX Building 23 (30' x 40') outside the Protected Area (PA) fence near the UHS. The PDDP takes suction from the UHS and provides a water supply to each unit. PDDPs are sized to simultaneously meet the flow requirements for both units by one pump. PDDPs utilize hydraulic submersible booster pumps to meet the NPSH requirements for the main pump. Suction straining is provided for the PDDP/hydraulic booster pump suctions.

The PDDP discharge is connected to a hardened hose station near the PDDP staging area via portable discharge hose. The path to the Unit 1 and Unit 2 Reactor Buildings will then be by a combination of buried pipe (EC 398941, Reference 47) and portable utility hose. Buried piping is utilized to avoid fences and other obstructions when transferring the water from the PDDP to inside the Protected Area (PA). As part of this discharge path, a second hose station with hardened enclosure (EC 398941) has been designed and located inside the PA where 10” portable utility hoses will be connected to a portable manifold that will be placed on the roadway to the east of the Reactor Buildings. One 6” portable utility hose is then routed from the portable manifold to each of the Reactor Buildings. One 6” portable utility hose enters the Unit 1 DG corridor vestibule area through one of the 10” penetrations installed on door D479. The other 6" portable utility hose will enter into the U2 DG corridor to Reactor Building air lock through one of the 10" penetrations in door D508.

Hose Reel Trailer #1 is spooled with 2200 feet of 10" portable utility hose. This trailer is hydraulically operated via connection to a Kubota tractor. The hose can be deployed without hydraulics (i.e., Kubota not available and being towed by the F-750) by placing the hydraulic reel motors in the DISENGAGE position on the hydraulic lever of the trailer.

The primary water supply connection on each unit is the 'B' Fuel Pool Cooling Emergency Make Up (FC EMU) piping on the 710' elevation in the reactor building for Unit 2 and in the DG corridor for Unit 1. A wye connection with an isolation valve and a throttle valve is added to the FC EMU line to provide for the FLEX connections. The Unit 2 "B" FC EMU line connection will be moved to the U2 DG corridor in a future modification for Phase 2 of the HCVS order EA-13-109.

The FLEX primary water supply connection flow path includes a wye and isolation valve in the 'B' FC EMU piping at the 761' elevation of the Rx Bldg.

A 5" utility hose will be run from this connection point to the 'B' RHR FLEX connection point between the Drywell Spray isolation valves. Two isolation valves are provided at the "B" RHR FLEX connection point.

The FLEX primary water supply flow path to the Spent Fuel Pool (SFP) is via the 'B' FC EMU piping to a refuel floor FC EMU hose connection and associated isolation valve. From the "B" FC EMU hose connection a 2.5" utility hose is routed to the SFP.

A one inch hose is routed from either the Primary or Alternate connection to outside the plant, to ensure water flow, thus inhibiting freezing under no flow conditions (Figure 2).

2.9.1.2 <u>Alternate FLEX PDDP Deployment Strategy</u>

The alternate FLEX deployment strategy is the same as the primary FLEX PDDP deployment strategy with the exception that the 6" portable utility hose routed into the reactor buildings is connected to the "A" FC EMU piping and then to the “A’ RHR loop at the FLEX connection between the “A’ RHR drywell spray valves. FLEX SFP make-up is via the “A” FC EMU hose connection and isolation valve on the refuel floor.

2.9.1.3 Contingency FLEX PDDP Deployment Path

As depicted on Figure 1, a contingency deployment path can be used if the primary deployment path from the hardened hose station in the PA to the east side of the reactor building is unavailable.

If using the contingency path, the 10” portable utility hose connected at the hardened hose station in the PA is routed to the north of the Unit 2 Reactor Building and routed through the Unit 2 Turbine Building trackway door. From there the 10” hose is then connected to a 10” x 6” x 6” wye to be subsequently routed to each of the units FC EMU piping for the primary or alternate FLEX strategies.

Contingency hose and wye connectors are also available to cross-tie FLEX water supplies at 710’ or 761’ reactor buildings.

2.9.2 FLEX Electrical Deployment

2.9.2.1 Primary Electrical Deployment Strategy

Using a Kubota tractor (or F750 truck) a 480VAC portable FLEX Generator and a cable trailer will be positioned south of the Unit 1 MPTs for Unit 1 and North of the Unit 2 MPTs for Unit 2. Portable cabling will be run from the portable generator and enter the Unit 1 DG corridor vestibule area through one of the penetrations installed on door D479 and into the U2 DG corridor to Reactor Building air lock through one of the penetrations in door D508.
Electrical connections from the portable cabling from the portable FLEX generator are made to a permanently installed floor mounted FLEX Primary Distribution Panel in the DG corridor vestibule area on Unit 1 and the DG corridor to Reactor Building air lock on Unit 2.

Permanent cables are installed from breakers at this distribution panel to the 480V Switchgear Buses 135X(235X), 135Y(235Y), 136X(236X) and 136Y(236Y).

The connection from the permanently mounted FLEX Primary Distribution Panel to the switchgear buses is made via a AK-25 frame mounted shunt unit in a spare cubicle at each bus, except for 136Y. The connection from the FLEX Primary Distribution Panel to 136Y is made through a disconnect switch located near 136Y.

The 500kW portable FLEX Generator is sized to carry the core FLEX electrical loads with spare capacity if optional loads are desired (such as ventilation fans, individual motor operated valves, etc.).

The FLEX Primary Distribution Panel can also provide power for the FLEX Temporary Power Center (TPC), 1(2)FF02E, and for the HCVS battery charger, 0DC53E.

The TPC will convert 480VAC power from the FLEX Primary Distribution Panel to 120/208VAC power feed for the following FLEX spider boxes with GFCI receptacles.

- 1(2)FF03E, FLEX 120VAC Spider Box 1
- 1(2)FF04E, FLEX 120VAC Spider Box 2
- 1(2)FF05E, FLEX 120VAC Spider Box 3

- 1(2)FF06E, FLEX 120VAC Spider Box 4
- 1(2)FF07E, FLEX 120VAC Spider Box 5
- 1(2)FF08E, FLEX 120VAC Spider Box 6

Refer to Figures 7, 8, 9, 12 and 13 for FLEX Primary Electrical Strategy connections.

LOA-FSG-002, FLEX Electrical Strategy, contains the instructions for use of the Primary Electrical Strategy.

2.9.2.2 Alternate Electrical Deployment Strategy

The alternate strategy deployment of the portable FLEX Generators and cable trailers are the same as the primary deployment strategy. The FLEX alternate electrical strategy provides an alternate means to power key electrical equipment via a 480 VAC Mobile Distribution Panel. The 125 VDC Division I, Division II battery chargers and the 250 VDC battery charger can be powered from portable FLEX Generator via a 480 VAC Mobile Distribution Panel. The 480 VAC Mobile Distribution Panel, 1(2)FF01E, is seismically restrained in the Diesel Generator Corridor (Unit 1) and in the Auxiliary Building at elevation 710'-6" (Unit 2). The 480 VAC Mobile Distribution Panel is rolled into place in the DG corridor when required. It provides alternate power connection points for the following Unit 1(2) equipment:

- 1(2)DC03E, 250VDC Battery Charger
- 1(2)DC09E, Div 1 125VDC Primary Battery Charger
- 1(2)DC23E, Div 1 125VDC Backup Battery Charger
- 1(2)DC17E, Div 2 125VDC Primary Battery Charger
- 1(2)DC16E, Div 2 125VDC Backup Battery Charger

The power connections to supply the alternate 480VAC power source to the battery chargers listed above are via transfer switches with plug-in connectors for temporary power. The transfer switches are permanently installed near the battery chargers and are part of the respective system. The transfer switches include:

- 1(2)DC25E, FLEX Transfer Switch 250V Battery Charger

- 1(2)DC26E-1(2)AA, FLEX Transfer Switch 125V Battery Charger 1(2)AA
- 1(2)DC27E-1(2)AB, FLEX Transfer Switch 125V Battery Charger 1(2)AB
- 1(2)DC29E-1(2)BA, FLEX Transfer Switch 125V Battery Charger 1(2)BA
- 1(2)DC28E-1(2)BB, FLEX Transfer Switch 125V Battery Charger 1(2)BB

The 480VAC Mobile Distribution Panel can also provide power for the FLEX Temporary Power Center (TPC) 1(2)FF02E. The HCVS battery charger, 0DC53E, can be powered from the Unit 2 480 VAC Mobile Distribution Panel.

The TPC will convert 480VAC power from the 480 VAC Mobile Distribution Panel to 120/208VAC power feed for the following FLEX "spider" boxes with GFCI receptacles.

- 1(2)FF03E, FLEX 120VAC Spider Box 1
- 1(2)FF04E, FLEX 120VAC Spider Box 2
- 1(2)FF05E, FLEX 120VAC Spider Box 3
- 1(2)FF06E, FLEX 120VAC Spider Box 4
- 1(2)FF07E, FLEX 120VAC Spider Box 5
- 1(2)FF08E, FLEX 120VAC Spider Box 6

The power connections to supply the alternate 480VAC power source to the FLEX equipment listed above consists of plug-in connectors on the panels. Temporary cables with plug-in connectors are provided for all alternate power connections from the 480VAC Mobile Distribution Panel.

Refer to Figures 10, 11, 12 and 13 FLEX Alternate Electrical Strategy connections.

LOA-FSG-002, "FLEX Electrical Strategy" contains the instructions for use of the Alternate Electrical Strategy.

2.9.3 Fueling of Equipment

The LSCS strategy for refueling equipment is provided by LOA-FSG-009, FLEX Equipment Fueling”.

Sources of Diesel Fuel Oil for FLEX equipment during a FLEX event include:

- Emergency Diesel Generator (EDG) Day Tanks
    - 0 EDG – 750 Gallons
    - 1A and 2A EDG – 750 Gallons each
    - 1B and 2B EDG – 1000 Gallons each
- EDG Storage Tanks
    - 0 EDG – 40,000 Gallons
    - 1A and 2A EDG – 40,000 Gallons each
    - 1B and 2B EDG – 30,000 Gallons each
- A trailer mounted Diesel Fuel Oil tank is in the Robust FLEX Storage Building 22 with a capacity of 390 Gallons.
- “A” and “B” Diesel Fire Pump (DFP) Fuel Day Tanks (550 Gallons each)
- Technical Support Center (TSC) Diesel Generator and Security Diesel Generator Diesel Storage Tank (2000 gallons)
- Security Diesel Generator Fuel Day Tank (275 Gallons)
- TSC Diesel Generator Fuel Day Tank (275 Gallons)
- Normal Site Fuel Supply, located to the South of the LaSalle Training Building, 0FS04T, (2000 - Gallons)
- FLEX Truck F-750 mounted fuel tanks; two @ 118 gallons each that are Power-Take-Off (PTO) driven, cross-connected and located on the truck bed. Tanks are used for equipment refueling.

The FLEX Primary Electrical Strategy will provide AC power, Division 1 & 2 only, for transfer of Diesel Fuel Oil from the EDG Storage Tank to the EDG Day Tank. The FLEX fueling strategy provides an AC powered portable 10 to 12 GPM pump (Tank Sweeper) for transfer of Diesel Fuel Oil from an EDG Day Tank to the designated destination.

FLEX Direct and Support Equipment requiring Diesel Fuel:

- Portable FLEX Generators, 500 KW CUMMINS, each with an installed capacity of 500 gallons.
- FLEX Portable Diesel Driven Pumps (PDDP), located at the Ultimate Heat Sink (UHS) with an installed capacity of 420 gallons.
- FORD F-750 truck with a 50-gallon tank.
- KUBOTA M9960 tractors each with an installed tank capacity of 29.1 gallons.
- Yanmar 5500 Watt Portable Generators with an installed capacity of approximately one gallon.
- Genesis Hydraulic Rescue Tool with an installed capacity of one gallon.
- Hydraulic Circular saw with an installed capacity of one gallon.

Portable 5-gallon Diesel Fuel Oil compatible containers are in FLEX Building 22 and Building 23.

In parallel with the buried portion of water piping for the FLEX PDDP pump discharge to the hose station in the hardened enclosure inside the PA, a pipe (EC 398941) is installed for transferring diesel fuel from inside the PA via a tanker truck to a fuel storage tank within the PDDP storage building.

2.10 Offsite Resources

2.10.1 National SAFER Response Center

To meet the requirements of Phase 3, the Strategic Alliance for FLEX Emergency Response (SAFER) team, an alliance between AREVA and Pooled Equipment Inventory Corporation (PEICo), was established. The SAFER team is contracted by the nuclear industry through PEICo to establish National SAFER Response Centers (NSRC) operated by Pooled Inventory Management (PIM) and in collaboration with AREVA to purchase, store, and deliver emergency response equipment in the case of a major nuclear accident or BDBEE in the U.S. The equipment will mitigate events that cause an extended loss of electrical power or motive force, and a loss of access to a site's ultimate heat sink.

The industry has established two (2) National SAFER Response Centers (NSRCs) to support utilities during BDB events. On-site BDB/FLEX equipment hoses and cable end fittings are standardized with the equipment supplied from the NSRC.

In the event of a BDB external event and subsequent ELAP/LUHS condition, equipment will be moved from an NSRC to a local assembly area established by the Strategic Alliance for FLEX Emergency Response (SAFER) team. For LSCS the local assembly area is the Pontiac Municipal Airport. From there, equipment can be taken to LSCS and staged at Staging Area 'B' (LSCS parking lot) by helicopter if ground transportation is unavailable or inhibited. Communications will be established between LSCS and the SAFER team via satellite phones and required equipment moved to the site as needed. First arriving equipment will be delivered to the site within 24 hours from the initial request. The order at which equipment is delivered is identified in the LSCS SAFER Response Plan documented in procedure CC-LA-118-1002

2.10.2 Equipment List

LSCS can cope indefinitely with the BDBEE/ELAP/LUHS event with the Phase 2 equipment already onsite, however, some of the NSRC equipment is used as spares or backups to this equipment. The equipment stored and maintained at the NSRC for transportation to the LSCS Staging Area B to support the response to a BDB external event at LSCS is listed in Section 7 of the SAFER Response Plan (CC-LA-118-1002) and summarized in Table 1 below. Table 1 identifies the equipment that is specifically credited in the FLEX strategies for LSCS but also lists the equipment that will be available for backup/replacement should on-site equipment break down. Since all the equipment will be located at the LSCS Staging Area B, the time needed for the replacement of a failed component will be minimal.

Table 1 – NSRC Equipment

Equipment	Performance Characteristics	
Medium Voltage Generator	4160 VAC	1 MW
Low Voltage Generator	480 VAC	1100 KW
Cable / Electrical	Various	
High Pressure Injection Pump/hose	2000 PSI	60 GPM

SG/RPV Make-up Pump/hose	500 PSI	500 GPM
Low Pressure / Medium Flow Pump/hose	300 PSI	2500 GPM
Low Pressure / High Flow Pump/hose	150 PSI	5000 GPM
Hose / Mechanical Connections	Various	
Lighting Towers	440,000 lumens	30 Feet high
Diesel Fuel Transfer Tank	500 gallon air-lift container	
Diesel Fuel Transfer	264 gallon tank, with mounted AC/DC pumps	
Portable Fuel Transfer Pump	60 GPM after filtration	
Electrical Distribution System	4160 VAC, 1200 A	
Suction Booster Lift Pump	5000 gpm, 26 feet of lift	

2.11 Equipment Operating Conditions

2.11.1 Ventilation

LOA-FSG-005, Area Ventilation, provides guidance for establishing ventilation in areas supporting the FLEX strategies. LOA-FSG-005 identifies the opening of doors, hatches, roll up doors as necessary to provide either natural circulation or forced ventilation via portable fans. Natural circulation may be used in lieu of fans with Shift Manager or designee approval. Outside doors are opened on an "as needed" basis in cold temperature conditions.

Portable fans are stored in approved FLEX storage locations (e.g. KNAACK Boxes) and would be powered from the portable FLEX generator via the TPC and deployed spider boxes per the FLEX Electrical Strategy.

Portable duct material (RCIC room ventilation) is stored in FLEX KNAACK boxes.

Operator Time Sensitive Actions for FLEX have been identified to provide cooling to the Main Control Room (MCR), Auxiliary Electric Equipment Room, (AEER), switchgear rooms and battery rooms. Door 251 from Division One Switchgear Room to Turbine Building Hallway and Door 895, Exterior from Turbine Building, Ground Floor Unit Two North Wall must be opened within 7 hours of the initiation of the BDBEE based on the time the Unit 2 Div I Switchgear Room would exceed its Required Cooling Temperature Threshold (RCTT) from Calc L-003969 (Reference 29).

The areas identified in LOA-FSG-005 include:

- Unit 1 and Unit 2 Auxiliary Building 710' Elevation
- Auxiliary Building 731' Elevation
- Auxiliary Building and MCR 768' Elevation
- Reactor Building Refuel Floor 843' Elevation
- Diesel Generator Corridor
- Unit 1 and Unit 2 RCIC Area

2.11.1.1 Unit 1 and Unit 2 Auxiliary Building 710' Elevation

The Unit 1 and Unit 2 Division I Switchgear, Division I battery and chargers, the 250 VDC battery and charger are all located in the Auxiliary Building on 710' elevation. LOA-FSG-005, Area Ventilation, attachment A describes the steps to provide additional ventilation for this area. Door 251 and Door 895 for cooling of the Unit 2 Div I switchgear room must be opened within 7 hours from the initiation of the ELAP event as a FLEX Time Sensitive Action (TSA).

2.11.1.2 Auxiliary Building 731' Elevation

The Unit 1 and Unit 2 Division II Switchgear, Division II battery and chargers, Division I and Division II Auxiliary Electrical Equipment Room (AEER) are all located in the Auxiliary Building on 731' elevation. LOA-FSG-005, Area Ventilation, attachment B describes the steps to provide additional ventilation for this area.

2.11.1.3 Auxiliary Building and MCR 768' Elevation

The Main Control Room is located in the Auxiliary Building on 768' elevation. LOA-FSG-005, Area Ventilation, attachment C describes the steps to provide additional ventilation for this area. In addition to portable fans Attachment C allows use of the Control Room Ventilation (VC) supply and exhaust fans if powered from the FLEX Electrical Strategy as an optional load.

2.11.1.4 Reactor Building 843' Elevation

Reactor Building 843' is the LaSalle Refuel Floor elevation and includes the SFP area. Calc L-003968 evaluated the Refuel Floor temperature and humidity conditions following an ELAP/LUHS event and subsequent boiling in the SFP.

LOA-FSG-005, Area Ventilation, attachment D provides ventilation actions to mitigate the temperature and humidity conditions on the Refuel Floor for such an event. LOA-FSG-005 includes use of the tool box approach in extreme temperatures (e.g. protective gear, ice vests, rotating personnel) to ensure worker safety for FLEX actions (SFP make-up) carried out on the Refuel Floor.

Ventilation to the outside can be achieved by opening and restraining the Refuel Floor to Turbine Building roof doors and by opening and restraining the Reactor Building roof hatch. A fan can be set up at the Refuel Floor to Turbine Building roof door after it is opened.

An additional ventilation strategy is available by cutting a opening (at least 200 square feet) in the Reactor Building roof. Based on actual SFP and Refuel Floor temperature conditions, the tool box approach may be preferred over cutting the opening in the Reactor Building roof.

2.11.1.5 Diesel Generator Corridor

The Diesel Generator Corridors are located on the 710' elevation and are used for FLEX storage areas and routing of FLEX hoses and cables. LOA-FSG-005 attachment E describes the steps to set up fans to move air from the east side of the corridor to the west side. On the west side of the DG Corridor the DG Corridor to Turbine Doors will be opened per attachment C of LOA-FSG-005.

2.11.1.6 Unit 1 and Unit 2 RCIC Area

The RCIC turbine and pump are located on 673' elevation in the Northeast corner of the respective reactor building for Unit 1 and Unit 2 RCIC. LOA-FSG-005, Area Ventilation, attachment F provides the necessary actions to provide additional ventilation for these areas. Portable ductwork and fans are used to transfer air from 710' reactor building to the 694' northeast corner and 673 northeast corner RCIC areas.

Additional cooling to the RCIC rooms, as described in LOA-FSG-005, Area Ventilation, attachment F, must be established within 11 hours and is a FLEX TSA. Establishing the additional ventilation extends the use of RCIC as described in EC 399297 FLEX RCIC Survivability Study (Reference 39)

2.12 Habitability

While it is anticipated that certain areas of the plant critical for the success of the FLEX strategies will exceed 120°F, personnel working in these areas will be protected through the application of heat stress control measures such as the use of cooling garments, stay times, and personnel rotation (tool box approach). Exelon procedure SA-AA-111, “Heat Stress Control”, (Reference 78) provides methods for protecting workers in areas of high temerature and humidity. While SA-AA-111 does not apply to emergency situations the methodolgy is consistent with the tool box approach for worker protection. Based on the use of cooling garments and other heat stress controls such as working in pairs and rotating personnel it is reasonable to assume the actions required to implement the FLEX strategies can be accomplished.
LSCS has on-hand cold weather garments and rain gear, in various sizes, for responders to wear during foul weather conditions supporting outside FLEX deployment actions. All the foul weather gear is stored in the FLEX Storage Buildings.

2.13 Lighting

LOA-FSG-006, Area Lighting, provides specific guidance to address lighting needs following a BDBEE.

Portable lighting available for use during a FLEX event include:

- Hardhat lights
- Flashlights
- Safe Shutdown Flashlights
- Lights on cable trailers powered by generators on the trailers
- 10 foot PRISM (inflatable) lights (in plant) powered by FLEX spider boxes
- 14 foot PRISM (inflatable) lights (in plant) powered by FLEX spider boxes

FLEX actions required in the first 6 hours can be completed by operators with flashlights, hardhat lights and DC emergency lighting that remaining energized.

After the first 6 hours with additional resources available from off-site, LOA-FSG-006 suggests the following areas for deployment of portable lighting:

- 710' U1/U2 RB – Northeast Corner Area, 14' PRISM.
- 761' U1/U2 RB – Southeast Corner, 10' PRISM.
- 710' AB – U1/U2 Switchgear and Battery Areas, Division One, 10' PRISM.
- 731' AB – U1/U2 Switchgear, Battery and Emergency Pressurization Areas, Division Two, 10' PRISM.
- 768' AB – Main Control Room (MCR) at center, 10' PRISM.
- 843’ RB – Refuel Floor, available portable lighting

Lighting available for use during a FLEX event:

- Eight (8) hour Emergency Lighting Battery Packs (ELBP).
- Portable FLEX Generators may be used to repower some ELBPs.
- Portable FLEX Generators may be used to repower some permanently installed lighting.

2.14 Communications

Initial communication announcements to on-site personnel during a BDB external event will be via the Plant Paging and Announcement system if available. If the Plant Paging and Announcement system is not available for on-site communications, bull horns that are stored outside the Work Execution Center (Aux Building 768’) will be used by designated on-site individuals for performing notification of site personnel.

Communication between operators in the LSCS Main Control Room (MCR) and FLEX deployment locations will utilize either the hand-held radios in the radio-to-radio or ‘talk around’ mode, or the installed sound powered phone system.

The primary strategy for on-site communications is utilization of hand-held portable radios using the radio-to-radio feature also known as ‘talk-around’ mode. On-shift Operations maintains and uses 10 radios. In addition, there are 14 spare radios and 74 spare radio batteries on chargers stored in the Robust FLEX Storage Building 22 to provide extended radio service time. Battery chargers for the radio equipment will be powered from the small portable generators that are stored in the Robust FLEX Storage Building 22 as needed during an ELAP/LUHS event.

The backup strategy for on-site communications uses Sound Powered Phones (SPP) between FLEX deployment locations and the Main Control Rooms. SPP kits with headsets and cords to reach the local FLEX deployment location SPP jack and SPP kits for the MCR operators have been staged in plant storage boxes and the MCR.

FLEX communication equipment is protected from hazards by storage in the Robust FLEX Storage Building 22 or designated in-plant storage boxes in buildings that meet the plant's design bases for the Safe Shutdown Earthquake (SSE). Portable communications equipment is inventoried per station procedure LOS-FSG-A1, FLEX Equipment Annual Inventory, and functional checked per station procedure LOS-FSG-SA1, FLEX Semi-Annual Equipment Surveillance.

Off-site communications will utilize satellite phones in the main control room and portable iridium satellite phones staged in the Shift Manager's office. The trailer mounted satellite equipment is stored in the 60' x 90' Robust FLEX Storage Building 22.

Guidance on On-site and Off-site communications is provided in LOA-FSG-010, Communications (Reference 63)

2.15 Water Source

For Phase 1, LSCS uses RCIC for injection to the RPV from either Condensate Storage Tank or the Suppression Pool. The LSCS SFP does not require a FLEX make-up water source in Phase 1.

For Phase 2 and Phase 3 LSCS utilizes the UHS as the water source for make-up to the RPV, SP, and SFP.

The UHS is an excavated pond with a capacity and surface area of 340 acre-feet and 81 acres, respectively, at the design level of 690 feet MSL (assumes 1.5 feet of sediment). The intake flume is a part of the excavated UHS and loss of the cooling lake has no effect on the UHS. The UHS post-accident temperature analysis indicates a peak water supply temperature of 107°F.

2.16 Shutdown and Refueling Analysis

LSCS has incorporated guidance from BWROG-TP-15-019, BWR-Specific Shutdown Refueling Mode Guidance, dated December 2015, (Reference 79) into procedures to ensure FLEX strategies can be implemented in all modes.

OU-AA-103, Shutdown Safety Management System (Reference 80) and LOA-FSG-004, FLEX Implementation During Shutdown/Refuel Modes (Reference 57), provides direction to evaluate time to boil and time to top-of fuel during shutdown/refuel modes and take action to ensure RPV injection using a FLEX water supply will be successful. Time to fuel uncovery defines when FLEX make-up systems must be available to supply water flow.

Availability of FLEX make-up water in less than the minimum staffing validated times and less than time to the top of active fuel is assured by considering and implementing the following as necessary:

- Use of additional resources available in an outage condition
- Pre-briefing workers/operators on FLEX implementation actions
- Pre-assign FLEX actions
- Pre-staging/Pre-deployment of FLEX equipment
- If RPV head is not removed protect means of de-pressurizing RPV to allow low pressure FLEX injection
- If RPV head is not removed consider allowing RPV to pressurize and restore RCIC for RPV injection

The procedures described above comply with the Nuclear Energy Institute position paper entitled "Shutdown/Refueling Modes" (Reference 23) dated September 18, 2013. The NEI position paper has been endorsed by the NRC staff (Reference 24).

2.17 Sequence of Events

Table 2 presents a Sequence of Events (SOE) Timeline for an ELAP/LUHS event at LSCS. Validation of each of the Flex time constraint actions has been completed in accordance with the Flex Validation Process document issued by NEI and includes consideration for staffing. Time to clear debris to allow equipment deployment is assumed to be up to 2 hours. This time is considered to be reasonable based on site reviews of the deployment paths and the location of the FLEX Storage Building. Debris removal equipment is stored in the Robust FLEX Storage Building 22.

Table 2: Sequence of Events Timeline

Action Item	Elapsed Time	Action	Time Constraint Y/N	Remarks/ Applicability
	0	Event Starts	NA	Plant @100% power.
1	0	Reactor Scram and SBO.		
2	~2 min	RCIC starts on lo-lo RPV water level and injects at 600 gpm	N	Automatic equipment function.
3	0-5 mins	Operating crew enters applicable EOP's and abnormal procedures for SBO.	Y (time critical activities in LOA-AP-101)	LOA-AP-101(201), Att. K to direct initial SBO response.
4	5 mins	DC load shedding initiated .	N	LOA-AP-101(201), Att. K, Step 2. Initiation of load shedding is not time critical – completion of load shedding is time critical.
5	5 mins	Attempt to start emergency diesel generators (3 for Unit 1, 2 for Unit 2)	N	LOA-AP-101(201), Att. K, Step 3.

Action Item	Elapsed Time	Action	Time Constraint Y/N	Remarks/ Applicability
6	5 mins	Equipment Operator dispatched to Aux Electric Equipment Room (AEER) to: • Control the ADS SRVs to support cooldown within 20 mins • Open all panel doors in AEER within 30 mins • Monitor and report critical parameters at Remote Shutdown Panel & 1H13-P629/1H13-P631 panels	N	LOA-AP-101(201), Att. K, Step 4. Dispatch of EO is not time critical – completion of the tasks is time sensitive and discussed below.
7	5 mins	Reactor Operator control RPV level with RCIC.	N	LOA-AP-101(201), Att. K, Step 5 For events in which CST is not available, suction path swapped to suppression pool.
8	15 mins	Defeat RCIC Low Steam Line Pressure Isolation (RO Control Room portion).	N	Not time critical since not depressurizing RPV at this time. LGA-RI-101(201), E.2

Action Item	Elapsed Time	Action	Time Constraint Y/N	Remarks/ Applicability
9	20 mins	Control of ADS SRVs to support cooldown established and an RPV depressurization at less than or equal to 20 deg F per hour is commenced.	Y	LOP-AP-101(201), Att. K, Step 6. Time sensitive portions are establishing control within 20 mins and depressurizing/cooling down slow enough.
10	30 mins	Partial Initial DC load shedding completed.	Y	LOA-AP-101(201), Att. K, Step 2, 30 min loads.
11	30 mins	Defeat RCIC Low Pressure Isolation Logic (EO AEER portion).	N	Not time critical since not depressurizing RPV at this time. LGA-RI-101(201), Att. A
12	30 mins	All panel doors in AEER opened.	Y	Time sensitive for AEER temperature evaluation.
13	30 mins	All panel doors in Main Control Room opened.	Y	LOA-AP-101(201), Att. K, Step 11. Time sensitive for Control Room temperature evaluation.
14	~60 mins	Control Room crew has assessed SBO and plant conditions and declares an Extended Loss of AC Power (ELAP) event.	Y	Time is reasonable approximation based on operating crew assessment of plant conditions.

Action Item	Elapsed Time	Action	Time Constraint Y/N	Remarks/ Applicability
15	~60 mins	Equipment Operators dispatched to begin setup/connection of FLEX equipment (480VAC generators to power battery chargers and FLEX pump).	N	DC coping analysis (Ref. 38) shows the 125VDC and 250VDC batteries have a minimum of 8 hours coping capability with initial and deep load shedding completed (as applicable to particular battery).
16	~180 mins	Initiate Extended DC load shedding to prolong 125 VDC battery life to ~8 hrs.	N	DC coping analysis (Ref. 38) shows that extended DC load shedding needs to be completed within 4.5 hrs for U1 Div. 1, 5.5 hrs for U1 Div. 2, 5.5 hrs for U2 Div. 1 and deep load shedding is not required for U2 Div. 2. Initiation of extended (deep) load shedding is shown in the timeline to allow ~1.5 hrs to complete.
17	180 mins	Initial DC load shedding completed.	Y	LOA-AP-101(201), Att. K, Step 2, 180 minute loads

Action Item	Elapsed Time	Action	Time Constraint Y/N	Remarks/ Applicability
18	4.5 hrs	Complete Extended DC load shedding per LOA-AP-101(201) Att. N step 4 for applicable 125VDC batteries.	Y	Timing of completion of extended DC load shedding is important to extending coping time to 8 hrs as described earlier in timeline.
19	5 hrs	Provide additional nitrogen supply for ADS SRV's.	Y	Per LOA-IN-101(201) & LOP-IN-05. Time sensitive per calculation L-003263.
20	~5.4 hrs	Initiate early containment venting strategy at a wetwell pressure of ~12 psig. Open hardened containment vent with path from the wetwell.	N	MAAP analysis (Ref. 33) indicates that the conceptual early containment venting strategy trigger of 12 psig in the wetwell will occur at ~5.4 hrs with this strategy.
21	6 hrs	480VAC generators connected to supply battery chargers for 125VDC (Div. 1 and 2) and 250VDC buses.	Y	Restore AC power to battery chargers prior to loss of each battery at the analyzed value of ~8 hrs.

Action Item	Elapsed Time	Action	Time Constraint Y/N	Remarks/ Applicability
22	6 hrs	FLEX pumps connected (electrically and water suction/discharge flow paths) and alignment for suppression pool makeup established. Suppression pool makeup begins.	Y	MAAP analysis (Ref. 33) is showing suppression pool makeup at 6.2 hrs based on the suppression pool level reduction from implementation of the early containment venting strategy at ~5.4 hrs. This MAAP analysis also shows a required makeup flowrate of ~95 gpm for the first 4 hrs after the vent is opened.
23	~6.7 hrs	Heat Capacity Temperature Limit (HCTL) curve exceeded, RPV depressurization to ~200 psig required. RPV pressure now maintained 150-250 psig range to support RCIC operation.	N	MAAP analysis (Ref. 33) indicates that the HCTL curve will be exceeded at ~6.7 hrs based on this strategy. RPV depressurization stops at ~200 psig (pressure band of 150-250 psig used) in RPV to preserve RCIC operation. Modified depressurization approach supported by BWROG changes to EPGs.

Action Item	Elapsed Time	Action	Time Constraint Y/N	Remarks/ Applicability
24	~11 hrs	Provide external air flow to RCIC room.	Y	GOTHIC analysis (Ref. 39) shows that external air flow needs to be provided within 13 hrs to prevent room temps from exceeding 169 deg F which is the maximum allowable value from the current SBO analysis.
25	12 hrs	Begin SFP injection based on FLEX "normal" scenario that begins with both units on-line at 100% power.	Y	EC 392196 indicates that SFP boiling begins at ~12 hrs with TAF being reached at ~123 hrs. Beginning SFP inject by ~12 hrs provides margin to degraded radiological conditions and TAF.
26	24 -72 hrs	Continue to maintain critical functions of core cooling (via RCIC), containment (via hardened vent opening and FLEX pump injection to suppression pool) and SFP cooling (FLEX pump injection to SFP). Utilize initial RRC equipment in spare capacity.	N	Not time critical/sensitive since Phase 2 actions result in indefinite coping times for all safety functions.

2.18 Programmatic Elements

2.18.1 Overall Program Document

Procedure CC-LA-118-1001 (Reference 72) provides a description of the Diverse and Flexible Coping Strategies (FLEX) Program for LSCS. This procedure implements Exelon fleet program document CC-AA-118 (Reference 71) which contains governing criteria and detailed requirements. The key elements of the program include:

- Summary of the LSCS FLEX strategies
- Maintenance of the FSGs including any impacts on the interfacing procedures (LGAs, LOAs, LOSs, etc.)
- Maintenance and testing of FLEX equipment (i.e., SFP level instrumentation, emergency communications equipment, portable FLEX equipment, FLEX support equipment, and FLEX support vehicles)
- Portable equipment deployment routes, staging areas, and connections to existing mechanical and electrical systems
- Validation of time sensitive operator actions
- The FLEX Storage Building and the Regional Response Center
- Supporting evaluations, calculations, and FLEX drawings
- Tracking of commitments and FLEX equipment unavailability
- Staffing and Training
- Configuration Management
- Program Maintenance

The instructions required to implement the various elements of the FLEX Program at LSCS and thereby ensure readiness in the event of a Beyond Design Basis External Event are contained in Exelon fleet program document CC-AA-118.

Design control procedure CC-AA-102 (Reference 75) 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.

Design control procedure CC-AA-309-101, "Engineering Technical Evaluations" (Reference 76) has been revised to ensure technical evaluations are performed when new information is received that potenetially challenges the conservatism of current external event design assumptions.

Future changes to the FLEX strategies may be made without prior NRC approval provided:

1) Revised FLEX strategies meet the requirements of NEI 12-06 (Reference 2) or a previously approved alternate approach,

and

2) An engineering basis is documented that ensures that the change in FLEX strategies continues to ensure the key safety functions (core and SFP cooling, containment integrity) are met.

2.18.2 Procedural Guidance

The inability to predict actual plant conditions that require the use of BDB equipment makes it impossible to provide specific procedural guidance. As such, the 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 EOPs (LGAs) or Abnormal Procedures (LOAs) strategies, the LGA or LOA, Severe Accident Mitigation Guidelines (SAMGs), or Extreme Damage Mitigation Guidelines (EDGMs) will direct the entry into and exit from the appropriate FSG procedure.

FLEX strategy support guidelines have been developed in accordance with BWROG guidelines. FLEX Support Guidelines (FSG) will provide available, pre-planned FLEX strategies for accomplishing specific tasks in the LGAs or LOAs. FSGs will be used to supplement (not replace) the existing procedure structure that establishes command and control for the event.

Procedural interfaces have been incorporated into LOA-FSG-011, "BDBEE Guidance" to the extent necessary to include appropriate reference to FSGs and provide command and control for the ELAP.

Changes to FSGs are controlled by Exelon fleet procedure AD-AA-101, Processing of Procedures and T&RMs. 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 has been accomplished in accordance with the guidelines provided in CC-LA-118-1004, FLEX Validation Process (Reference 74).

Table 3 – FLEX FSG Procedures

Procedure number	**Procedure Title**
LOA-FSG-001	Loss of Vital Instrumentation
LOA-FSG-002	FLEX Electrical Strategy
LOA-FSG-003	FLEX Water Supply Strategy
LOA-FSG-004	FLEX Implemetation During Shutdown/Refuel Modes
LOA-FSG-005	Area Ventilation
LOA-FSG-006	Area Lighting
LOA-FSG-007	FLEX Spent Fuel Pool Level Indication
LOA-FSG-008	Overhead Lines
LOA-FSG-009	FLEX Equipment Fueling
LOA-FSG-010	FLEX Communication
LOA-FSG-011	FLEX Beyond Design Basis External Event Guidance
LOA-FSG-012	FLEX Deployment Path Debris Removal
LOA-FSG-013	Long-Term FLEX Recovery Actions

2.18.3 Staffing

Using the methodology of NEI 12-01, Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities, an assessment of the capability of LSCS on-shift staff and augmented Emergency Response Organization (ERO) to respond to a Beyond Design Basis External Event (BDBEE) was performed. The results were provided to the NRC in a letter dated September 25, 2014 (Reference 22).

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

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

LSCS Operations 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 (LGAs) and Abnormal Operating Procedures (LOAs). 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 LSCS, as augmented by site auxiliary personnel, is sufficient to support the implementation of the FLEX strategies, 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 LSCS site resources, supplemented by Exelon fleet resources, as necessary.

2.18.4 Training

The LSCS 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).

Using the SAT process, Job and Task analyses were completed for the new tasks identified as applicable to the FLEX Mitigation Strategies. Based on the analysis, training for Operations was designed, developed and implemented for Operations continuing training. "ANSI/ANS 3.5, Nuclear Power Plant Simulators for use in Operator Training" certification of simulator fidelity is considered to be sufficient for the initial stages of the BDB external event scenario training. Full scope simulator models have not been explicitly upgraded to accommodate FLEX training or drills. The simulator has been modified to allow for operator training to be conducted for operation of the HCVS. Overview training on FLEX Phase 3 and associated equipment from the SAFER NSRCs was also provided to LSCS Operators. 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.

Initial training has been provided and periodic training will be provided to site emergency response leaders on BDB emergency response strategies and implementing guidelines. Personnel assigned to direct the execution of mitigation strategies for 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.

Where appropriate, integrated FLEX drills will be conducted periodically; with all time-sensitive actions evaluated over a period of not more than eight years. It is not required to connect/operate temporary/permanently installed equipment during these drills.

LSCS has incorporated FLEX drills into the Drill and Exercise program per EP-AA-122-100, Drill and Exercise Planning and Scheduling.

2.18.5 Equipment List

The equipment stored and maintained at the LSCS FLEX Storage Buildings and various pre-staged locations at LSCS necessary for the implementation of the FLEX strategies in response to a BDB external event are listed in CC-LA-118-1001, Site Implementation of Diverse and Flexible Coping Strategies, attachment 2.

Table 4 identifies the quantity, applicable strategy, and capacity/rating for the major BDB/FLEX equipment components only, as well as, various clarifying notes.

Table 4 – Major FLEX Equipment

Phase	Description of Equipment	Strategy
2	Three (3) 500 KW 480V AC diesel generators for primary and alternate strategies (0FF01KA, 0FF01KB, 0FF01KC)	Core, Containment, SFP, Instrumentation
2	Two (2) cable trailers (4/0 cables for diesel generators) (One trailer has an extra set of cables to meet the N+1 requirement)	Core, Containment, SFP, Instrumentation
2	Two (2) Hale Potable Diesel Driven Pumps (PDDP) Pump (Each pump trailer also includes 2 submersible suction lift pumps) (0FF30A, 0FF30B)	Core, Containment, SFP
2	Two (2) 10" hose trailers (2200' of 10" hose available on each trailer for supply to both units)	Core, Containment, SFP
2	FLEX Water Manifold (Distributes 10" hose discharge to a 6" hose supply for each unit) (10" x 6" x 6" wye available for N+1)	Core, Containment, SFP
2	F-750 truck with plow and fuel oil storage tanks	Core, Containment, SFP, Access
2	Two (2) Kubota Tractors	Core, Containment, SFP, Access
2	Four (4) 5500 watt portable (Yanmar) generators	Core, Containment, SFP, Access
2	One (1) MCR Satellite Trailer	Core, Containment, SFP, Instrumentation
2	One (1) OSC/TSC Satellite Trailer	Core, Containment, SFP, Instrumentation

2.18.6 N+1 Equipment Requirement

NEI 12-06 Rev. 2 invokes an N+1 requirement for the major BDB FLEX equipment that directly performs a FLEX mitigation strategy for core cooling, containment, or SFP cooling in order to assure reliability and availability of the FLEX equipment required to meet the FLEX strategies. LSCS meets this requirement.

This NEI 12-06 Rev.2 approach is to store "N" sets of equipment in a fully robust building and selected +1 equipment in a commercial building. Note that for LaSalle, most of the +1 equipment is stored in a fully robust building. For all hazards scoped in for the site, the FLEX equipment is stored in a configuration such that no one external event can reasonably fail the site FLEX capability (N).

To ensure that no one external event will reasonably fail the site FLEX capability (N), Exelon will ensure that N equipment is protected in the robust building. To accomplish this, Exelon has developed procedures to address the unavailability allowance as stated in NEI 12-06 Revision 2 Section 11.5.4., (see Maintenance and Testing section below for further details).

Hoses and cables used for FLEX strtategies are passive components being stored in a protected facility. It is postulated the most probable cause for degradation/damage of these components would occur during deployment of the equipment. Therefore the +1 capability is accomplished by having sufficient hoses and cables to satisfy the N capability + 10% spares or at least 1 length of hose and cable. This 10% margin capability ensures that failure of any one of these passive components would not prevent the successful deployment of a FLEX strategy.

The N+1 requirement does not apply to the BDB FLEX support equipment, vehicles, and tools. However, these items are covered by an administrative procedure and are subject to inventory checks, unavailability requirements, and any maintenance and testing that are needed to ensure they can perform their required functions.

2.18.7 Equipment Maintenance and Testing

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

EPRI has completed and has issued “Preventive Maintenance Basis for FLEX Equipment – Project Overview Report”. Preventative Maintenance Templates for the major FLEX equipment including the portable diesel pumps and generators have also been issued.

The PM Templates include activities such as:

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

The EPRI PM Templates for FLEX equipment conform to the guidance of NEI 12-06 Rev. 2 (Reference 2) providing assurance that stored or pre-staged FLEX equipment are being properly maintained and tested. EPRI Templates are used for equipment where applicable. However, in those cases where EPRI templates were not available, Preventative Maintenance (PM) actions were developed based on manufacturer provided information/recommendations and Exelon fleet procedure ER-AA-200, Preventive Maintenance Program. Detailed information on FLEX and FLEX support equipment PM’s is contained in FLEX program document CC-AA-118, Diverse and Flexible Coping Strategies, section 4.4.

Refer to Table 5 for an overview of Maintenance and Testing performed for FLEX equipment. Detailed information on FLEX and FLEX support equipment PM’s is contained in FLEX program document CC-AA-118 and PMID 348007.

Table 5 – Maintenance Procedures for FLEX Equipment

Document No.	Description
LOS-FSG-M1	Monthly general equipment and building checks, deployment path check
LOS-FSG-Q1	Quarterly functional check of F-750 truck and 390 gal fuel trailer
LOS-FSG-SA1	Semi-Annual functional testing of 500kw FLEX generators, PDDP, Communications equipment, Kubota tractors, and other support equipment
LOS-FSG-A1	Annual FLEX Equipment Inventory
LOS-FSG-A2	Annual sampling of FLEX Diesel Fuel Oil
LOS-FSG-A3	Annual maintenance and testing on Kubota tractors, F-750 truck and other FLEX support equipment (e.g. oil and filter changes, change lube oil)
LOS-FSG-SR1	Triennial performance testing of FLEX 500kw generators and PDDP pumps
PMID 348007-21 and 22	Semi-Annual maintenance and testing of FLEX satellite equipment
PMID 348007-54 through 59	5Y performance inspection and megger of FLEX 500kw generators
PMID 348007-62	6Y FLEX Satellite equipment battery replacements
PMID 348007-68 through 70	10Y FLEX 500kw generator output breaker trip check
PMID 348007-71	10Y FLEX Distribution Panel trip check, inspect, exercise
PMID 348007-72 through 79	10Y FLEX Shunt device and disconnect switch exercise
PMID 348007-80	10Y FLEX Cable and Connector inspect and megger
PMID 348007-81	10Y FLEX Hose pressure test or replace

The unavailability of FLEX equipment and applicable connections that directly perform a FLEX mitigation strategy for core, containment (including HCVS), and SFP is controlled and managed per LSCS procedure CC-LA-118-1001, Site Implementation of Diverse and Flexible Coping Strategies, such that risk to mitigating strategy capability is minimized. The guidance in this procedure conforms to the guidance of NEI 12-06 Rev 2 as follows:

- The unavailability of plant equipment is controlled by existing plant processes such as the Technical Specifications. When plant equipment which supports FLEX strategies becomes unavailable, then the FLEX strategy affected by this unavailability does not need to be maintained during the unavailability.
- If FLEX equipment is likely to be unavailable during forecast site specific external events (e.g., hurricane), appropriate compensatory measures should be taken to restore equivalent capability in advance of the event
- The required FLEX equipment may be unavailable for 90 days provided that the site FLEX capability (N) is met. If the site FLEX (N) capability is met but not protected for all of the site's applicable hazards, then the allowed unavailability is reduced to 45 days
- One of the connections to plant equipment required for FLEX strategies can be unavailable for 90 days provided the remaining connection remains available such that the site FLEX strategy is available
- If FLEX equipment or connections become unavailable such that the site FLEX capability (N) is not maintained, initiate actions within 24 hours to restore the site FLEX capability (N) and implement compensatory measures (e.g., use of alternate suitable equipment or supplemental personnel) within 72 hours.
- If FLEX equipment or connections to permanent plant equipment required for FLEX strategies are unavailable for greater than 45/90 days, restore the FLEX capability or implement compensatory measures (e.g., use of alternate suitable equipment or supplemental personnel) prior to exceedance of the 45/90 days.

FLEX support equipment is defined as equipment not required to directly support maintenance of the key safety functions. There are no requirements specified in NEI 12-06 for unavailability time for any of the FLEX support equipment. This equipment is important to the successful Implementation of the LSCS FLEX strategy and Exelon Generation Company (EGC) requires establishment the following unavailability times:

- One or more pieces of FLEX support equipment available but not in its evaluated configuration for protection restore protection within 90 days
- One or more pieces of FLEX support equipment (except communications equipment) is unavailable, restore the equipment to available within 90 days AND implement compensatory measures for the lost function within 14 days.
- One or more pieces of FLEX communications equipment is unavailable, restore the equipment to available within 90 days AND implement compensatory measures for the lost function within 45 days.

CC-LA-118-1001, Site Implementation of Diverse and Flexible Coping Strategies, also includes allowed unavailability times for SFPLI and HCVS equipment as follows”

- One channel of SFPLI is unavailable then restore within 90 days
- Both channels of SFPLI is unavailable then initiate action within 24 hours to restore one channel to functional and restore one channel within 72 hours
- If the SFPLI equipment 90 day or 72 hour required actions are not met then develop and implement an alternate method of monitoring.
- If the Primary or Alternate HCVS Control method or monitoring instrumentation is unavailable then restore within 90 days
- If the Primary and the Alternate HCVS control methods are unavailable then restore either the Primary or Alternate control method within 30 days
- If the HCVS equipment 90 or 30 day required actions are not met then initiate compensatory actions for the lost HCVS function

References

1. NRC Order EA-12-049, Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, March 12, 2012

2. NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, Revision 2, December 2015

3. NRC JLD-ISG-2012-01, Revision 1, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, January 22, 2016

4. NRC Order EA-12-051, Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, March 12, 2012

5. 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

6. NRC JLD-ISG-2012-03, Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation, Revision 0, August 29, 2012

7. NEI 12-01, Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities, Revision 0, April 2012

8. NRC Order 13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions, June 6, 2013

9. NEI 13-02, Industry Guidance for Compliance with NRC Order EA-13-109, BWR Mark I & II Reliable Hardened Vents Capable of Operation Under Severe Accident Conditions, Revision 1, April 2015

10. NRC JLD-ISG-2013-02, Revision 0, Compliance with Order EA-13-109 Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions, November 14, 2013

11. 10 CFR Section 50.63, Loss of all alternating current power

12. LaSalle County Power Station Updated Final Safety Analysis Report, Revision 22, April 2016

13. LaSalle Technical Specifications

14. TQ-AA-1, Systematic Approach to Training Process Description, Revision 002, July 2014

15. CNG-TR-1.01-1031, Emergency Response Training Program, Revision 00200, April 2015

16. TQ-AA-150, Operator Training Programs, Revision 011, March 2015

17. Exelon Position Paper EXC-WP-12, Required Actions for FLEX Support Equipment, Revision 0, January 2015

18. EPRI Preventive Maintenance Basis for FLEX Equipment – Project Overview Report, Report #3002000623, September 2013

19. Seismic Hazard and Screening Report (CEUS Sites), Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, FLL 14-013, March 2014

20. NEI APC14-17, FLEX Validation Process, July 2014

21. AD-AA-101, Processing of Procedures and T&RMs, Revision 026, December 2014

22. 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, RS-14-187, September 25, 2014

23. NEI Position Paper Shutdown and Refueling: ADAMS Accession No. ML13273A514

24. NRC Endorsement of NEI Shutdown and Refueling paper: ADAMS Accession No. ML13267A382

25. S&L Calculation 2014-05010, LaSalle FLEX Pump Sizing L-003961

26. VTIP J-1027 – Vendor manual – Collection of Various Flex Equipment Vendor Information

27. VX-09 - Battery Rooms Hydrogen Concentration

28. L-003968 - Temperature and Humidity Transient in the Reactor Building 843'-6" Operating Floor Following a BDBEE

29. L-003969 - Transient Heat-Up Analysis for the U1/U2 Control Room, AEER, DIV. 1 & DIV. 2 Switchgear Rooms Following a BDBEE

30. L-003447 LaSalle Units 1 & 2, 125VDC System Analysis

31. L-003448 LaSalle Units 1 & 2, 250VDC System Analysis

32. L-003263 Volume Requirements for ADS Back-Up Compressed Gas System Bottle Banks

33. LS-MISC-017, MAAP Analysis to Support Initial FLEX Strategy

34. L-003353 ISFSI Dry Cask Storage - Fire Hazard Analysis

35. L-003961 FLEX Pump Sizing Hydraulic Calculation

36. L-004000 - Evaluation of Liquefaction Potential for BDBEE FLEX Staging Area & Equipment Deployment Paths

37. L-004001 FLEX Diesel Fuel Line Evaluation

38. EC 391795 Battery Coping Times During ELAP with Extended Load Shedding

39. EC 399297 FLEX RCIC Survivability Study

40. EC 392331 RCIC ROOM Heatup For Extended Loss of AC Power (ELAP) in Support of FLEX

41. EC 396061 (U1) / EC 396060 (U2) FLEX Primary and Alternate Strategy – Mechanical

42. EC 396062 (EC 396069) FLEX U1(U2) Primary Strategy – Electrical Install 480V Power Source to 480V SWGR Buses 135X(235X), 135Y(235Y), 136X(236X) and 136Y(236Y) from a Portable 480V Generator

43. EC 397688 Installation of 60'X90' FLEX Robust Storage Structure Inside PA-Building #22

44. EC 397689 Installation of 30'X40' FLEX Robust Storage Structure Outside PA-Building #23
45. EC 397690 FLEX Commercial Building Inside PA
46. EC 396065 (U1) / EC 396093 (U2) FLEX Instrumentation Power (AC to DC) Install 125VDC/120VAC Inverter to Power Existing 120VAC/24VDC Power Supply that Feeds Existing Containment Instrumentation.
47. EC 398941 FLEX - Buried Water and Diesel Pipe, Road Improvements & Railroad Track Removal
48. EC 400694 FLEX Diesel Fuel Oil Study
49. EC 400759 Location of FLEX Storage Equipment Inside the Plant
50. EC 400418 FLEX Refuel Floor Venting Evaluation
51. EC 394010 SFP Instrumentation
52. EC 392196 SFP Uncovery Time for Outage and Online Scenarios
53. EC 397691(392353) U1(U2) Hardened Containment Vent System (HCVS)
54. LOA-FSG-001 Loss of Vital Instrumentation
55. LOA-FSG-002 FLEX Electrical Strategy
56. LOA-FSG-003 FLEX Water Supply Strategy
57. LOA-FSG-004 FLEX Implementation During Shutdown / Refuel Modes
58. LOA-FSG-005 Area Ventilation
59. LOA-FSG-006 Area Lighting
60. LOA-FSG-007 FLEX Spent Fuel Pool Level Indication
61. LOA-FSG-008 Overhead Lines
62. LOA-FSG-009 FLEX Equipment Fueling
63. LOA-FSG-010 FLEX Communications
64. LOA-FSG-011 FLEX Beyond Design Basis External Event Guidance

65. LOA-FSG-012 FLEX Deployment Path Debris Removal

66. LOA-FSG-013 FLEX Recovery Actions

67. LOA-AP-101(201) AC Power System Abnormal

68. LOA-IN-101(201) Loss of Drywell Pneumatic Supply

69. LOP-IN-05 Replacing Nitrogen Bottles on Instrument Nitrogen System

70. LGA-RI-101(201) Alternate Vessel Injection Using RCIC Including Defeat of RCIC Isolations

71. CC-AA-118 Diverse and Flexible Coping Strategies (FLEX) and Spent Fuel Pool Instrumentation Program

72. CC-LA-118-1001 Site Implementation of Diverse and Flexible Coping Strategies (FLEX) and Spent Fuel Pool Instrumentation Program

73. CC-LA-118-1002 SAFER Response Plan for LSCS

74. CC-LA-118-1004 FLEX BDBEE Validation Process

75. CC-AA-102 Design Input and Configuration Change Impact Screening

76. CC-AA-309-101 Engineering Technical Evaluations

77. Resolution 2014-02 Toolbox Approach for Extreme Temperatures

78. SA-AA-111 Heat Stress Control

79. BWROG-TP-15-019, BWR-Specific Shutdown Refueling Mode Guidance, dated December, 2015

80. OU-AA-103, Shutdown Safety Management Program

81. L-002457, Rev.8 LaSalle County Station Ultimate Heat Sink Analysis

82. LGA-VQ-102(202), Unit 1(2) Emergency Containment Vent

83. LGA-003, Primary Containment Control

84. EC 396064(396092) U1(U2) FLEX Alternate Electrical Strategy

85. Exelon Generation Company, LLC Letter to USNRC, Response to March 12, 2012, Request for Information Enclosure 2, Recommendation 2.1, Flooding, Required Response 2, Flooding Hazard Reevaluation Report, dated March 12, 2014 (RS-14-055)

86. NRC Letter, LaSalle County Station, Units 1 and 2 - Interim Staff Response to Reevaluated Flood Hazards Submitted in Response to 10 CFR 50.54(f) Information Request - Flood-Causing Mechanism Reevaluation (TAC NOS. MF3655 and MF3656), dated September 3, 2015 ADAMS Accession No. ML15211A482

87. Exelon Generation Company, LLC Letter to USNRC, Mitigating Strategies Flood Hazard Assessment (MSFHA) Submittal, dated October 28, 2016 (RS-16-182)

88. NRC Letter, LaSalle County Station, Units 1 and 2 - Flood Hazard Mitigation Strategies Assessment (CAC NOS. MF7937 AND MF7938), dated January 11, 2017, ADAMS Accession No. ML16355A418

89. U.S. NRC (Leeds, E & Johnson, M.), *“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”*, Letter to All Power Reactor Licensees et al., Washington D.C., March 12, 2012.

90. LaSalle County Station, Units 1 and 2, Exelon Generation Co., LLC - Seismic Hazard and Screening Report (Central and Eastern United States (CEUS) Sites), Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, [March 31, 2014], RS-14-068 (ML14091A013) – S&L Report No. SL-012194

91. LaSalle County Station, Units 1 and 2, Exelon Generation Co., LLC - Seismic Mitigating Strategies Assessment (MSA) Report for the Reevaluated Seismic Hazard Information – NEI 12-06, Appendix H, Revision 4, H.4.4 Path 4: GMRS < 2xSSE, [August 22, 2017], RS-17-092 - Report No. EXLS014-RPT-001, Rev 0