Exelon Generation®

Order No. EA-12-049

RS-16-006

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

R. E. Ginna Nuclear Power Plant
Renewed Facility Operating License No. DPR-18
NRC Docket No. 50-244

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. Letter from M. G. Korsnick (CENG) to Document Control Desk (NRC), 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 26, 2012
5. Letter from M. G. Korsnick (CENG) to Document Control Desk (NRC), 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
6. Letter from M. G. Korsnick (CENG) to Document Control Desk (NRC), Supplement to 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 March 8, 2013
7. Letter from E. D. Dean (CENG) to Document Control Desk (NRC), R. E. Ginna Nuclear Power Plant - 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 27, 2013

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8. Letter from M. G. Korsnick (CENG) to Document Control Desk (NRC) – February 2014 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, 2014 (FLL-14-004)
9. Letter from M. G. Korsnick (CENG) to Document Control Desk (NRC) – August 2014 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, 2014 (FLL-14-029)
10. Letter from M. G. Korsnick (CENG) to Document Control Desk (NRC) – February 2015 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 20, 2015 (RS-15-061)
11. 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-15-218)
12. Letter from J. S. Bowen (NRC) to M. G. Korsnick (CENG), R. E. Ginna Nuclear Power Plant – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049, (Mitigation Strategies) (TAC No. MF1152), dated February 19, 2014
13. NRC Letter, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated March 12, 2012
14. Exelon Generation Company, LLC letter to USNRC, Response to March 12, 2012, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, Enclosure 5, Recommendation 9.3, Emergency Preparedness – Staffing, Requested Information Items 1, 2, and 6 - Phase 2 Staffing Assessment, dated June 8, 2015 (RS-15-123)
15. Letter from J. P. Boska (NRC) to J. E. Pacher (EGC), R. E. Ginna Nuclear Power Plant – 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. MF1152 and MF1147), dated June 18, 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), previously Constellation Energy Nuclear Group, LLC (Exelon, the licensee). 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. References 5 and 6 provided the R. E. Ginna Nuclear Power Plant OIP.

Reference 1 required submission of a status report at six-month intervals following submittal of the OIP. References 7, 8, 9, 10, and 11 provided the first, second, third, fourth, and fifth six-month status reports, respectively, pursuant to Section IV, Condition C.2, of Reference 1 for R. E. Ginna Nuclear Power Plant.

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 R. E. Ginna Nuclear Power Plant.

R. E. Ginna Nuclear Power Plant 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 R. E. Ginna Nuclear Power Plant with Reference 1.

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

Overall Integrated Plan Open Items

1. Implement a design change to install permanent protected FLEX equipment connection points. (also see OI 23)	Reference 7 and updated with this submittal as provided below
2. Provide for onsite storage of Phase 2 FLEX components that is protected against external events by design or location. Implement a design change to provide a protected storage location for transportation (equipment and fuel) and debris removal equipment. Evaluate deployment strategies and deployment routes for hazards impact. Evaluate requirements and options and develop	Reference 8 and updated with this submittal as provided below

strategies related to the storage onsite of the FLEX portable equipment. Establish deployment routes from FLEX equipment storage locations to connection points. Develop a strategy and purchase equipment to respond to events that may require debris removal such as following a flood, tornado, earthquake, or snow storm. Develop a strategy to move FLEX equipment, including providing reasonable protection from a BDBEE.	
3. Exceptions for the site security plan or other (license/site specific – 10 CFR 50.54x) requirements of a nature requiring NRC approval will be communicated in a future 6-month update following identification.	Reference 8
4. Develop and implement procedures to commence feeding the steam generators (S/Gs) from Standby Auxiliary Feedwater (SAFW) powered by the new SAFW Diesel Generator (D/G) and taking suction from the new Condensate Storage Tank (CST) prior to reaching 5 ft in the existing CSTs.	Reference 10 and updated with this submittal as provided below
5. Develop and implement a FLEX method / procedure to refill the new SAFW CST prior to losing suction.	Reference 11
6. Develop and implement a program and/or procedure to keep FLEX equipment deployment pathways clear or with identified actions to clear the pathways.	Reference 11 and updated with this submittal as provided below
7. Determine schedule for when NSRCs will be fully operational.	Reference 7
8. Define criteria for the local NSRC staging area by June 2013.	Reference 8
9. Establish a suitable local staging area for portable FLEX equipment to be delivered from the NSRC to the site.	Reference 9
10. Develop site specific playbook for delivery of portable FLEX equipment from the NSRC to the site.	Reference 11
11. Perform an analysis to determine the diesel driven portable high pressure pump upper and lower head requirements to provide for a minimum of 215 gpm to a S/G without causing Reactor Coolant System (RCS) pressure to decrease to the point where nitrogen will be injected from the SI Accumulators, assuming suction is directly from the Ultimate Heat Sink (UHS).	Reference 9 and updated with this submittal as provided below
12. Develop and implement procedures to close Safety Injection (SI) Accumulator injection valves or vent the SI Accumulators prior to nitrogen injection into the RCS.	Reference 11
13. Perform an analysis to determine the time to restore feed to a S/G if only one S/G was able to be supplied with	Reference 8

feedwater after a trip and then feed is lost to that one S/G. This is to account for the reduction in water available for heat removal.	
14. Implement the design change to install the 1 MW SAFW D/G, 160,000 gallon Condensate Storage Tank (CST), and enclosure meeting the reasonable protection requirements of NEI 12-06.	Reference 7 and updated with this submittal as provided below
15. Develop and implement procedures to feed S/Gs using a SAFW Pump powered by the new SAFW D/G and taking suction on the new 160,000 CST. Revise procedures to direct Operators to manually establish makeup to the S/Gs via this flow path if the Turbine Driven Auxiliary Feedwater (TDAFW) Pump fails to deliver water to the S/Gs.	Reference 10
16. Implement a design change to protect a S/G Atmospheric Relief Valve (ARV) from Tornado Missiles to address reactor core cooling and heat removal using a high capacity portable diesel driven pump.	Reference 10 and updated with this submittal as provided below
17. Perform an analysis to demonstrate adequate manpower, communications capability, and habitability for local operation of the S/G ARVs. If this cannot be demonstrated, implement a design change to provide for ARV control from the Control Room for seismic and tornado missile events.	Reference 11
18. Develop and implement procedures/administrative controls to ensure that the new CST maintains a minimum usable volume at all times.	Reference 10
19. Perform an analysis or implement a design change to qualify S/G Pressure instrumentation for a Tornado Missile event.	Reference 11
20. Identify instrumentation and develop procedures to take field readings of necessary parameters, including (Pressure Indicator) PI-430 and (Level Indicator) LI-427.	Reference 10
21. Implement a strategy to connect a portable air compressor at a location/ configuration to support ARV operation.	Reference 10
22. Develop and implement procedures to refill the new CST from an alternate water source prior depleting the usable volume (approximately 15 hours after the event).	References 8 and 11
23. Implement a design change as part of the installation of the new CST to install a mechanical connection that will allow the tank to be refilled from a portable diesel driven pump.	Reference 10
24. Perform an analysis to establish plant conditions in Phase 2 that will allow diesel driven high capacity portable pump to be utilized as soon as plant resources are available to provide defense in depth for maintaining an adequate heat sink should SAFW fail.	Reference 8 and updated with this submittal as provided below

25. Implement a design change to install a new isolation valve upstream of the FLEX connection to S/G B in case a tornado missile impacts a section of unprotected piping between the SAFW Building and the connection point.	Reference 11
26. Implement a strategy to provide a sustainable source of nitrogen and/or air to the Power Operated Relief Valves (PORVs) to protect RCS Integrity during a BDBEE while in Mode 4 or Mode 5, loops filled.	References 8 and 11
27. Develop and implement procedures to provide guidance for water solid S/G cooldown using FLEX equipment.	Reference 11
28. Ensure NSRC can supply D/Gs capable of powering vital bus loads.	Reference 8
29. Implement a strategy to provide connections to 480 Volt vital busses to be able to connect to NSRC supplied D/Gs.	Reference 10 and updated with this submittal as provided below
30. Ensure NSRC can supply a water processing unit.	Reference 9
31. Implement a design change to install low leakage Reactor Coolant Pump (RCP) seals. The new seals need to be able to withstand T_{hot} for an extended period of time.	Reference 8
32. Perform an analysis to validate that a FLEX Boric Acid Storage Tank (FBAST) with a boron concentration of at least 2750 parts per million (ppm) and no more than 3050 ppm, and containing a minimum usable volume of 7000 gallons, is sufficient to maintain the reactor subcritical at Beginning of Life (BOL) or End of Life (EOL) conditions with T_{ave} at or near no-load T_{ave}, and at EOL conditions with a cooldown to 350°F. (Analysis must be bounding for current and future cycles.)	Reference 8
33. Implement a design change to connect a new pre-staged high pressure charging pump and FLEX diesel driven portable charging pump to the RWST.	References 9 and 11
34. Implement a strategy to batch mix boron in the FBAST.	Reference 9
35. Implement a design change to install a pump capable of pumping 75 gallons per minute (gpm) of borated water from the RWST into the RCS at 1500 pounds per square inch (psi), with discharge piping connected to the Safety Injection System.	References 10 and 11
36. Develop and implement procedures to initiate RCS boration prior to commencing RCS cooldown to provide margin to prevent re-criticality.	Reference 11
37. Implement a design change to connect a portable diesel engine driven high pressure pump to the RWST and the Safety Injection System, which is capable of pumping 75 gpm of borated water from the RWST to the RCS at 1500 psi.	References 10 and 11
38. Ensure the NSRC can supply a mobile boration unit.	References 9 and 11
39. Perform an analysis to determine minimum RCS makeup flow sufficient for simultaneous core heat removal and	Reference 8 and updated with this submittal as

boron flushing for Mode 5, loops not filled and pressurizer manway not removed.	provided below
40. Perform an analysis to determine the transition point from gravity fill of the refueling cavity to when forced makeup is required.	Reference 11
41. For Mode 5, Loops Not Filled, and Pressurizer Manway Not Removed, RCS Heat Removal will be by RCS Bleed and Feed. Items under consideration are: • Establish RCS feed path using low pressure pump capable of [To Be Determined] gpm at > 50 psig and a maximum discharge pressure of 410 psig to the RCS. • Establish sufficient RCS bleed path (PORVs, Reactor Head Vents) • Implement a strategy to provide a connection point for Instrument Air to Containment (OI 47) • Establish feed to available S/Gs Partial strategy for consideration - Fill available S/Gs to provide limited heat sink function and additional time before boiling of the coolant occurs. Existing procedural guidance for Water Solid S/G Cooldown provides guidance that can be modified for use with a high flow portable diesel driven pump to maintain the limited heat sink function. • If Water Solid S/G Cooldown is effective to maintain core cooling and heat removal, secure RCS Bleed and Feed and maintain Pressurizer Level.	Reference 8 and updated with this submittal as provided below
42. Perform an analysis to determine RCS vent path requirements for Mode 5 with PORV vent path.	Reference 8 and updated with this submittal as provided below
43. Develop and implement procedures to makeup to the refueling cavity from the new CST, UHS, or RWST to maintain refueling cavity level and boron concentration.	References 9 and 11
44. Perform a boron mixing analysis for the effects on RCS boron concentration by providing unborated water to the refueling cavity via the transfer canal from the Auxiliary Building to Containment.	Reference 8
45. Evaluate the viability of feed and bleed for available S/Gs to provide a limited heat sink function and additional time before boiling of the coolant occurs as a parallel mitigating strategy during Modes 5 & 6. This analysis must address reflux condensation and its potential effects on reactor shutdown margin.	Reference 8 and updated with this submittal as provided below
46. Implement a design change to establish provisions for refilling the FBAST with borated water.	Reference 9
47. Implement a strategy to provide a connection point for Instrument Air to Containment.	Reference 8 and updated with this submittal as provided below

48. Perform an evaluation to determine a method for recirculation cooling of the RCS if the Auxiliary Building Sub-basement is flooded by Tornado Missiles damaging non-protected tanks on the Auxiliary Building Operating Floor.	Reference 8 and updated with this submittal as provided below
49. Perform an analysis to determine the containment pressure profile during an ELAP / Loss of Ultimate Heat Sink (LUHS) event and determine the mitigating strategies necessary to ensure the instrumentation and controls in containment which are relied upon by the Operators are sufficient to perform their intended function.	Reference 8 and updated with this submittal as provided below
50. Perform an analysis of the containment function to determine the mitigating strategy acceptance criteria for an ELAP / LUHS event.	Reference 9 and updated with this submittal as provided below
51. Implement a strategy to determine containment pressure after a Tornado Missile event.	References 7 and 10
52. Develop the Phase 3 strategy after the containment pressure analysis is completed as described in Maintain Containment, PWR Portable Equipment Phase 2.	Reference 10 and updated with this submittal as provided below
53. Ensure the NSRC will provide additional portable pumps and equipment to spray water into containment or supply water to the Containment Recirculation Fans / Coolers.	Reference 9
54. Implement a strategy to provide for a protected makeup connection to the Spent Fuel Pool (SFP) cooling piping to provide makeup to the SFP that exceeds SFP boil-off and provide a means to supply SFP makeup without accessing the SFP walkway.	References 8 and 11
55. Provide the necessary connecting hoses and/or equipment to work with existing pumps and water sources for filling the SFP.	Reference 11
56. Implement new FSG-11, Alternate SFP Makeup and Cooling, to provide multiple strategies for establishing a diverse means of SFP makeup and cooling for at least 72 hours.	References 9 and 11
57. Perform an analysis to determine if a vent pathway from the SFP is needed for steam and condensate to minimize the potential for steam to cause access and equipment problems in the Auxiliary Building. (also see OI 62)	Reference 10
58. SFP Water Level instrument numbers will be provided upon detailed design completion.	Reference 8
59. Ensure the NSRC will provide additional portable pumps and equipment to: • provide water from the UHS to the Standby SFP Heat Exchanger to remove heat from the SFP cooling system with the Standby SFP Recirculation Pump; or • provide water to SFP Heat Exchanger A to remove heat from the SFP Cooling System with the Standby SFP Recirculation Pump or SFP Pump A.	Reference 9

60. Implement a strategy to supply the battery chargers from the 1 MW D/G using existing plant equipment connection points.	References 9 and 11
61. Implement a strategy to supply the battery chargers from a 100 kW D/G using existing plant equipment connection points.	References 9 and 11
62. Perform GOTHIC calculations consistent with NUMARC 87-00, *Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors*, to determine the effects of a loss of HVAC during an ELAP for the following areas: • Intermediate Building, TDAFW Pump and ARV/ (Safety Valve (SV) areas • Auxiliary Building, Refueling Water Storage Tank (RWST) area • Battery Rooms, Relay Room, and Control Room • Standby Auxiliary Feedwater Building	Reference 11
63. Perform an analysis to evaluate the Battery Room low temperature for an ELAP event, assuming -16°F air temperature to determine if, and when, Battery Room heating is required.	Reference 11
64. Implement a strategy for accessing the UHS for all BDBEEs and to meet required deployment times. This must also address how debris in the UHS or other raw water sources will be filtered / strained and how the resulting debris will effect core cooling.	References 8 and 11
65. Implement a strategy to provide for transferring diesel fuel from the D/G A and D/G B Fuel Oil Storage Tanks (FOSTs) to a fuel transfer vehicle.	Reference 8 and updated with this submittal as provided below
66. Perform an analysis to provide a basis that the Offsite D/G FOSTs are reasonably protected from BDBEEs.	Reference 9 and updated with this submittal as provided below
67. Develop the strategy to transfer fuel from protected fuel storage locations to FLEX equipment.	Reference 9 and updated with this submittal as provided below
68. Develop strategies to provide for emergency lighting to support Operator actions after a BDBEE.	Reference 8 and updated with this submittal as provided below
69. Develop a strategy to protect onsite consumables for use after a BDBEE.	Reference 10
70. Develop and implement procedures to establish battery room ventilation within 72 hours of the event to prevent exceeding the unacceptable hydrogen concentration limit of 2%, once the GOTHIC analysis has been completed as discussed in Phase 2.	Reference 11
71. Table 3 lists Phase 3 Response Equipment / Commodities that are being considered for pre-staging at an offsite location. These include:	Reference 8

• Radiation Protection Equipment • Commodities – Food, Potable Water • Diesel Fuel • Heavy Equipment – Transportation, Debris Removal • Boric Acid • Portable Lighting • Portable Toilets	
72. Install wide range SFP level instrumentation in accordance with NRC Order EA-12-051.	Reference 10
73. Implement a strategy to provide cooling water to the RHR Heat Exchangers using a portable diesel driven pump.	Reference 7 and updated with this submittal as provided below
74. Any additional non-safety equipment will be identified and evaluated for suitability in the mitigation strategies.	Reference 8 and updated with this submittal as provided below

Interim Staff Evaluation Open Items

None	

Interim Staff Evaluation Confirmatory Items

Item No. 3.1.1.A	Reference 11
Item No. 3.1.1.1.A	Reference 11
Item No. 3.1.1.3.A	Reference 11
Item No. 3.1.4.2.A	Reference 11
Item No. 3.2.1.A	Reference 11
Item No. 3.2.1.B	Reference 10 and updated with this submittal as provided below
Item No. 3.2.1.1.A	Reference 11
Item No. 3.2.1.2.A	Reference 11
Item No. 3.2.1.2.B	Reference 9 and updated with this submittal as provided below
Item No. 3.2.1.8.A	Reference 11
Item No. 3.2.1.9.A	Reference 9 and updated with this submittal as provided below
Item No. 3.2.3.A	Reference 11
Item No. 3.2.4.2.A	Reference 11
Item No. 3.2.4.4.A	Reference 11
Item No. 3.2.4.4.B	Reference 11
Item No. 3.2.4.5.A	Reference 11
Item No. 3.2.4.8.A	Reference 11 and updated with this submittal as provided below
Item No. 3.3.1.A	Reference 9 and updated with this submittal as provided below

NRC Audit Report Open Items

Audit Open Item	Completion Response Reference
AQ 1-B	Reference 11
SE 1-E	Reference 11 and updated with this submittal as provided below
SE 7-E	Reference 11 and updated with this submittal as provided below
SE 11-E	Reference 11 and updated with this submittal as provided below
SE 12-E	Reference 11 and updated with this submittal as provided below
SE 13-E	Reference 11 and updated with this submittal as provided below
SE 14-E	Reference 11 and updated with this submittal as provided below
SE 16-E	Reference 11
SE 17-E	Reference 11 and updated with this submittal as provided below
SE 18-E	Reference 11

The following table documents completion of the final remaining open items. As previously stated, EGC provides the response for the following items and considers them to be complete for R. E. Ginna Nuclear Power Plant.

Item	Description	Reference
OIP Open Item 1 *Implement a design change to install permanent protected FLEX equipment connection points.*	FLEX equipment connection points have been installed to provide the ability to add water to the S/Gs, the RCS, or the SFP: • Within the SAFW Building Annex, which is a fully protected building, two hose connections have been installed in the new DI Water Storage Tank (TCD05) discharge and return piping. These hose connections, at valves 9764 and 9782 (P&ID 33013-1238) provide the ability to re-fill or draw from TCD05; and, along with hose connections at valve 9786, to feed directly to the suction of the SAFW pumps, by use of the diesel driven FLEX pump drafting off of Lake Ontario. • In the basement of the Auxiliary	Complete

	Building, a hose connection is provided in the SFP Recirculation Pump suction piping. This hose connection, at valve 8662 (P&ID 33013-1248) provides the ability for the diesel driven FLEX pump, drafting off of Lake Ontario, to replenish the SFP water loss, due to boil off. • A hose connection at valve 9757 (P&ID 33013-1238) in the SAFW pump discharge cross-tie piping allows for the diesel driven FLEX pump to feed directly to both S/Gs. • An Alternate RCS Injection System has been designed as a permanently mounted, hard-piped system of FLEX equipment that is housed in protected buildings and spaces. It allows for providing borated water from the RWST to the RCS, via the Safety Injection headers. A trailer-mounted diesel driven Alternate RCS Injection FLEX pump is provided as a redundant pump to the permanently mounted pump. Hose connections at valves 9056 and 9072 (P&ID 33013-1230) provide the ability to connect the trailer mounted pump to the hard-piped Alternate RCS Injection System. • In addition to the new Alternate RCS Injection system to inject borated water from the RWST through the SI Headers into the RCS (with portable diesel driven backup), an alternate means of providing RCS injection through an alternate injection point is available. This alternate means of injecting borated water into the RCS involves repowering a Charging Pump from the SAFW D/G utilizing temporary power cables and manually lining up to inject from the RWST to the RCS through AOV-392A (Charging Valve Regenerative Heat Exchanger to Loop B Hot Leg), which opens at a 250 psig differential pressure to allow flow to the RCS.	

OIP Open Item 2 Provide for onsite storage of Phase 2 FLEX components that is protected against external events by design or location. Implement a design change to provide a protected storage location for transportation (equipment and fuel) and debris removal equipment. Evaluate deployment strategies and deployment routes for hazards impact. Evaluate requirements and options and develop strategies related to the storage onsite of the FLEX portable equipment. Establish deployment routes from FLEX equipment storage locations to connection points. Develop a strategy and purchase equipment to respond to events that may require debris removal such as following a flood, tornado, or snow storm. Develop a strategy to move FLEX equipment, including providing reasonable protection from a BDBEE.	The following are the functions for which Ginna has provided FLEX equipment, together with a description of their protection against external events: 1. Provide Auxiliary Feedwater to the steam generators. - The "N" means employs permanently installed SAFW pumps, taking suction from a robust 160,000 gallon DI Water Storage Tank, powered by a permanently installed 1 MW SAFW D/G. The D/G, switchgear, and pumps/ piping are all located within robust structures. FLEX "N+1" equipment can provide the water to the S/Gs following S/G depressurization, either from the 160,000 gallon tank DI Water Storage Tank, or directly from Lake Ontario. The FLEX pump and hoses are stored in a commercial ASCE 7-10 building. 2. Isolate Safety Injection Accumulators. - The "N" function is performed by repowering a cubicle in MCC "C" and one in MCC "D" from the SAFW D/G, then closing the isolation valves. In the event a tornado damages MCC "C", an air compressor is connected to an instrument air line, allowing the accumulator to be vented. All necessary cables, connectors, hoses, and the air compressor are stored in robust locations. Comparable equipment is used for the "N+1" strategy, substituting the 100 kW D/G for the SAFW D/G. This 100 kW D/G, as well as necessary hoses, cables, and connections are stored in the commercial ASCE 7-10 building. 3. Repower the battery chargers. - This "N" function is performed by repowering a cubicle in MCC "C" and one in MCC "D" from the SAFW D/G. In the event a tornado damaged MCC "C", the SAFW D/G would be connected directly to affected battery charger. All cables and connection required for these functions are stored	Complete

	in robust locations. The "N+1" strategy is comparable, substituting the 100 kW D/G for the SAFW D/G. The 100 kW D/G, as well as the necessary cables and connections are stored in the commercial ASCE 7-10 building. 4. Primary Inventory/Reactivity Control. - The "N" function is performed by powering the installed Alternate RCS Injection pump, taking suction from the robust RWST, and injecting into the SI lines. A booster pump can be installed, and powered from the 1 MW D/G or the 100 kW portable diesel generator, to allow full use of the RWST contents. All pumps, piping, diesel generator, hoses, cables, and connectors are stored in a robust structure. There are two means of providing the "N+1" function. A portable diesel driven Alternate RCS Injection pump can be connected in parallel with the electric Alternate RCS Injection pump. Also, a diverse means of providing RCS inventory/reactivity control is by powering an installed charging pump from the SAFW D/G. The portable Alternate RCS Injection pump, as well as all necessary hoses, cabling, and connections are stored in the commercial ASCE 7-10 building. 5. Spent Fuel Pool Cooling/ inventory Control. - The "N" function is provided by employing a portable FLEX diesel driven pump taking suction from the discharge canal and filling directly to the SFP. This pump can provide flow to refill the 160,000 gallon DI Water Storage Tank, as well as the SFP, using a manifold. The FLEX pump and manifold are stored in a robust structure. The hoses are stored in hose trailers, separated from each other by the width of a site-specific tornado (1040 feet), accounting for the prevailing tornado direction for the	

	region. The "N+1" function is provided by another diesel driven FLEX pump taking suction from the discharge canal. This pump can also provide flow directly to the S/Gs following depressurization, concurrently with refilling of the SFP. Another connection point to the SFP is via valve 8662. The pump is a redundant counterpart to the one employed for the "N" strategy and is stored with another manifold in the commercial ASCE 7-10 building. 6. Mode 5 Containment Venting. - The "N" function is performed by opening installed valve 7444. If valve 7444 is not available due to a flooding event, the air compressor is used to open the containment purge valve. The compressor, fittings, hoses, and tools are stored in a robust structure. The "N+1" strategy can be the same as the "N" strategy, using a redundant air compressor. The air compressor and necessary fittings, hoses and tools are stored in the commercial ASCE 7-10 building. An alternative strategy is to open the containment personnel and equipment airlock outer doors, and open the equalizing valves. 7. Dewatering Auxiliary Building Sub-basement (Steam Generators unavailable) for Mode 5 RHR. - In the event a tornado missile damages susceptible tanks on the Auxiliary building operating floor, flooding the RHR and Reactor Coolant Drain Tank (RCDT) area, the area must be dewatered prior to reinitiating forced RCS flow. The "N" strategy deploys a submersible sump pump, powered from the SAFW D/G, to remove the water from the sub-basement. This water is pumped outside the Auxiliary Building. The sump pump, DG, hoses, cables, and connectors are all stored in robust locations. The "N+1" strategy is	

	comparable, substituting the 100 kW D/G for the SAFW D/G. The necessary diesel, pump, hoses, cables, and connectors are stored in the commercial ASCE 7-10 building. 8. Mode 5 Residual Heat Removal. - Following dewatering of the sub-basement, forced flow RCS recirculation cooling can be attained. The "N" strategy is to provide power to the installed RCDT Pump "B" from the SAFW D/G (the RCDT pumps can operate after being submerged). All cables, connectors, and junction boxes are stored in a robust structure. The "N+1" strategy provides for the "A" RCDT pump to be powered for the 100 kW D/G. The 100 kW D/G as well as all necessary connectors, cables, and junction boxes are stored in the commercial ASCE 7-10 building. 9. Heat Sink for Mode 5 RHR. - A means to remove the heat being circulated by the RCDT pumps is necessary. The "N" strategy is to align a diesel driven FLEX pump from the discharge canal to valve 760A, B bonnet-to-hose adapters. This flow would cool the RCDT flow. The water circulating from the FLEX pump would be discharged via hose to outside the Auxiliary Building. The FLEX pump and all hoses, fittings, connections, and flanges are located in robust structures. The "N+1" strategy is comparable except that the redundant FLEX pump, as well as the necessary hose, fittings, connectors, and flanges are stored in the commercial ASCE 7-10 building. 10. Communication. - There is a permanently installed satellite dish to provide satellite communication between the station and the EOF as well as the state and county officials. In the event a BDBEE damaged the permanent satellite dish, a portable dish is	

	provided. The portable dish, trailer, UPS system, cabling, and portable diesel generator are stored in a robust structure. A repeater system is installed to facilitate radio communication onsite during an event. In the event the permanently installed system would be damaged by a BDBEE, a redundant repeater would be deployed. The repeater, antenna, tripod, and cable are all installed in a robust structure. 11. Refueling. - Redundant sources of diesel fuel are available for refueling the SAFW D/G, 100 kW D/G, the diesel driven FLEX pumps, the diesel driven portable Alternate RCS Injection pump, and the smaller diesel generators. Two fuel trailers, each with 990 gallons of ultra-low sulfur fuel, are stationed at the site. They are stored so as to be separated by the width of the site-specific tornado (1040 feet), accounting for the prevailing tornado direction for the region. Each fuel trailer has the necessary fuel transfer equipment. Once deployed, the trailers can be refilled from the onsite fuel oil storage tanks. 12. Debris Removal/ Equipment Transportation. - The site has a Case 621 pay loader, as well as a Ford F-350 pickup truck with a snow plow, to remove debris caused by a BDBEE. Each vehicle is also equipped with equipment to check for live wires in downed power lines. Each vehicle is also equipped with a pintle hitch, which can be used to transport mitigation equipment, such as the 100 kW D/G, the portable satellite trailer, the FLEX pumps, the fuel trailers, the hose trailers, and the air compressors to their deployment points. Primary and alternate deployment routes for Phase 2 portable FLEX equipment are	

	identified in GN-WP-01, BDBEE Debris Removal for Ginna Station. Ginna Station has designated a Case 621F Pay loader and a Ford F350 4-wheel drive (equipped with a snow plow) as the debris removal/ transport equipment. The Case 621F Pay loader is stored outside to the south (near the White Barn), outside of the Protected Area. The Ford F350 4-wheel drive is stored inside the L-Building, inside of the Protected Area. These specific locations provide over 1040 ft. of separation to satisfy the tornado "diverse locations" storage requirements for FLEX equipment per NEI 12-06. The bounding case is to use the Case 621F Loader to provide debris removal capabilities in the event of a tornado event that passes through the Protect Area. Based on NEI 12-06 guidance regarding acceptable separation distance and tornado travel path, it is assumed that the Ford F350 located on site is unavailable because it is not stored within a tornado missile hardened structure. It is also assumed that if a tornado event was to impact the Case Loader, it would not directly impact the F350 stored in the L-Building. A tornado event is judged bounding for debris removal efforts for other beyond design basis events, including snow, high winds, and floods. In the event of site impacting tornado event, the Case 621F Loader would be required to travel approximately 1/2 of a mile of public roadway and approximately 1/2 of a mile of station access roadways to reach the on-site storage locations for the FLEX mitigation equipment. From the furthest point of stored location for FLEX equipment, it is also approximately 3/4 of a mile to the final point of use, dependent on availability of the primary and alternate routes. Engineering walk downs of the Case 621F loader deployment path have identified a number of potential debris sources. When loader is deployed from the White Barn area, the equipment operator may encounter downed power lines. The operator shall find any alternate path around the downed lines. If no	

	alternate path exists, the operator shall obtain shift manager or Site Emergency Director Authorization to check lines with an available proximity device, verify safe, and drive over or cut lines as required. As the loader proceeds west on Lake road, the operator encounters approximately 1/4 mile section of a moderately wooded area, with mixed species of hard and soft woods, averaging less than 12" diameter at the trunk. The Case Loader has a lifting capacity of 18,684 lbs., and is equipped with a grapple bucket, providing the capability to capture the entire tree to the bucket, lifting it, and relocating if required. The Case 621F loader is capable of simultaneously pushing multiple trees of average size to the side of the road. In the lowest gearing and at maximum torque operating range, the loader will be operating at approximately 3 mph. With a conservative assumption of 15 reversing and clearing debris cycles of 1 minute each (15 Minutes), travel through the 1/4 mile of the moderately wooded area at 3 mph (5 Minutes), it is calculated that the Case 621F loader will clear the maximum expected debris through the most challenging section of the off-site deployment path in 30 minutes, including addressing downed power lines (10 Minutes). The remainder of the deployment path to the Protected Area is less than 1 ½ miles and will have minimal debris, based on surrounding landscape, terrain and structures. The loader has a maximum road speed travel of 24 mph, but for this assessment only 6 mph travel speed will be considered. Assuming an average of 6 mph travel speed the loader is travel the remaining 1 ½ miles to the Protected Area in 15 minutes. With additional conservative assumption of 10 reverse and clear debris cycles of 1 minute each (10 Minutes) and addressing additional downed power lines (10 Minutes), it is expected that the Case 621F loader will require an additional 35 minutes to arrive at	

	the Protected Area. Once the loader has entered the PA, an additional ¾ of a mile of travel path must be cleared for either the primary or alternate routes from equipment storage locations. The two protected storage locations are the hardened sea vans west of engineering building annex (Project Building) and the SAFW Annex. Based on engineering studies of tornado damages and debris field at industrial sites, it is not expected that building structures or on-site materials or equipment would provide significant debris removal challenges for the Case 621F loader or Ford 350. The 150' tall high mast lighting towers are assumed to fail under a beyond design basis event. Given available deployment routes, it is possible that high mast lights may be within the debris field but it is reasonable to expect that poles will not be blocking the alternate path. Given the width of travel routes available it is expected that the debris equipment will be able to bypass high mast lights. Therefore, assuming an average of 6 mph travel speed the loader can travel the remaining 1 ½ miles inside the Protected Area in 15 minutes (Primary and Alternate route combined). With a conservative assumption of 10 reverse and clear debris cycles of 1 minute each (10 Minutes) and addressing any additional on-site downed power lines (10 Minutes), it is expected that the Case 621F loader will require an additional 35 minutes travel time. In conclusion, it has been established that all potential and credible debris along the travel path from the most distant and diversely located debris removal equipment can be cleared in 100 minutes for a worst case scenario for debris removal effort. To add further conservatism to timeline studies, the debris removal time will be rounded up to 2 hours.	
	ECA-0.0, Loss of All AC Power, Step 11 RNO states: IF the TDAFW pump is feeding S/Gs, THEN monitor CST level. WHEN CST	<u>Complete</u>

OIP Open Item 4 Develop and implement procedures to commence feeding the steam generators (S/Gs) from Standby Auxiliary Feedwater (SAFW) powered by the new SAFW Diesel Generator (D/G) and taking suction from the new Condensate Storage Tank (CST) prior to reaching 5 ft in the existing CSTs.	level lowers to 5 feet, THEN initiate SAFW feed to the S/Gs, refer to ATT-5.5, Attachment SAFW with Suction from DI Water Storage Tank during SBO. ECA-0.0 Step 22b (continuous action step) directs the operators to Monitor CST Level - GREATER THAN 5 FEET. The RNO column states: Dispatch EO to initiate SAFW using the SAFW or NFPA D/G, refer to ATT-5.5, Attachment SAFW with Suction from DI Water Storage Tank during SBO.	
OIP Open Item 6 Develop and implement a program and/or procedure to keep FLEX equipment deployment pathways clear or with identified actions to clear the pathways.	CC-GI-118, Ginna Implementation of Diverse and Flexible Coping Strategies (FLEX) and Spent Fuel Pool Instrumentation Program, specifies the deployment path maintenance and availability requirements. When two or more deployment path options are available, temporarily blocking one path to support plant operations is acceptable. Compensatory actions will be in place for durations longer than 5 business days. A-52.12, Nonfunctional Equipment Important to Safety, will track the deployment paths blocked time. When only one deployment path is available, temporarily blocking this path to support plant operations is acceptable. Compensatory actions SHALL be in place for any duration beyond a single shift. O-6.1, Equipment Operator Rounds, directs checking FLEX deployment paths are clear each round. OPG-IWS-SUPPORT, Operations Support of the Integrated Work Schedule, directs SRO review of scheduled work to determine if it will involve blocking FLEX deployment paths.	<u>Complete</u>
OIP Open Item 11 Perform an analysis to determine the diesel driven portable high pressure pump	Calculation 617.1, R. E. Ginna FSG Setpoints, Setpoint H.17 determined that the minimum pressure which prevents injection of accumulator nitrogen into the RCS for ELAP conditions, plus allowances for normal channel accuracy, was 290 psig. ECA-0.0, Loss of All AC Power, Appendix A directs	<u>Complete</u>

upper and lower head requirements to provide for a minimum of 215 gpm to a S/G without causing Reactor Coolant System (RCS) pressure to decrease to the point where nitrogen will be injected from the SI Accumulators, assuming suction is directly from the Ultimate Heat Sink (UHS).	operators to depressurize selected S/G(s) to 290 psig when establishing low pressure S/G feed and then refer to FSG-10, Passive RCS Injection Isolation, to isolate or vent the SI Accumulators to prevent nitrogen injection into the RCS. DA-ME-15-005, FLEX RHR/CCW/SW Hydraulic Model, predicts FLEX SAFW pump performance feeding S/Gs while drafting from the lake. The analysis predicts that the pump is capable of delivering 232 gpm split to both generators (116 each) if the S/Gs are at 305 psia. 305 psia was chosen as a reasonable S/G target pressure after approximately 6 hours of effective SAFW flow per the Mode 1 RELAP analysis RWA-1323-003, Ginna RELAP5 ELAP Analysis for Mode 1.	
OIP Open Item 14 Implement the design change to install the 1 MW SAFW D/G, 160,000 gallon Condensate Storage Tank (CST), and enclosure meeting the reasonable protection requirements of NEI 12-06.	A 1 MW SAFW D/G and a 160,000 gallon (nominal) DI Water Storage Tank have been installed on a 3' thick concrete foundation with caissons to bedrock. The diesel generator is mounted on the foundation and housed within the SAFW Bldg. Annex. The DI Water Storage Tank is mounted on the foundation with all piping to and from the tank enclosed in a steel plate structure. All structures on the foundation are designed to withstand seismic and tornado wind loads and tornado missile impact. The SAFW Building Annex is also capable of withstanding a flood, as all wall penetrations are either above the design flood level or are flood-protected. Therefore, the 1 MW SAFW D/G and a 160,000 gallon (nominal) DI Water Storage Tank meet the reasonable protection requirements of NEI 12-06. (References: ECP-11-000104-015-7-01, Revision 2, Design Change Technical Evaluation for Diesel Driven Standby Aux Feedwater Project - De-Ionized Water Tank Installation; ECP-11-000104-015-7B-01, Revision 2, Design Change Technical Evaluation for Diesel Driven Standby Aux Feedwater Project – De-Ionized Water Tank Criteria; ECP-13-00421, DDSAFW Project Standby Auxiliary Feedwater Building Annex; GNP011-C-2, Standby Auxiliary Feedwater	<u>Complete</u>

	Annex Design)	
OIP Open Item 16 Implement a design change to protect a S/G Atmospheric Relief Valve (ARV) from Tornado Missiles to address reactor core cooling and heat removal using a high capacity portable diesel driven pump.	ECP-14-000727, Hardened Masonry Walls Surrounding Cable Tunnel Entrance to Protect Vital Instrumentation Following a Seismic Event or Tornado, reinforced/protected the IB walls from a Tornado/Missile event thereby protecting both S/G ARVs from Tornado Missiles to allow for a symmetric cooldown.	Complete
OIP Open Item 24 Perform an analysis to establish plant conditions in Phase 1 that will allow diesel driven high capacity portable pump to be utilized as soon as plant resources are available to provide defense in depth for maintaining an adequate heat sink should SAFW fail.	DA-ME-15-005, FLEX RHR/CCW/SW Hydraulic Model, predicts FLEX SAFW pump performance feeding S/Gs while drafting from the lake. The analysis predicts that the pump is capable of delivering 232 gpm split to both generators (116 each) if the S/Gs are at 305 psia. 305 psia was chosen as a reasonable S/G target pressure after approximately 6 hours of effective SAFW flow per the Mode 1 RELAP analysis RWA-1323-003, Ginna RELAP5 ELAP Analysis for Mode 1.	Complete
OIP Open Item 29 Implement a strategy to provide connections to 480 Volt vital busses to be able to connect to NSRC supplied D/Gs.	A connection point for the NSRC 4160V FLEX D/G is described in FSG-5, Initial Assessment and FLEX Equipment Staging (Attachment I, Establishing Long Term Core Cooling), and FSG-12, Alternate CNMT Cooling (Attachment C, Align Temporary Electrical Power Supply to CNMT Fan Coolers), which provide directions for connecting the NSRC 4160V FLEX D/G to Bus 16 Station Service Transformer Cubicle rear panel bus bars, including a figure of the bus bar arrangement.	Complete
OIP Open Item 39 Perform an analysis to determine minimum RCS makeup flow sufficient for simultaneous core heat removal and boron flushing for Mode 5, loops not filled and pressurizer manway not removed.	RWA-1323-004, Ginna RELAP5 ELAP Analysis for Mode 5 predicts RCS conditions for Mode 5 ELAP events. The analysis evaluated cases with small PORV vents and also cases with the pressurizer manway removed. DA-ME-15-011, FLEX Mode 5 RHR Strategy, evaluates Mode 5 decay heat strategies for an ELAP event. Without some RHR system decay heat removal, makeup rate requirements during the first 15 hours are expected to be less than 140 GPM to	Complete

	maintain RCS approximately 30" above the hot leg. Without some RHR system decay heat removal, makeup rate requirements after 15 hours are expected to be less than 110 GPM. These makeup rates are significantly more than that required to just remove decay heat (the makeup rate is more than twice the boil off rate during the first 15 hours per RWA-1323-004). The greater makeup rate was due to moisture carryover through the large manway opening predicted to occur in the RELAP model of RWA-1323-004. Boron precipitation was determined to not be a concern in RWA-1323-004.	
OIP Open Item 41 For Mode 5, Loops Not Filled, and Pressurizer Manway Not Removed, RCS Heat Removal will be by RCS Bleed and Feed. Items under consideration are: • Establish RCS feed path using low pressure pump capable of [To Be Determined] gpm at > 50 psig and a maximum discharge pressure of 410 psig to the RCS. • Establish sufficient RCS bleed path (PORVs, Reactor Head Vents) • Implement a strategy to provide a connection point for Instrument Air to Containment (OI 47) • Establish feed to available S/Gs Partial strategy for consideration - Fill available S/Gs to provide limited heat sink function and additional time before boiling of the coolant occurs. Existing procedural guidance for Water Solid S/G Cooldown provides guidance that can be modified for use with a high flow portable diesel driven pump to maintain the	Mode 5 RELAP model RWA-1323-004, Ginna RELAP5 ELAP Analysis for Mode 5, demonstrates use of a PORV vent path. Alternate RCS Injection Pump installation under ECP-14-000169 provides adequate flow (75 gpm) and head to feed under these conditions. The strategy to provide a connection point for Instrument Air to Containment is addressed under OIP Open Item 47 below. However, Instrument Air is not needed for the Mode 5 strategy. A Diesel driven FLEX pump is capable of feeding S/G for conditions discussed under response to OIP Open Item 45 below. A partial core cooling and heat removal strategy that may be utilized is to fill available S/Gs to provide a limited heat sink function and additional time before boiling of the coolant occurs. RWA-1323-004 includes cases with S/Gs available that shows feed and bleed (steam) of available S/Gs provide a limited heat sink function and reduces the amount of boiling to containment. AP-ELEC.4, Loss of All AC Power while on Shutdown Cooling, and FSG-3, Alternate Low Pressure Feedwater, implement S/G cooling for this event. Procedure ER-FIRE.3, Alternate Shutdown for Aux Building Basement/Mezzanine Fire, Section 6.7, Water Solid S/G Cooldown, provides guidance that can be modified for	Complete

limited heat sink function. • If Water Solid S/G Cooldown is effective to maintain core cooling and heat removal, secure RCS Bleed and Feed and maintain Pressurizer Level.	use if additional S/G cooling is desired. Water solid cooldown requires both SAFW pumps and S/Gs to be available for cooldown. A high flow portable diesel driven pump can also be used in place of the SAFW pumps. R.E. Ginna Nuclear Power Plant Fire Protection Program Section 5.1.6.1, Water-Solid Steam Generator Operation, documents that water solid S/G operation can cool the RCS to less than 200°F in less than 72 hours.	
OIP Open Item 42 Perform an analysis to determine RCS vent path requirements for Mode 5 with PORV vent path.	RWA-1323-004, Ginna RELAP5 ELAP Analysis for Mode 5, was performed with small PORV vent size and also with pressurizer manway removed. RWA-1323-004 shows that the PORV vent path is adequate for a mitigation strategy. FSG-14, Shutdown RCS Makeup, provides actions to establish RCS makeup flowpaths during shutdown conditions.	<u>Complete</u>
OIP Open Item 45 Evaluate the viability of feed and bleed for available S/Gs to provide a limited heat sink function and additional time before boiling of the coolant occurs as a parallel mitigating strategy during Modes 5 & 6. This analysis must address reflux condensation and its potential effects on reactor shutdown margin.	RWA-1323-004, Ginna RELAP5 ELAP Analysis for Mode 5, includes cases with S/Gs available that shows feed and bleed (steam) of available S/Gs provide a limited heat sink function and reduces the amount of boiling to containment. AP-ELEC.4, Loss of All AC Power while on Shutdown Cooling, and FSG-3, Alternate Low Pressure Feedwater, implement S/G cooling for this event. While some reflux condensation can occur during this event, the required RCS makeup rates are significantly more than that required to just remove decay heat (the makeup rate is more than twice the boil off rate during the first 15 hours per RWA-1323-004) and do not impact shutdown margin. The greater makeup rate was due to moisture carryover through the large manway opening predicted to occur in the RELAP model of RWA-1323-004.	<u>Complete</u>
OIP Open Item 47 Implement a strategy to provide a connection point for Instrument Air to Containment.	The strategy is to provide a source of air to the Instrument Air piping in the Intermediate Building basement near valve 5392. The strategy involves disconnecting a union between valve 5392 and the containment penetration. A union/hose fitting adapter is	<u>Complete</u>

	then installed so that air can be fed from a portable air compressor to the Containment Instrument Air header. (DA-ME-15-013, FLEX Miscellaneous Calculations)	
OIP Open Item 48 Perform an evaluation to determine a method for recirculation cooling of the RCS if the Auxiliary Building Sub-basement is flooded by Tornado Missiles damaging non-protected tanks on the Auxiliary Building Operating Floor.	Ginna has developed an alternate RHR strategy that is described in DA-ME-15-006, Fukushima Timeline Analysis. Following a seismic or tornado missile event there is a possibility of flooding the Auxiliary Building Subbasement due to failure of non-qualified tanks and piping. A sump pump will be used to dewater the subbasement if this occurs. The sump pump is capable of dewatering the subbasement in less than 11 hours. The Alternate RHR strategy uses the Reactor Coolant Drain Tank Pumps (canned motor pumps), after pumping out the Auxiliary Building Subbasement, to circulate water from the RCS hot leg, through both RHR heat exchangers, and back to the RCS cold leg. A FLEX pump is used to circulate water from the lake to the CCW side of the RHR Heat Exchanger through hosing and a bonnet adapter on valve 760A. The lake water is discharged near Deer Creek through hoses connected to a bonnet adapter at valve 760B. The strategy is justified in DA-ME-15-005, FLEX RHR/CCW/SW Hydraulic Model, and DA-ME-15-011, FLEX Mode 5 RHR Strategy.	Complete
OIP Open Item 49 Perform an analysis to determine the containment pressure profile during an ELAP / Loss of Ultimate Heat Sink (LUHS) event and determine the mitigating strategies necessary to ensure the instrumentation and controls in containment which are relied upon by the Operators are sufficient to perform their intended function.	The Containment pressure profile during an ELAP / LUHS event was analyzed in RWA-1403-001, GOTHIC FLEX Containment Analysis. Instrumentation being credited is qualified for the predicted conditions given that the temperature profile (220°F peak) is well below the containment Design Basis EQ envelope (286°F peak). Per E-0, Reactor Trip or Safety Injection, adverse containment values are used for instruments whenever containment pressure is > 4 psig or radiation > 10E5 R/hr. The ELAP response procedures use instrument values for adverse containment when necessary. Some instruments, such as containment pressure and S/G pressure, are	Complete

	not in containment and do not need adverse values.	
OIP Open Item 50 Perform an analysis of the containment function to determine the mitigating strategy acceptance criteria for an ELAP / LUHS event.	The mitigating strategy acceptance criteria is to maintain Containment pressure below the design pressure of 60 psig and Containment temperature below the containment design temperature of 286°F (UFSAR Table 3.11-1). For Mode 1, the analysis shows that with no operator actions, containment pressure will slowly increase to less than 20 psig over 72 hours and containment temperature will slowly increase to 220°F over the same 72 hours. Since 20 psig is below containment design pressure of 60 psig (UFSAR Table 3.11-1) and 220°F is below the containment design temperature of 286°F (UFSAR Table 3.11-1), no mitigation actions are necessary to maintain or restore containment cooling during Phases 1 or 2. Mode 5 ELAP containment temperatures are predicted to plateau below 250°F if the containment is vented based on RWA-1403-001. Ginna Station's Mode 5 strategy plans include venting the Containment during Phase 2, RHR heat removal, and also establishment of lake flow to the CRFCs so that Containment can be isolated.	<u>Complete</u>
OIP Open Item 52 Develop the Phase 3 strategy after the containment pressure analysis is completed as described in Maintain Containment, PWR Portable Equipment Phase 2.	For Modes 1 through 4, to minimize challenging instrument operation in containment, actions can be taken during Phase 3 to maintain containment pressure less than 20 psig, which is below the containment design pressure of 60 psig. At approximately 35 hours from the start of the BDBEE, equipment provided from a NSRC can be available to power one or more Containment Recirculation Fans (CRFs) and supply cooling water from Lake Ontario to one or more Containment Recirculation Fan Coolers (CRFCs). RWA-1403-001 shows that one CRF and associated CRFC placed in service at 35 hours will reduce containment pressure and temperature. Procedure ECA-0.0, Loss of All AC Power, directs performing FSG-12, Alternate Containment Cooling, to restore containment cooling using the NSRC supplied equipment.	<u>Complete</u>

	The NSRC equipment will be used to repower Containment Recirculation Fans and supply water to Containment Recirculation Fan Coolers if Containment temperature is greater than 200°F or Containment pressure is greater than 15 psig. For Modes 5 and 6, CRFC cooling can be established during Phase 3 by deploying a diesel driven portable pump provided by the NSRC, with a hard suction hose to draft from Lake Ontario, and with the discharge hose connected to the Containment Recirculation Fan Cooler (CRFC) supply side (outside of Containment) via a fire hose type connection. Hose adaptor inserts were designed and fabricated to be placed in the location of butterfly valves 4628 and 4641 on the supply side of the B and C CRFCs. This arrangement provides lake flow rates consistent with Design Basis heat removal flow requirements per DA-ME-15-005, FLEX RHR/CCW/SW Hydraulic Model). Existing safety-related discharge piping returns CRFC discharge water back to the Lake. A D/G provided from the NSRC can power one or more CRFs.	
OIP Open Item 65 Implement a strategy to provide for transferring diesel fuel from the D/G A and D/G B Fuel Oil Storage Tanks (FOSTs) to a fuel transfer vehicle.	FSG-5, Initial Assessment and Flex Equipment Staging, directs establishing diesel fuel source and refueling means. Attachment G, Refueling the Fuel Tank Trailers, provides the guidance for filling the fuel tank trailers from the outside diesel fuel oil storage tanks or from the Emergency D/G fuel oil storage tanks.	Complete
OIP Open Item 66 Perform an analysis to provide a basis that the Offsite D/G FOSTs are reasonably protected from BDBEEs.	DA-ME-14-005, Reasonable Protection Evaluation of Offsite Fuel Storage Tanks, determined that the Offsite Fuel Oil Storage Tanks are reasonably protected, except for the external flood. ER-SC.2, High Water (Flood) Plan, directs personnel to "PROTECT the offsite fuel storage tanks and fuel transfer building by VERIFYING Vehicle Barrier System blocks are in place on the west side of the building." Fuel Oil can be accessed by the manway or if it is assessed that the "Pump house" is intact, electrical connection points and a transfer switch exist that can be	Complete

	used to power the installed pump and refill the fuel trailers. For the external flood, plugs are inserted into the vent lines to prevent flood water from entering the tanks. The strategy is described in ER-SC.2. With the implementation of the above protective strategy in ER-SC.2, the tanks are "Reasonably Protected" in accordance with NEI 12-06 from all postulated BDBEEs.	
OIP Open Item 67 Develop the strategy to transfer fuel from protected fuel storage locations to FLEX equipment.	Travel paths for the fuel handling equipment are the same as the travel paths for the portable FLEX equipment, and are evaluated in GN-WP-01, BDBEE Debris Removal for Ginna Station. Refueling of portable FLEX equipment, including the SAFW D/G, will be accomplished by using two (2) - 990 Gallon towable fuel trailers. Refueling times and actions were incorporated into the timelines for the Phase 2 Staffing Study. Some changes from the Phase 2 Staffing Study were incorporated into the R. E. Ginna Nuclear Power Plant NEI 12-06 FLEX Validation Plan, which also indicated that all tasks were able to be accomplished with available personnel. The capacity of a refueling trailer is 990 gallons. The fuel oil tank for the SAFW D/G is 660 gallons. With a complete refill of the SAFW D/G, 330 gallons of fuel would remain to fill an operating FLEX Pump (171 gallons working capacity) and 100 KW D/G (144 gallons working capacity). Fuel will be drawn from the FOSTs using small engine driven pumps and discharging to the refueling trailers. FSG-105, FLEX Support Equipment – FLEX Fuel Tank Trailer (TBD01A / TBD01B), provides operating guidance for the fuel tank trailer.	Complete
OIP Open Item 68 Develop strategies to provide for emergency lighting to support Operator actions after a BDBEE.	FSG-5, Initial Assessment and Flex Equipment Staging, Attachment F contains lighting strategies to provide for emergency lighting to support Operator actions, including the following items stored in robust locations: • Large portable "Smith Lights" LED battery operated work lights. • Additional flashlights with a supply of batteries.	Complete

	• Hard hat head lamps with a supply of batteries.	
OIP Open Item 73 Implement a strategy to provide cooling water to the RHR Heat Exchangers using a portable diesel driven pump.	Ginna has analyzed alternate RHR heat removal capability using the Reactor Coolant Drain Tank (RCDT) Pumps to circulate water from the RCS hot leg, through both RHR heat exchangers, and back to the RCS cold leg. The strategy uses a FLEX pump to circulate water from the lake to the CCW side of the RHR Heat Exchanger through hosing and a bonnet adapter on valve 760A. The lake water is discharged near Deer Creek through hoses connected to a bonnet adapter at valve 760B (DA-ME-15-005, Fukushima Timeline Analysis).	Complete
OIP Open Item 74 Any additional non-safety equipment will be identified and evaluated for suitability in the mitigation strategies.	With the exception of the SBAFW pumps, all of the FLEX equipment is considered non-safety-related. All "N" equipment is located in robust structures and secured so as not to be affected by seismic motion. All support equipment is either located within a robust structure or is separated by the site specific tornado width, accounting for the prevailing tornado direction, so as not to be affected by the same tornado. "N+1" equipment is located in a commercial structure meeting ASCE 7-10 and is not separated from the buildings where the N equipment is located. All support and "N+1" equipment is secured as needed so as not to be affected by seismic events. For non-safety-related installed equipment that is used in the mitigation strategies, Ginna has installed a 1 MW SAFW D/G along with a 160,000 Gallon SAFW DI Water Storage Tank. Although installed in a Seismic / Tornado and Flood proof structure, the SAFW D/G is classified as non-safety. The tank is also classified as non-safety (connection points and piping penetrations are protected by design or orientation). It is seismically mounted and provides a suction source to the two safety-related SAFW Pumps. During an ELAP, the SAFW D/G will start and manual transfer switches operated to provide power to the two safety-related SAFW Pumps, which will then provide feed	Complete

	water to the S/Gs. Ginna has also installed a non-safety related high pressure positive displacement Alternate RCS Injection pump with power being supplied by the SAFW D/G through a breaker on its associated load center. The Alternate RCS Injection pump is installed in the existing SAFW Building, which is safety related. The suction source is from the RWST. Alternate RHR uses the Reactor Coolant Drain Tank (RCDT) Pumps to circulate water from the RCS hot leg, through both RHR heat exchangers, and back to the RCS cold leg. The RCDT Pumps are augmented quality.	
ISE CI 3.2.1.B Consider the prioritization of staging portable equipment that may be required to isolate/vent the accumulators when certain cooldown maneuvers are necessary. The licensee's plan was to enter containment and locally close the accumulator isolation valves. The NRC staff asked for an alternate plan in case the containment building had an adverse environment. The staff requests that the licensee make available for audit their plan to isolate or vent the RCS cold leg accumulators to avoid injecting nitrogen into the RCS.	Following an ELAP event, there is a procedural requirement to cooldown/ depressurize the RCS to reduce RCP seal leakage and to inject borated water from the SI Accumulators. SI Accumulator injection replaces fluid lost from the RCP seals and increases shutdown margin. It is also important to ensure that nitrogen in the SI accumulators does not enter the RCS because that could impede natural circulation. The plan to avoid injecting nitrogen into the RCS is to isolate or vent the SI Accumulators as follows: FSG-10, "Passive RCS Injection Isolation," provides actions to isolate or vent the SI accumulators to prevent nitrogen injection. For ELAP events where electrical power is available from either the SAFW D/G (1 MW) or portable 100 KW D/G, and both MCC 'C' and MCC 'D' are accessible, power is restored to MCC 'C' and MCC 'D' by opening all input and output breakers and powering the MCCs via a battery charger breaker. Once MCC 'C' and MCC 'D' are energized, the SI Accumulator isolation valve breakers for MOV-841 and MOV-865 are closed and MOV-841 and MOV-865 are closed from the Control Room. If both MCC 'C' and MCC 'D' cannot be repowered due to the ELAP event, or if the SI Accumulator isolation valves cannot be closed, then Instrument Air is established to	<u>Complete</u>

	Containment to vent the SI Accumulators. In this case a portable diesel air compressor is staged, AOV-5392, Instrument Air Containment Isolation Valve, is removed, and the air hose is connected to the union of the instrument air pipe entering containment. Once Instrument Air is restored to Containment, the SI Accumulators can be vented from the Control Room by opening SI Accumulator N2 Fill/Vent AOVs 834A and 834B, and by opening the common SI Accumulator Vent Valve HCV-945.	
ISE CI 3.2.1.2.B Confirm that the RCP seal O-rings will maintain their integrity at the temperature conditions experienced during the ELAP event, and that the RCP seal leakage rate used in the ELAP analysis is adequate and acceptable. The staff requests that the licensee make available for audit a list of where the B type O-rings are located and an evaluation of the impact of high temperatures on those O-rings.	The NRC Flex Audit in April 2015 requested that Ginna make available for audit a list of where the B type O-ring Seals (Eastern 7228-B) are located and provide an evaluation of the impact of high temperatures on those O-rings. The concern is that the 7228-B high temperature O-rings are only qualified to 550°F. These O-rings may be exposed to 556.3°F RCS water during BDB ELAP scenarios. Westinghouse has qualified the current generation O-ring (7228-C) to 582°F (the material specification is the same for the 7228-B and 7228-C compound O-rings. High temperature performance (e.g., extrusion resistance) is expected to be the same for both O-rings.). The A RCP contains all 7228-C O-rings. The following list shows the locations of the "B" compound O-ring (7228-B); • RCP A – All O-rings are 7228-C compound • RCP B – Six 7228-B compound O-rings are currently installed in the B RCP seal package and are scheduled to be replaced in April 2017. The April 2017 refueling outage will provide the normally scheduled PM maintenance window for the major inspection of the B RCP seal package. The following provides justification for use of the 7228-B compound O-ring in the B RCP until replacement during the April 2017 seal maintenance. Note: The current stock of RCP O-rings (Seal Service Kit – Item # G9111263 and the Seal Rebuild	<u>Complete</u>

	Kit – Item # G9111271) only contain 7228-C O-rings. All future RCP seal maintenance (starting with RFO'15) will only use 7228-C compound or 7228-D compound O-rings. <u>Discussion</u> The 7228-B compound O-rings in the #1 seal ring and runner (Westinghouse P/N 4389B72X72) are located between the ceramic faceplates and the corresponding stainless steel seal support housing. These are stationary O-rings that create a seal on the bottom side of the precision machined ceramic faceplate and associated housing. Failure of these O-rings would result in increased leakage to the inlet of the number 2 seal. This leakage would be contained (and limited) by the number 2 seal and the flow restricting venturi in the seal return line. The clearance between the ceramic faceplate and the corresponding stainless steel seal support housing is approximately 0.002 inch as shown in Table 6-1 of WCAP-10541 Revision 2. The remaining four 7228-B compound O-rings (Westinghouse P/N 4389B72E75, 620B492E79 and 4395B55E06) are all located in stationary locations in the #2 seal housing or downstream of the #2 seal. The clearance at these locations ranges from 0.0 inches to approximately 0.018 inches (WCAP-10541 Revision 2). There are no 7228-B compound O-rings in the most critical locations which are the #1 and #2 channel seals. WCAP-10541 Revision 2 discusses qualification testing for the early generation of High Temperature O-rings Seals (Eastern 7228 and 7228-A compound) in Section 6. The qualification testing of the 7228 series compound was completed using the 1-F and 2-D locations shown in Table 6-1 and Figure 6-1 of WCAP-10541. Testing was completed at 0.018 inch gap and 550°F/1800psid and 0.031 inch gap and 550°F/1200psid for a minimum of 18 hours.	

	WCAP-10541 highlights that 4 of the most critical parameters affecting extrusion failure are: 1) differential pressure, 2) temperature, 3) extrusion gap and 4) time at elevated temperature and pressure. The qualification of the 7228-B compound was completed in the same manner as the 7228-A compound. The 7228-B compound O-rings were tested to 1800 psid. From PWROG-14015-P, Table 6, Category 1 plants (includes Ginna) have a maximum pressure at the pump outlet (i.e., outlet of the #1 seal) of 951 psia at a cold leg pressure of 2250 psia. Based on this information, the following conclusions are made for the 7228-B compound O-rings installed in the Ginna B RCP: 1. The differential pressure across the two 7228-B compound O-rings in the #1 seal ring and runner would be 1299 psid (2250 psia – 951 psia = 1299 psid). Since the gap at these locations (0.002 inch) and differential pressure (1299 psid) are considerably less than the test conditions (0.018 inch/1800 psid and 0.031 inch/1200 psid), and since these are considered two critical parameters that significantly influence extrusion failure (WCAP-10541 page 6-7). Ginna considers the worst case ELAP conditions to be bounded by the qualification test parameters. This conclusion is also based on the maximum expected time (10 minutes) (Qualification testing has shown that the 7228-B O-rings will last in excess of 18 hours at 550°F) and temperature above the qualification limit (6.3°F) as detailed in the temperature discussion below. 2. From PWROG-14015-P, Table 6, Category 1 plants (includes Ginna) have a maximum pressure at the pump outlet (i.e., outlet of the #1 seal) of 951 psia at a cold leg pressure of 2250 psia during ELAP conditions. The maximum RCS cold leg temperature during ELAP	

	conditions based on the lowest SG Relief valve setting for Ginna of 1085 psig at saturation conditions equates to 556.3°F. The enthalpy at this condition (2250 psia/556.3°F) is 555 Btu/lbm. Assuming isenthalpic expansion of the fluid through the #1 seal, the following conditions will exist at the outlet of the #1 seal (inlet to #2 seal): P = 951 psia, H = 555 Btu/lbm, T = 539°F. This shows that the highest expected temperature at the #2 seal ring and downstream locations would be less than the 550°F qualification test temperature. Therefore, there is no elevated temperature concern for these O-rings. <u>Maximum Possible Time at Elevated Temperatures</u> The maximum RCS cold leg temperature during ELAP conditions based on the lowest SG Relief valve setpoint (saturated conditions at 1085 psig) is 556.3°F. During an ELAP event, the RCS average temperature is assumed to be the no load temperature of 547°F. This is achieved by local operator action (ECA-0.0 Step 3 RNO, per Phase 2 staffing study) completing at T+30 minutes. The Tcold at these conditions will be approximately 530°F. It is important to note that the Model 93 RCP includes a 54.5 gallon volume of 120°F cold water that will last for approximately 27 minutes before RCS water at 556.3°F reaches the #1 seal. This time assumes the historical value of 2 gpm seal leak-off from the B RCP. Based on this sequence, the maximum time the #1 seal O-rings may be exposed to RCS water above 550°F is estimated to be 10 minutes (3 minutes from depletion of purge volume until the start of operator action to establish 547°F plus 7 minutes to establish 547°F). This assumption is conservative since heat capacitance of the thermal barrier, main flange, seal housing, pump shaft and bearing will likely prevent the temperature from exceeding 550°F.	

	Conclusion Based on the bounding condition expected during ELAP events, there is reasonable assurance that O-ring extrusion failure will not occur. Therefore, Ginna considers it acceptable to operate with 7228-B O-rings installed in the B RCP until the next scheduled maintenance window in April of 2017 as supported by the following facts: • Ginna will take prompt action (ECA-0.0 Step 3) to establish RCS Tavg at 547°F during ELAP scenarios • The #1 seal O-rings may be exposed to the elevated temperatures for no more than 10 minutes • The temperature at the #2 seal O-rings will not exceed 550°F • The maximum possible temperature (556.3°F) is only 6.3°F above qualification test conditions • The extrusion gap and postulated differential pressures are less than or equal to test conditions • Testing has shown that the O-rings will last in excess of 18 hours at 550°F	
ISE CI 3.2.1.9.A Confirm design information and supporting analysis developed for portable equipment that provides the inputs, assumptions, and documented analyses that the mitigation strategy and support equipment will perform as intended.	Pumps will perform as intended as documented in the following hydraulic calculations. - Portable FLEX pump capability to feed S/G and SFP is evaluated in DA-ME-15-005 - SAFW capability to feed S/G is evaluated in ADC-14-000599-CN-001 and ECP-14-000749-CN-001 - NSRC pump capability to feed alternate RHR is evaluated in DA-ME-15-005 - NSRC pump capability to feed CRFC is evaluated in DA-ME-15-005 - FLEX sump pump capability is evaluated in DA-ME-15-005 - Alternate RCS Injection Pump Capability is evaluated in ECP-14-000169-015-7B-01 - Alternate RCS Injection Booster Pump capability is evaluated in DA-	Complete

	ME-15-005 Flow and pressure requirements are demonstrated for the following: - A single SAFW pump is capable of feeding both SGs. - FLEX pump sizing to support feeding both SGs and the SFP. - Sump pump can remove up to 121 gpm from sub-basement. - SAFW Pump operation with the cross-tie modification. - Alternate RCS injection. DA-ME-15-005, FLEX RHR/CCW/SW Hydraulic Model, predicts FLEX SAFW pump performance feeding S/Gs while drafting from the lake. The analysis predicts that the pump is capable of delivering 232 gpm split to both generators (116 each) if the S/Gs are at 305 psia. 305 psia was chosen as a reasonable S/G target pressure after approximately 6 hours of effective SAFW flow per the Mode 1 RELAP analysis RWA-1323-003, Ginna RELAP5 ELAP Analysis for Mode 1. A positive displacement pump is being used for RCS injection and is capable of supporting RCS injection strategies (discharge pressure and flow).	
ISE CI 3.2.4.8.A Confirm that the final electrical design has the necessary electrical isolations and protections. The NRC staff determined that the auto start feature of the 1 MW FLEX DG in the SAFW Annex, which automatically energizes the bus, is an alternative to NEI 12-06, as is the use of a permanently installed FLEX DG. The staff accepted the permanent DG in the ISE review, but was unaware of the auto start feature at that time. Also, the staff needs to evaluate the	The reasons why an auto start and load feature could be an acceptable alternative to NEI 12-06 were provided in Reference 11. A connection point for the NSRC 4160V FLEX D/G is described in FSG-5, Initial Assessment and FLEX Equipment Staging (Attachment I, Establishing Long Term Core Cooling), and FSG-12, Alternate CNMT Cooling (Attachment C, Align Temporary Electrical Power Supply to CNMT Fan Coolers), which provide directions for connecting the NSRC 4160V FLEX D/G to Bus 16 Station Service Transformer Cubicle rear panel bus bars, including a figure of the bus bar arrangement.	<u>Complete</u>

connection points for the 4160V FLEX DG from the NSRC. The staff requests that the licensee make available for audit the reasons why an auto start and load feature could be an acceptable alternative to NEI 12-06, and provide a list of connection points for the 4160V FLEX DG.		
ISE CI 3.3.1.A Confirm sufficient quantities of FLEX equipment to meet N+1, and identify their storage locations. The staff requests that the licensee make available for audit the location where each piece of FLEX equipment will be stored and the associated protection from external events at these storage locations.	All "N" equipment used to mitigate post Extended Loss of Alternate AC Power (ELAP)are either permanently installed in a robust structure and properly anchored, capable of resisting Beyond Design Basis External Events (BDBEE), or are portable equipment anchored in place in robust armored SeaVans which can resist flooding, seismic forces, and tornado winds/missiles. The "N+1" equipment provides a portable means of providing redundant/diverse means of accomplishing post-ELAP functions. This equipment is stored in a commercial building analyzed in accordance with ASCE 7-10. There is also certain equipment used to support post-ELAP functions. This equipment consists of a tow truck, a debris remover, two hose trailers, and two fuel trailers. This support equipment is stored in areas which are separated by the width of a site-specific tornado (1040 feet), accounting for the prevailing tornado path for the region (southwest to northeast). The following are the functions for which Ginna has provided FLEX equipment, together with a description of the "N" and "N+1" equipment and their storage locations: 1. Provide Auxiliary Feedwater to the steam generators. - The "N" means employs permanently installed SAFW pumps, taking suction from a robust 160,000 gallon DI Water Storage Tank, powered by a permanently installed 1 MW SAFW	<u>Complete</u>

	D/G. The D/G, switchgear, and pumps/ piping are all located within robust structures. A portable FLEX pump, which can be used to refill the DI Water Storage Tank, is also located within this robust structure. FLEX "N+1" equipment can provide the water to the S/Gs following S/G depressurization, either from the 160,000 gallon tank DI Water Storage Tank, or directly from Lake Ontario. The FLEX pump and hoses are stored in a commercial ASCE 7-10 building. 2. Isolate Safety Injection Accumulators. - The "N" function is performed by repowering a cubicle in MCC "C" and one in MCC "D" from the SAFW D/G, then closing the isolation valves. In the event a tornado damages MCC "C", an air compressor is connected to an instrument air line, allowing the accumulator to be vented. All necessary cables, connectors, hoses, and the air compressor are stored in robust locations. Comparable equipment is used for the "N+1" strategy, substituting the 100 kW D/G for the SAFW D/G. This 100 kW D/G, as well as necessary hoses, cables, and connections are stored in the commercial ASCE 7-10 building. 3. Repower the battery chargers. - This "N" function is performed by repowering a cubicle in MCC "C" and one in MCC "D" from the SAFW D/G. In the event a tornado damaged MCC "C", the SAFW D/G would be connected directly to affected battery charger. All cables and connection required for these functions are stored in robust locations. The "N+1" strategy is comparable, substituting the 100 kW D/G for the SAFW D/G. The 100 kW D/G, as well as the necessary cables and connections are stored in the commercial ASCE 7-10 building. 4. Primary Inventory/Reactivity Control. - The "N" function is performed by	

	powering the installed Alternate RCS Injection pump, taking suction from the robust RWST, and injecting into the SI lines. A booster pump is installed, and powered from the 1 MW D/G, or the 100 kW portable diesel generator, to allow full use of the RWST contents. All pumps, piping, diesel generator, hoses, cables, and connectors are stored in a robust structure. There are two means of providing the "N+1" function. A portable diesel driven Alternate RCS Injection pump can be connected in parallel with the electric Alternate RCS Injection pump. Also, a diverse means of providing RCS inventory/reactivity control is by powering an installed charging pump from the SAFW D/G. The portable Alternate RCS Injection pump, as well as all necessary hoses, cabling, and connections are stored in the commercial ASCE 7-10 building. 5. Spent Fuel Pool Cooling/ inventory Control. - The "N" function is provided by employing a portable FLEX diesel driven pump taking suction from the discharge canal and filing directly to the SFP. This pump can provide flow to refill the 160,000 gallon DI Water Storage Tank, as well as the SFP, using a manifold. The FLEX pump and manifold are stored in a robust structure. The hoses are stored in hose trailers, separated from each other by the width of a site-specific tornado (1040 feet), accounting for the prevailing tornado direction for the region. The "N+1" function is provided by another diesel driven FLEX pump taking suction from the discharge canal. This pump can also provide flow directly to the S/Gs following depressurization, concurrently with refilling of the SFP. Another connection point to the SFP is via valve 8662. The pump is a	

	redundant counterpart to the one employed for the "N" strategy and is stored with another manifold in the commercial ASCE 7-10 building. 6. Mode 5 Containment Venting. - The "N" function is performed by opening installed valve 7444. If valve 7444 is not available due to a flooding event, the air compressor is used to open the containment purge valve. The compressor, fittings, hoses, and tools are stored in a robust structure. The "N+1" strategy can be the same as the "N" strategy, using a redundant air compressor. The air compressor and necessary fittings, hoses and tools are stored in the commercial ASCE 7-10 building. An alternative strategy is to open the containment personnel and equipment airlock outer doors, and open the equalizing valves. 7. Dewatering Auxiliary Building Sub-basement (Steam Generators unavailable) for Mode 5 RHR. - In the event a tornado missile damages susceptible tanks on the Auxiliary building operating floor, flooding the RHR and Reactor Coolant Drain Tank (RCDT) area, the area must be dewatered prior to reinitiating forced RCS flow. The "N" strategy deploys a submersible sump pump, powered from the SAFW D/G, to remove the water from the sub-basement. This water is pumped outside the Auxiliary Building. The sump pump, DG, hoses, cables, and connectors are all stored in robust locations. The "N+1" strategy is comparable, substituting the 100 kW D/G for the SAFW D/G. The necessary diesel, pump, hoses, cables, and connectors are stored in the commercial ASCE 7-10 building. 8. Mode 5 Residual Heat Removal. - Following dewatering of the sub-basement, forced flow RCS recirculation cooling can be attained.	

	The "N" strategy is to provide power to the installed RCDT Pump "B" from the SAFW D/G (the RCDT pumps can operate after being submerged). All cables, connectors, and junction boxes are stored in a robust structure. The "N+1" strategy provides for the "A" RCDT pump to be powered for the 100 kW D/G. The 100 kW D/G as well as all necessary connectors, cables, and junction boxes are stored in the commercial ASCE 7-10 building. 9. Heat Sink for Mode 5 RHR. - A means to remove the heat being circulated by the RCDT pumps is necessary. The "N" strategy is to align a diesel driven FLEX pump from the discharge canal to valve 760A, B bonnet-to-hose adapters. This flow would cool the RCDT flow. The water circulating from the FLEX pump would be discharged via hose to outside the Auxiliary Building. The FLEX pump and all hoses, fittings, connections, and flanges are located in robust structures. The "N+1" strategy is comparable except that the redundant FLEX pump, as well as the necessary hose, fittings, connectors, and flanges are stored in the commercial ASCE 7-10 building. 10. Communication. - There is a permanently installed satellite dish to provide satellite communication between the station and the EOF as well as the state and county officials. In the event a BDBEE damaged the permanent satellite dish, a portable dish is provided. The portable dish, trailer, UPS system, cabling, and portable diesel generator are stored in a robust structure. A repeater system is installed to facilitate radio communication onsite during an event. In the event the permanently installed system would be damaged by a BDBEE, a redundant repeater	

	would be deployed. The repeater, antenna, tripod, and cable are all installed in a robust structure. 11. Refueling. - Redundant sources of diesel fuel are available for refueling the SAFW D/G, 100 kW D/G, the diesel driven FLEX pumps, the diesel driven portable Alternate RCS Injection pump, and the smaller diesel generators. Two fuel trailers, each with 990 gallons of ultra-low sulfur fuel, are stationed at the site. They are stored so as to be separated by the width of the site-specific tornado (1040 feet), accounting for the prevailing tornado direction for the region. Each fuel trailer has the necessary fuel transfer equipment. Once deployed, the trailers can be refilled from the onsite fuel oil storage tanks. 12. Debris Removal/ Equipment Transportation. - The site has a Case 621 pay loader, as well as a Ford F-350 pickup truck with a snow plow, to remove debris caused by a BDBEE. Each vehicle is equipped with equipment to check for live wires in downed power lines. Each vehicle is also equipped with a pintle hitch, which can be used to transport mitigation equipment, such as the 100 kW D/G, the portable satellite trailer, the FLEX pumps, the fuel trailers, the hose trailers, and the air compressors to their deployment points. There is also an electric Trailer caddy, capable of moving any of the FLEX mitigation equipment, stored in a robust structure.	
SE 1-E The final validation and verification and timeline checks of procedures and operator actions during an ELAP need to be performed when procedures are completed. The staff is	The final validation and verification and timeline checks of procedures and operator actions during an ELAP were performed to the completed procedures. This includes the timeline for initiating feedwater to the SGs. The R. E. Ginna Nuclear Power Plant NEI 12-06 FLEX Validation Plan that shows the actions for an ELAP can be completed as	<u>Complete</u>

especially concerned with the timeline for initiating feedwater to the SGs. The staff requests that the licensee make available for audit the validation and verification of the procedures and timeline that shows the actions for an ELAP can be completed as planned.	planned was made available on the ePortal for NRC staff review.	
SE 7-E In planning operator actions for ELAP, the licensee relies on an analysis of plant response using the modeling code RELAP5/MOD3.3. The NRC staff needs to evaluate the results obtained by the licensee. No input is needed at this time. The NRC staff will evaluate the licensee's results.	While Ginna utilizes the WCAP-17601-P evaluation model for ELAP coping, Ginna relies upon the plant specific thermal-hydraulic analyses that were performed using RELAP5/MOD3.3 Patch 03 (RWA-1323-001, Ginna RELAP5 Base Deck for EPU Nominal Conditions, and RWA-1323-003, Ginna RELAP5 ELAP Analysis for Mode 1). The Ginna specific analysis shows a coping time that is shorter than predicted in WCAP-17601-P. This in large part is due to the modeling of total RCS leakage which Ginna conservatively assumes to be 61 gpm. (25 gpm per RCP versus 21 gpm per RCP in the WCAP and 11 gpm RCS leakage versus 1 gpm in the WCAP) Other plant variations to the generic WCAP-17601-P analysis result in differences between the generically predicted coping time and the actual coping time.	<u>Complete</u>
SE 11-E Discuss all areas where local manual actions are performed and evaluate the ability to perform these tasks based on local conditions such as heat, cold, humidity, radiation, lighting, and communications. The NRC staff requests that the licensee make available for audit a list of all local manual actions and evaluate if the conditions allow for the task to be accomplished in accordance with the event timeline.	Local manual actions are employed throughout much of the plant. HVAC calculations have been performed for all areas requiring access. Results are described below. There are flashlights and miner's hats, along with large quantities of batteries, stored in robust protected locations. These will be made available to plant personnel as needed to perform local actions. A communications test of the radio system was performed, utilizing the new protected repeater. Communications was excellent throughout the areas where communication to perform local mitigation actions is required. All areas requiring access have multiple egress and exit points. 1. Standby AFW Building Annex – the local actions taken in this room are the initiation and control of Standby AFW flow, initiation of Alternate RCS	<u>Complete</u>

	Injection, and monitoring of Spent Fuel Pool level. HVAC calculations indicate that there will be no adverse environmental conditions within this room to inhibit the performance of local actions. The temperature limits in these areas are 60°F to 104°F. 2. Auxiliary Building – several manipulations are expected to occur in this building. When initiating Alternate RCS Injection, four manual valves must be manipulated. When repowering MCC C and D to provide for battery charging and accumulator isolation valve closure, cables must be deployed from the Waste Gas Compressor room to the motor control centers. When dewatering the Auxiliary Building sub-basement and aligning Reactor Coolant Drain Tank pump flow and FLEX pump flow to the 760 A, B bonnet-to-hose adapters, cabling and hoses must be run in various sections of the Auxiliary Building. Also, running hose to the edge of the spent fuel pool, or, alternatively, to valve 8662 for spent fuel pool makeup is performed in the Auxiliary Building. HVAC calculations have been performed which demonstrate that environmental conditions at the operating floor peak at about 125°F. The time duration for actions in this area is less than 1 hour. At lower levels of the Auxiliary Building, where actions could have several hours duration, the peak temperature remains below 110°F. 3. Intermediate Building – The Atmospheric Relief Valves must be locally controlled but do not require continuous occupancy. The operator will spend most of their time outside the Intermediate Building in a low noise area. With timely opening of doors, HVAC calculation demonstrates that peak temperatures are limited to 117-122°F. Other actions in the Intermediate Building	

	include taking of local readings for vital instrumentation, and the use of an air compressor to vent the Safety Injection accumulators. HVAC calculations indicate the peak temperatures in these areas are 110-115°F. 4. Control Room – Many manipulations are performed within the control room. HVAC calculations demonstrate that with the timely opening of doors, peak temperatures are limited to 116°F. 5. Relay room/annex – the radio repeater system is stored in the annex. The antenna, tripod, and cabling would be deployed via local actions from that room. HVAC calculations indicate the peak temperature in that room would be limited to 103°F.	
SE 12-E Discuss strategies involving RCS makeup and boration to verify shutdown margin is maintained and methods of venting the RCS to permit injection flow. The NRC staff requests that the licensee make available for audit an evaluation of shutdown margin and the ability to inject borated water into the RCS without taking the pressurizer solid.	RCS venting is a contingency action if RCP seal leakage remains unexpectedly low. With expected RCS leakage following an ELAP event, SI Accumulator injection will occur during the cooldown directed by ECA-0.0, "Loss of All AC Power," and is necessary to maintain sufficient RCS inventory for single-phase natural circulation flow (two-phase flow is acceptable if greater than the single phase flow rate) in the RCS. Should RCP seal leakage remain unexpectedly low, RCS cooldown will reduce RCS pressure and pressurizer level but may result in sufficient SI Accumulator injection to provide adequate shutdown margin. FSG-1, "Long Term RCS Inventory Control," and FSG-8, "Alternate RCS Injection," provide tables to determine the volume of boration required to maintain subcriticality, Xenon-Free at 350°F, and direction to inject additional borated water to the RCS. If venting the RCS is required then two parallel reactor vessel head vent paths are available. Each path is capable of venting 9 gpm of makeup down to a RCS pressure of 380 psig. With both reactor vessel vent paths open, borated makeup at 9 gpm can be accommodated down to 190 psig. (DA-ME-	<u>Complete</u>

	15-013, FLEX Miscellaneous Calculations) Less than 9 gpm boration would normally be required given that the shutdown margin calculation (CALC-2014-0002, "Cycle 38 Reactor Engineering Calculations," Revision 0) assumed the 9 gpm boration started at 20 hours. The two available reactor head vent paths provide defense in depth for venting. As documented in the Technical Evaluation Report on Reactor Coolant System Vents for Ginna in the Safety Evaluation by the Office of Nuclear Reactor Regulation, dated September 28, 1983, the non-condensable gases, steam, and/or liquids vented from the reactor vessel head are piped and discharged directly to the refueling cavity and the discharges from the pressurizer are piped to the pressurizer relief tank. The staff found that the vent system at Ginna is acceptable and in conformance with the requirements of 10 CFR 50.44 paragraph (c)(3)(iii) and the guidelines of NUREG-0737 Item II.B.1, and NUREG-0800 section 5.4.12. The Alternate RCS Injection System utilizes positive displacement pumps capable of injecting RWST water into the RCS at 75 gpm and 1575 psig. FSG-1 checks RCS pressure LESS THAN 1575 psig then directs aligning and establishing RCS Injection flow. Operators are directed to control RCS Injection flow to maintain pressurizer level BETWEEN 13% [40% adverse containment] AND 75% [65% adverse containment]. FSG-1 directs the operators to FSG-8 if RCS pressure is NOT LESS THAN 1575 psig, or if the volume of boration is not adequate for plant conditions. FSG-8 directs Operators to align an available RCS Injection Pump, establish RCS conditions sufficient for injection with RCS Pressure LESS THAN 1575 psig and Pressurizer Level LESS THAN 75%, and (if RCS Pressure is not LESS THAN 1575 psig and Pressurizer Level is not LESS THAN 75%) then open reactor vessel head vent valves (two valves in series for both trains) to	

	depressurize RCS for boration. IF head vent valves are not available, then Operators are directed to an attachment to lower RCS pressure using a PORV. This attachment cautions Operators that a PORV should only be used if no other means for RCS depressurization is available. If pressurizer level is greater than 95%, then Operators are to contact the Technical Support Center to evaluate opening a pressurizer PORV to allow water release as needed to provide a boration letdown path. If the reactor vessel head vent valves are opened, Operators are directed to close the head vent valves IF Pressurizer level decreases below 13% [40% adverse containment] OR Alternate RCS Injection pump fails. Alternate RCS Injection flow is established when RCS pressure is less than 1575 psig and Pressurizer level is less than 95% OR RLVIS upper range is less than 97%. If necessary to support RCS makeup and boration strategies, FSG-1 directs Operators to Open reactor head vent valve to depressurize the RCS for additional boration. If a reactor head vent valve cannot be opened, then Operators are directed to an attachment to lower RCS pressure using a PORV. This attachment cautions Operators that a PORV should only be used if no other means for RCS depressurization is available. If pressurizer level is greater than 95%, then Operators are to contact the Technical Support Center to evaluate opening a pressurizer PORV to allow water release as needed to provide a boration letdown path. CALC-2014-0002 addresses shutdown margin input for the tables in FSG-1 and FSG-8 to maintain subcriticality, Xenon-Free conditions at 350°F in the RCS. A water-solid RCS is not permitted with boration termination criteria in FSG-1 and FSG-8.	
SE 13-E	At this time the PWROG continues to resolve issues over the amount of RCP seal leakage that would be expected during an extended	Complete

Provide justification for the ability of the RCP seals to limit the leakage from the RCS during ELAP conditions to the leakage values assumed in the plant analyses. The staff acknowledges that this is applicable to all pressurized-water reactors with standard Westinghouse RCP seals. The staff has pursued this with the Pressurized-Water Reactor Owners Group without reaching a resolution. The NRC staff requests that the licensee make available for audit an evaluation of compensatory margins in the analysis that could compensate in the event that RCP seal leakage is greater than assumed in the analysis.	loss of ac power (ELAP) for reactors with the standard Westinghouse seals. The Ginna RCP seal leak rate profile and the analysis to validate the capability to maintain natural circulation core cooling used plant specific values/analyses, which are more conservative than those generic values listed in Westinghouse WCAP-17601-P, "Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs." NSAL 14-1 Revision 1 was issued on 09/08/2014. Since its issuance, the PWROG has issued report PWROG-14015-P Revision 2 (April 2015) "No. 1 Seal Flow Rate for Westinghouse Reactor Coolant Pumps Following Loss of All AC Power-Task 2: Determine Seal Flow Rates". This document provides much greater detail for the expected seal leakage values expected during a loss of all AC power compared to the generic information provided in NSAL 14-1. Ginna Station is considered a "Category 1" plant within PWROG-14015-P Rev 2. The category signifies the seal leak-off line piping configuration that was analyzed within the document to summarize the expected leak rates for that configuration. Categorization of the different plants is documented within PWROG-14008-P. Ginna Isometric drawings of the seal leak-off piping along with engineered drawings of the flow meter venturis were provided to Westinghouse to assist in classification of the seal leak off line into category 1. Ginna has since reviewed the categorization and installed plant configuration and concurs in the categorization within PWROG-14008-P subsequently used within PWROG-14015-P. PWROG-14027-P, "No. 1 Seal Flow Rate for Westinghouse RCPs following Loss of All AC Power, Task 3: Evaluation of Revised Seal Flow Rate on Time to Enter Reflux Cooling and Time at which the Core Uncovers," also classifies Ginna as a Category 1 plant. Compared to the Category 1 leak rate model	

	input from the Westinghouse documents, Ginna has schedule 160 2" pipe, (ID of 1.689 therefore more conservative than 2.067 ID of Sch 40 pipe). Ginna piping is greater than 2 feet in length; therefore conservative. Ginna has more than one globe valve (valves 270 A, B and 293 A, B); therefore conservative. Ginna has more than one 90-degree bend (5 between valve 293A and venturi 175, 3 between valve 293B and venturi 176); therefore conservative. Ginna flow element is 0.2321 inches; therefore conservative. Downstream piping is ¾ inch and exceeds 2 feet in length; therefore conservative. (Isometric drawings C-381-357 sheets 28, 29, and 34) The maximum flow results within PWROG-14015-P for category 1 identify that 21 gpm is a conservative bounding value since the calculated maximum for category 1 is 17.5 gpm. (Note that for added conservatism Ginna assumed a 25 gpm leak rate per seal in RWA-1323-003 "Ginna RELAP5 ELAP analysis for Mode 1"; though Ginna agrees with the 17.5 gpm within the PWROG report). Even given the increase in RCP seal leakage shown in NSAL-14-1 at lower pressures, Ginna's conservative RCP seal leakage assumptions provide significant margin to bound final resolution of NSAL-14-1 impact and thus, NSAL-14-1 has no impact on Ginna Staton's strategies. During Plant events that result in loss of reactor coolant pump (RCP) seal cooling; such as station blackout, extended loss of AC power, or fires that affect power supplies, the leakage through the RCP No. 1 seal increases. During the aforementioned event, without there being power to the CCW or Charging systems to provide seal water/cooling to the pumps, it would be possible for RCS water to enter the RCP No. 1 seal leak-off line piping. During such an event, this piping would be required to resist the worst-case design temperatures and pressures of the RCS so that the pressure	

	boundary of the piping is not compromised. For beyond design basis events, where RCP seal water is lost, the system is designed to withstand RCS cold leg pressure and temperature while maintaining RCS leakage below the analyzed limits. The system must withstand these temperatures and pressures from the RCP seal to the final set of Venturi breakdown orifices. These breakdown orifices (FE-175 and FE-176) have the most limiting diameter for the system and control system flow. The seal leak-off piping downstream of the seals, to the last break down orifices, has been reviewed to ensure that its design meets the required conditions that would be experienced during loss of RCP seal cooling. Ginna Station's high pressure seal leak-off lines were originally analyzed to a transient value of 552.5 F and 2485 psig under the seismic upgrade program. (Note the drawings of the seal leakoff (SLO) lines identify the design conditions as 650°F and 2485 psig). PWROG-14015-P analyzes the leak rates for a temperature above 552.5°F but below 2485 psig. PWROG-14015-P Table 18 provides the recommended pressure and temperature to verify seal leak off line piping integrity. Due to Ginna's existing design condition of 2485 psig for the SLO piping, Ginna shows significant margin to the expected 2045 psia within Table 18. Ginna structural engineering has reviewed the stress analysis for the seal leak off piping and supports; this review has concluded the piping and supports are adequate for the estimated maximum temperatures and pressures for the Ginna SLO piping. The seal leak-off piping for the "A" RCP, from the RCP seal to valve 385A (downstream of FIT-175) was qualified as part of Gilbert line segments CVC-225 and CVC-250. The seal leak-off piping for the "B" RCP, from the RCP seal to valve 385B (downstream of FIT-176) was qualified as part of Gilbert line segment CVC-200, fluid line CV-21. CVC-200, CVC-	

	225, and CVC-250 are respectively qualified to withstand thermal stresses by the following Gilbert Analyses: SDTAR-80-05-119, SDTAR-80-05-118 and SDTAR-80-05-035. All subsequent changes and revisions to these analyses have maintained the same design temperature and pressure. These analyses apply Equations 11, 13, and 14 of ASME B31.1 -1973 to analyze pressure, deadweight, and thermal stresses in the piping. Equation 12 of B31.1 deals with pipe stresses from earthquakes. The stresses generated from an event described herein are independent from earthquakes so that Equation 12 is not required to be considered. Equation 11 of B31.1 evaluates the piping for pressure and deadweight stresses. The pressure used by all three analyses for Equation 11 was 2485 psig. The allowable stress that the stress output values were compared to was S_h = 16,600 psi (allowable stress of A376 TP316 steel @ 650°F). The allowable stresses that were applied to equation 11 were based on a 650°F design temperature. Based on the pressure and allowable stresses used by the analyses, these bound the conditions of the BDB Event discussed herein. Equation 11 remains satisfied. Equations 13 and 14 of B31.1 consider thermal stresses to the piping. The worst case transient conditions that were applied to the piping for all three analyses for these equations were 2485 psig at 552.5°F. The piping meets the prescribed pressure for the BDB Event (applies to Equation 14 only). However, the temperature of the piping is expected to exceed the prescribed temperature by 7.5°F. This will cause stresses to the piping and supports to exceed those which were previously qualified by the following amount (70°F considered as ambient): $[(560°F - 70°F) / (552.5°F - 70°F) – 1] \times 100 = +1.554\%$	

	The allowable stress that was considered by the analyses for Equation 13 was SA = 26,255 psi. This is less than the actual allowable (S_A = 27,525 psi) of A376 TP316 steel at 650°F (bounding) for use by Equation 13. Since the allowable stress that is considered for Equation 14 is $S_A + S_h$, the allowable stress that was considered for Equation 14 is also bounded. The allowable stresses used by Equations 13 and 14 in the analyses meet the conditions of the BDB Event. Pipe supports are evaluated using an absolute summation of forces for all events and comparing the stresses that are generated to the code allowable stresses. Applied forces to the system pipe supports will not increase by more than 1.554% as was previously calculated. Since the seal leak-off piping and support stresses are not expected to increase by more than 1.554% these may reach a point that is beyond the code allowable limits. However, based on this minimal increase the stresses will not reach the yield point since the code limits maintain stresses well below the yield point. The piping and supports will not fail and will maintain their function during the event. In addition, the SDTAR analyses and associated Pipe Support analyses were reviewed for margin. Despite the increase in temperature, code allowable stress limits are expected to be met for the Piping and Supports during the BDB Event. The piping downstream of the breakdown orifices is not qualified to withstand RCS pressures and temperatures. If the pipe were to rupture beyond the orifices, then RCS leakage would still be maintained since the breakdown orifices would remain intact. (OPEX Evaluation AR 2472861-07) The set pressure for the common seal leak off header piping relief valve (Ginna EIN	

	valve 314) is 152 psig (148-156 psig allowable band). The relief has a J orifice which corresponds to 1.287 square inches. For detailed view of the common heater piping see the isometric drawings in the C-381-357 series. Ginna has reviewed the most recent maintenance work orders for the RCP seals and has identified that the part numbers for the #1 Runner and #1 Ring correspond to the silicon nitride material. Part numbers 4D00542G03 and 4D00541G03 are shown on Westinghouse Drawing 4D00544 rev 4 under notes B and C as having silicon nitride faceplates. To address concerns with the ability of the RCP O-rings to withstand high temperatures during an ELAP event, operations personnel will take action per procedure ECA-0.0. Step 3 of ECA-0.0 directs operators to adjust S/G ARVs to control Tavg at 547°F (~530°F Tcold). The Phase 2 staffing study determined that an operator can be dispatched to locally operate ARVs and control Tavg to 547°F within 30 minutes of event initiation. With this operator action performed in the early stages of the ELAP event, the period of time in which the O-rings within the RCP seals would be above 550°F is minimized. At approximately 2 hours from event initiation, a longer-term cooldown is initiated per ECA-0.0 to reduce RCS temperature to approximately 410°F via manual/local operation of the ARVs. This cooldown is expected to achieve an RCS cold leg temperature of less than 450°F in four hours from event initiation. A second RCS cooldown will be initiated to achieve an RCS temperature and pressure of less than 350°F and 400 psig within 24 hours of event initiation. Margins to the PWROG analysis that could compensate in the event that RCP seal leakage is greater than the PWROG analysis	

	are achieved by comparing the Ginna plant specific values/analyses to the PWROG RCP seal leak rates for a Category 1 plant, including the reflux cooling analysis methodology and WCAP 17601-P coping times: 1. For conservatism RWA-1323-003, "Ginna RELAP5 ELAP Analysis for Mode 1," using plant-specific parameters, assumed a 61 gpm RCS leak rate (25 gpm per seal AT 2250 psia + 10 gpm worst case tech spec identified leakage + 1 gpm worst case tech spec unidentified leakage). For the PWROG-14027-P Category 1 plant, RCP seal leakage at 2250 psia is 16 gpm, at 2000 psia it is 17.2 gpm, at 1850 psig it is 17.3 gpm at 1500 psia it is 17.5 gpm, at 1250 psia it is 15.7 gpm, at 850 psia it is 12.0 gpm, at 600 psia it is 9.3 gpm and at 385 psia it is 6.7 gpm. RWA-1323-003 treats the seals as an orifice for leakage reduction as RCS pressure drops. Due to the conservative RCP seal leakage assumptions, Ginna's assumed RCP seal leakage is conservatively greater than the PWROG-14027-P provided data points. At 1500 psia Ginna's RCP seal leakage is calculated as ~ 21 gpm, at 1250 psia leakage is calculated as ~ 19.5 gpm, at 600 psia leakage is calculated as ~ 12.5 gpm, and at 385 psia leakage is calculated as ~ 9 gpm. 2. RWA-1323-003 determined that two-phase loop flow will be less than single-phase loop flow at approximately 15.5 hours from the start of the event in place of the generic time to enter reflux cooling of 24.2 hours (PWROG-14027-P). To comply with NRC endorsement of the boron mixing generic concern, ECA-0.0, "Loss of all AC Power," directs charging at 8 hours into the event per FSG-1, "Long Term RCS Inventory	

	Control," to ensure subcriticality is maintained. However, it is likely that charging will commence earlier per FSG-1 based on RVLIS and/or Pressurizer levels. The NEI 12-01 Phase 2 Staffing Assessment determined that FSG-1 can be implemented in 1 hour from ELAP initiation to restore RCS Inventory using the alternate makeup strategy when an ELAP is in progress, PRZR level is less than 13% [40% adverse CNMT] and time and personnel are available to perform this strategy. 3. If signs of increased RCS leakage are detected such that RVLIS indicates less than 93% and RCS pressure is less than 500 psig, operators are directed to perform FSG-1. 4. The Technical Specification minimum RWST borated water volume of ≥ 300,000 gallons provides an abundant supply of onsite borated water for RCS makeup. The new Alternate RCS Injection System is capable of pumping 75 gpm from the RWST into the RCS at 1500 psi. A portable diesel engine driven high pressure pump provides alternate borated makeup capability to the RCS. This pump is also capable of pumping 75 gpm of borated water from the RWST to the RCS at 1500 psi. A Charging Pump provides the capability to provide 60 gpm to an alternate injection point if the Alternate RCS Injection connection is not available. These RCS makeup rates provide margin to the conservative RCS leakage rates assumed in RWA-1323-003 and significantly more margin to the expected leakage rates in PWROG-14027-P. In summary, the FLEX strategy for RCS makeup provides the capability to initiate FSG-1, "Long Term RCS Inventory Control," in 1 hour from start of the ELAP event,	

	provides for RCS makeup rates that are well above expected RCS and RCP seal leakage rates, and in conjunction with RCS cooldown/depressurization and SI Accumulator injection provides the capability to maintain natural circulation cooling conditions in the RCS even if RCP seal leakage rates are unexpectedly high.	
SE 14-E Determine if all components in the RCP seal leakoff line that function to limit seal leakage flow are capable of withstanding the pressure predicted during an ELAP event, or evaluate the new leakage flow that would result from a failure of the seal leakoff line. No input is needed at this time. The NRC staff will evaluate the licensee's response.	Leakoff line integrity has been evaluated by design engineering under OPEX response to IG-15-1 AR 2463300-07. The Design temperature and pressure of the seal leak off line up to the flow limiting venturi flow meters per the associated isometric drawings C-381-357 series is 650°F and 2485 psig. The line segments were originally analyzed for a worst case transient of 552.5°F and 2485 psig under analyses SDTAR-80-05-118, 119, and 035. These analyses apply Equations 11, 13, and 14 of ASME B31.1 -1973 to analyze pressure, deadweight, and thermal stresses in the piping. Equation 12 of B31.1 deals with pipe stresses from earthquakes. The stresses generated from an event described herein are independent from earthquakes so that Equation 12 is not required to be considered. Equation 11 of B31.1 evaluates the piping for pressure and deadweight stresses. The pressure used by all three analyses for Equation 11 was 2485 psig. The allowable stress that the stress output values were compared to was Sh = 16,600 psi (allowable stress of A376 TP316 steel @ 650°F). The allowable stresses that were applied to equation 11 were based on a 650°F design temperature. Based on the pressure and allowable stresses used by the analyses, these bound the conditions of the BDB Event discussed herein. Equation 11 remains satisfied. Equations 13 and 14 of B31.1 consider thermal stresses to the piping. The worst case transient conditions that were applied to the piping for all three analyses for these equations were 2485 psig at 552.5°F. The piping meets the prescribed pressure for the	<u>Complete</u>

	BDB Event (applies to Eqn. 14 only). However, the temperature of the piping is expected to exceed the prescribed temperature by 7.5°F. This will cause stresses to the piping and supports to exceed those which were previously qualified by the following amount (70°F considered as ambient). [(560°F - 70°F) / (552.5°F - 70°F) – 1] x 100 = +1.554% The allowable stress that was considered by the analyses for Equation 13 was SA = 26,255 psi. This is less than the actual allowable (SA = 27,525 psi) of A376 TP316 steel at 650°F (bounding) for use by Equation 13. Since the allowable stress that is considered for Equation 14 is (SA + Sh), the allowable stress that was considered for Equation 14 is also bounded. The allowable stresses used by Equations 13 and 14 in the analyses meet the conditions of the described BDB Event. Pipe supports are evaluated using an absolute summation of forces for all events and comparing the stresses that are generated to the code allowable stresses. Applied forces to the system pipe supports will not increase by more than 1.544% as was previously calculated. NEI 12-06 is the implementation guide for Flex Strategies. Since this scenario is a Beyond Design Basis Event, NEI 12-06 may be invoked. The guidance in NEI 12-06, Section 7.3.1 indicates that code stress limits may be exceeded as long as the function of the structure or component is maintained. Since the seal leak-off piping and support stresses are not expected to increase by more than 1.554%, these may reach a point that is beyond the code allowable limits. However, based on this minimal increase the stresses will not reach the yield point since the code limits maintain stresses well below the yield point. The piping and supports will not fail and will maintain their function during	

	the event. In addition, the SDTAR analyses and associated Pipe Support analyses were reviewed for margin. Despite the increase in temperature, code allowable stress limits are expected to be met for the Piping and Supports during the described BDB Event. The piping downstream of the breakdown orifices is not qualified to withstand RCS pressures and temperatures. If the pipe were to rupture beyond the orifices, then RCS leakage would still be maintained since the breakdown orifices would remain intact. Since all piping and components upstream of the breakdown flow meters is high pressure/temperature rated, no operator action is credited for isolating any low pressure piping portions. No modifications to the SLO piping are necessary as structural integrity will be maintained. The components downstream of the flow meters past the piping class break as identified on the piping isometrics may be susceptible to over pressurization. Since these components are downstream of the flow restricting flow meters which provide choked flow, the seal leak rate would not worsen.	
SE 17-E RCS injection does not have primary and alternate injection points as specified by NEI 12-06, Section 3.2.2 and Table D-1. The NRC staff requests that the licensee make available for audit a strategy for RCS injection that conforms to NEI 12-06, or provides justification for an alternative to NEI 12-06.	An alternate strategy for alternate RCS injection has been developed with an alternate injection point as specified by NEI 12-06, Section 3.2.2 and Table D-1. In addition to the new Alternate RCS Injection system to inject borated water from the RWST through the SI Headers into the RCS (with portable diesel driven backup), an alternate means of providing RCS injection through an alternate injection point is available. This alternate means of injecting borated water into the RCS involves repowering a Charging Pump from the SAFW D/G utilizing temporary power cables and	<u>Complete</u>

	manually lining up to inject from the RWST to the RCS through AOV-392A (Charging Valve Regenerative Heat Exchanger to Loop B Hot Leg), which opens at a 250 psig differential pressure to allow flow to the RCS. FSG-1, Long Term RCS Inventory Control, provides actions to restore RCS inventory. The primary method of RCS injection is to use the installed Alternate RCS Injection Pump powered from the SAFW D/G, taking suction on the RWST, and discharging to the SI headers. The alternate methods of RCS injection are to use the Alternate RCS Injection Diesel Driven FLEX Pump followed by Charging Pump 'B' to the alternate injection point. To use the Alternate RCS Injection Diesel Driven FLEX Pump, it is moved from its storage location to east of the SAFW Building and connected to the Alternate RCS Injection System via high pressure suction and discharge hoses. Pump suction is aligned to the RWST and discharge to the SI headers. If RCS injection via the installed Alternate RCS Injection Pump or the Alternate RCS Injection Diesel Driven FLEX Pump is not available, then RCS makeup is established using Charging Pump 'B' to the alternate injection point.	

MILESTONE SCHEDULE – ITEMS COMPLETE

Milestone	Completion Date
Commence Engineering and Design	July 2013
Commence Procurement of Equipment	July 2013
Commence Installation of Equipment	July 2013
Submit 6-Month Status Report	August 2013
Develop Strategies/Contract with the National SAFER Response Center	July 2015
Submit 6-Month Status Report	February 2014
Complete Engineering and Design	October 2015
Create Maintenance and Testing Procedures	October 2015
Submit 6-Month Status Report	August 2014
Procedure Changes Training Material Complete	November 2015

Milestone	Completion Date
Develop Training Plan	July 2015
Submit 6-Month Status Report	February 2015
Issue FLEX Support Guidelines	November 2015
Perform Walk-throughs or Demonstrations	November 2015
Provide onsite and augmented staffing assessment considering functions related to Near-Term Task Force (NTTF) Recommendation 4.2.	June 2015
Implement Training	October 2015
Submit 6-Month Status Report	August 2015
Complete Procurement of Equipment	October 2015
Full compliance with EA-12-049 is achieved	November 3, 2015
Submit Completion Report	December 2015

ORDER EA-12-049 COMPLIANCE ELEMENTS SUMMARY

The elements identified below for R. E. Ginna Nuclear Power Plant as well as the site OIP response submittal (References 5 and 6), the 6-Month Status Reports (References 7, 8, 9, 10, and 11), and any additional docketed correspondence, demonstrate compliance with Order EA-12-049.

Strategies - Complete

R. E. Ginna Nuclear Power Plant 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 R. E. Ginna Nuclear Power Plant 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 R. E. Ginna Nuclear Power Plant 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 R. E. Ginna Nuclear Power Plant has been procured in accordance with NEI 12-06, Sections 11.1 and 11.2, received at R. E. Ginna Nuclear Power Plant, initially tested/performance verified as identified in NEI 12-06, Section 11.5, and is available for use.

Maintenance and testing will be conducted through the use of the R. E. Ginna Nuclear Power Plant Preventative Maintenance program such that equipment reliability is achieved.

Protected Storage – Complete

The storage facilities required to implement the FLEX strategies for R. E. Ginna Nuclear Power Plant have been completed and provide protection from the applicable site hazards. The equipment required to implement the FLEX strategies for R. E. Ginna Nuclear Power Plant is stored in its protected configuration.

Procedures – Complete

FLEX Support Guidelines (FSGs) for R. E. Ginna Nuclear Power Plant 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 R. E. Ginna Nuclear Power Plant 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 R. E. Ginna Nuclear Power Plant has been completed in accordance with 10CFR50.54(f), "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force review of Insights from the Fukushima Dai-ichi Accident," Recommendation 9.3, dated March 12, 2012 (Reference 13), as documented in Reference 14.

National SAFER Response Center – Complete

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

Validation – Complete

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

FLEX Program Document - Established

The R. E. Ginna Nuclear Power Plant FLEX Program Document (CC-GI-118) has been developed in accordance with the requirements of NEI 12-06.

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

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 4th day of January 2016.

Respectfully submitted,

James Barstow
Director - Licensing & Regulatory Affairs
Exelon Generation Company, LLC

Enclosure:

R. E. Ginna Nuclear Power Plant Final Integrated Plan – Mitigating Strategies NRC Order EA-12-049

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Enclosure

R. E. Ginna Nuclear Power Plant

Final Integrated Plan – Mitigating Strategies NRC Order EA-12-049

(121 pages)

Exelon Generation®

R. E. GINNA NUCLEAR POWER PLANT

FINAL INTEGRATED PLAN

MITIGATION STRATEGIES (NRC ORDER EA-12-049)

December 2015

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1 Introduction

This integrated plan provides the R.E. Ginna Nuclear Power Plant (Ginna) approach for complying with Order EA-12-049 (Reference 1) using the methods described in NRC JLD-ISG-2012-01 (Reference 3).

1.1 Implementation Capability Requirements Overview

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

The FLEX strategy relies upon the following principles:

1. Initially cope by relying on installed plant equipment (Phase 1)
2. Transition from installed plant equipment to on-site FLEX equipment (Phase 2)
3. Obtain additional capability and redundancy from off-site resources until power, water, and coolant injection systems are restored or commissioned. (Phase 3)
4. Response actions are prioritized based on available equipment, resources, and time constraints. The initial coping response actions can be performed by available site personnel post-event.
5. Transition from installed plant equipment to on-site FLEX equipment involve on-site, off-site, or recalled personnel as justified by evaluation.
6. Strategies that have a time constraint to be successful are identified and a basis provided that the time can reasonably be met.

While initial approaches to FLEX strategies take no credit for alternate ac sources, credit is taken for an installed diesel generator (D/G) that can be manually connected to operate equipment utilized in FLEX strategies. This D/G is not connected to, and is not connectable, to the offsite or onsite emergency ac power systems.

An element of the set of strategies to maintain or restore core and SFP cooling and containment functions includes knowledge of the time that Ginna can withstand challenges to these key safety functions using installed equipment during a beyond-design-basis external event (BDBEE). This knowledge provides an input to the choice of storage locations and conditions of readiness of the equipment required for the follow-on phases. This duration is related to, but distinct from the specified duration for the requirements of 10 CFR 50.63, *Loss of all alternating current power*, (Reference 6) paragraph (a), because it represents our current capabilities rather than a required capability. As such Ginna 1) accounts for the SFP cooling function, which is not addressed by 10 CFR 50.63(a); and 2) assumes the non-availability of alternate ac sources, which may be included in meeting the specified durations of 10 CFR 50.63(a). This is implicit in the FLEX principles described in Section 3.2.1.7, Paragraph (6) and Section 3.2.2, Paragraph (1) of NEI 12-06 (Reference 4). Maintenance of the guidance and strategies addressing estimate of capability will be kept current to reflect plant conditions following facility changes such as modifications or equipment outages. Ginna recognizes that changes in the facility can impact the duration for which the initial response phase can be accomplished, the required initiation times for the transition phase, and the required delivery and initiating times for the final phase.

1.2 Implementation Plan

Capabilities for responding to ELAP and LUHS scenarios caused by BDBEEs are described in the following sections.

2 General Elements

2.1 Characterization of External Hazards

The applicable extreme external hazards for Ginna are seismic, external flooding, ice, snow, high winds (including tornadoes), low temperature and high temperature as detailed below:

2.1.1 Seismic:

Ginna has two license basis earthquake spectra. These spectra are Regulatory Guide (RG) 1.60 shapes with the Operating Basis Earthquake (OBE) having a peak horizontal ground acceleration of 0.08g and the Safe Shutdown Earthquake (SSE) having a peak horizontal ground acceleration of 0.20g (UFSAR, Reference 25). Per NEI 12-06 Section 5.2 (Reference 4), all sites will consider the seismic hazard.

The Ginna UFSAR (Reference 25) Section 2.5.3 was reviewed to perform a limited evaluation of the liquefaction potential outside the power block area for a SSE event. Two onsite slopes, whose failures may be of safety concern, were identified by Rochester Gas & Electric (RG&E). The first slope is located about 200 feet (ft) northwest of the turbine building while the second slope is located east of the screen house. Both slopes were excavated from the original ground elevation of about 270 ft down to elevation 255 ft in silty clay soil and were graded at approximately 7.5 horizontal to 1 vertical. In order to assess the stability of those slopes, assumptions have been made about the subsurface conditions and the soil parameters. Stability analyses, both static and pseudostatic with earthquake load, were performed by the NRC staff using a commercially available computer program, MCAUTO's "Slope" program. The results of the slope analyses performed by the NRC staff during the Systematic Evaluation Program show that the factors of safety against slope failure under both static and earthquake loading conditions are less than unity, indicating that these slopes are not stable and that failure would take place along an arc of radius about 175 ft. Since the slopes were not determined to be stable, the impact of their failures was further evaluated by the NRC staff. The most critical failure arc, as calculated, would intercept the slope at elevation 276 ft, adjacent to the crest and at elevation 257 ft, adjacent to the toe. The lateral spread of the slope failure adjacent to the toe is estimated by the staff to be somewhere around 8 ft, based on post-failure equilibrium. At the first slope, northwest of the turbine building, there is no structure nor equipment located within or adjacent to the slope except a roadway. Therefore, the failure of that slope would not pose any safety concern but might close the road. The second slope, east of the screen house, is sufficiently removed from any required safety-related equipment. Thus, its failure would not be of safety concern.

Ginna screened in for assessing seismic impact.

A soil liquefaction analysis (References 48, 49, 50, 51, and 52) was performed to ensure FLEX equipment could be deployed down the paths to reach the drafting station at the discharge canal following a seismic event.

The following conclusions from the analysis are noted:

- Liquefaction is not a concern for the large majority of the soil samples tested.

- The slopes to the west and east remain serviceable following an earthquake with no liquefaction concern.
- The roadway at the toe of the slope remains serviceable.

For the FLEX implementation project, (deployment path, not structures), the following conclusions from the analysis and in discussion with the preparer/reviewer it reasonable to assume that these slopes are the bounding case during a seismic event considering the site's topographic profile. Localized liquefaction of soils on the deployment path will not have a substantial effect due to:

- Of the reviewed soil samples, limited soil samples were noted to be capable of liquefaction
- There are no large loads (structures or bridges) located on deployment paths (universal stress field)
- The soil is confined (flat areas with no slopes to fail)
- If liquefaction occurs during a seismic event, some soil strength will be regained over time following the event.
- Debris remover may be utilized to negate any effects of liquefaction and transit the deployment path.

Large Portable FLEX equipment are secured, as appropriate, to protect them during a seismic event, and stored equipment and structures were evaluated and protected from seismic interactions, as appropriate, to preclude interaction during a seismic event that could cause damage to the equipment. ECP-15-000380, *FLEX Equipment Anchorage/Tie-Downs* (Reference 10) provides the seismic storage design requirements for FLEX equipment.

Conformance to NEI 12-06 Section 5.3.3, Considerations 2 and 3, is addressed as follows. Large internal flooding sources that are not seismically robust were evaluated for SEP topic IX-3 (Reference 15), and were reevaluated during IPEEE reviews as part of the Seismic Walkdowns (Reference 16). Failure of non-seismically qualified tanks in the Auxiliary Building could cause flooding in the Auxiliary Building subbasement where the Residual Heat Removal pumps are located. If a seismic event occurs while in lower modes, then Residual Heat Removal will be implemented in Phase 2. In this scenario, the water would be pumped from the subbasement to gain access to the equipment. Adequate resources (personnel and equipment) and time are allotted for this activity. The Intermediate Building, Standby Auxiliary Feedwater Building, Standby Auxiliary Feedwater Building Annex, Containment and Control Building do not have non-seismically qualified water sources that could cause internal flooding following a seismic event.

Conformance to NEI 12-06 Section 5.3.3, Consideration 4, is addressed as follows. Ginna is not impacted by failure of a not seismically robust downstream dam. Ginna is located on the South shore of Lake Ontario. Lake Ontario water levels are regulated by the Moses- Saunders power dam in Massena, NY. Levels currently range from 245.0 ft. to 246.7 ft. (IGLD85) (Reference 18). Prior to dam construction, the water level ranged from 242.6 ft. to 249.3 ft. (IGLD85). Failure of the Robert-Saunders Moses power dam would not have an adverse effect on the Ginna FLEX strategy.

2.1.2 External Flooding

Ginna is a "wet" site which means that portions of the plant are below the design basis flood level. The source of the event that leads to the design basis flood level of elevation

273.8' is regional precipitation resulting in a Probable Maximum Flood (PMF) (UFSAR, Reference 25). Per Table 6-1 of NEI 12-06, the warning time would be days and the persistence of the event could be many hours to days. Thus, Ginna screened in for assessing external flooding impact.

The probable maximum flood at Ginna is caused by an extreme regional precipitation event. NEI 12-06 Table 6-1 states that floods caused by regional precipitation events have days of warning time associated with them.

Regarding deployment of portable equipment during flooding: ER-SC.2, *High Water (Flood) Plan* (Reference 11), identifies two severity levels that exist with respect to external flooding: Level 1 and Level 2. The symptoms or triggers that initiate a Level 1 flooding condition are as follows: (1) 5 inches of rain over a 24-hour period forecasted in the next 3 days; (2) Shift Manager discretion. The symptoms that initiate a Level 2 flooding condition are as follows: (1) Forecasted rainfall of 10 inches or more within the next 24 hours; (2) Lake level rises to a level of 252 ft., as noted in the discharge canal and a continued rise is observed or expected; (3) Flooding of Deer Creek reaches access road bridge handrail; (4) Wave action causes water splashing over discharge canal wall OR pushes water over the armor stone; (5) Flooding of the Screen House or Turbine Building Basement; (6) Shift Manager discretion.

Per ER-SC.2, during a Level 1 flooding condition, personnel are dispatched to place FLEX dewatering pumps in the following areas: Auxiliary Building/RHR Subbasement; inside engineered barriers in the Turbine Building Basement near Emergency D/G Rooms and inside engineered barriers in the Turbine Building Basement near the Battery Rooms. The 100 KW portable FLEX D/G is to be staged on the Turbine Building Operating Floor as a source of power for the dewatering pumps. Additionally, in accordance with ER-SC.2, personnel are to move portable FLEX equipment (2 diesel driven portable FLEX pumps and portable FLEX fuel transfer pump) and trailers to high ground (SW of Engineering Building, High Integrity Container Storage Facility or other location approved by Engineering). It should be noted that these are contingency actions and are not credited as FLEX strategies. Credited FLEX equipment consists of the doors and seals of the Battery Rooms, Air Handling Room, and the Diesel Generator Rooms. No flooding of the Auxiliary Building is anticipated during the Probable Maximum Flood.

As previously stated, the 100 KW portable FLEX D/G is used as a source of power for the FLEX dewatering pumps. Details related to fuel consumption of the 100 KW portable FLEX D/G are documented in DA-ME-14-003, *Fukushima Fuel Consumption Analysis* (Reference 24). Table 2 of this analysis concludes that it would take approximately 12.1 hours for the 100 KW portable FLEX D/G to deplete its fuel tank (conservatively assuming an initial fuel oil level of 55% at the beginning of the event). According to DA-ME-15-006, *Fukushima Timeline Analysis* (Reference 30), the flooding event only has a persistence of 10 hours; as a result, a sufficient amount of fuel oil exists within the 100 KW portable FLEX D/G to operate throughout the duration of the flood. Should refueling be required, STP-O-40.2, *Diesel Driven FLEX Generator Periodic/Annual Load Bank Test*, Attachment 4 (Reference 31), provides guidance for refueling the 100 KW portable FLEX D/G utilizing two FLEX Fuel Tank Trailers. Each fuel tank trailer contains 990 gallons of diesel fuel. For added conservatism, these tanks were not credited for use in DA-ME-14-003. Per ER-SC.2, during a Level 1 flooding condition, personnel are dispatched to fill the Diesel Fuel Truck and Fuel Trailers with Diesel Fuel and Stage at high ground onsite. As a result, approximately 1,980 gallons of non-utilized diesel fuel would be available for refueling the 100 KW portable FLEX D/G if required.

During a flood, access to the ultimate heat sink will be temporarily unavailable due to floodwater on site. NTTF Recommendation 2.1 flooding reevaluation results (Reference 42) show that the persistence of the flood is approximately 10 hours. Ginna has installed a 160,000 gallon SAFW DI Water Storage Tank which has adequate inventory for approximately 24 hours of heat removal. This tank is protected from all events (seismic, tornado and flood), and will be used as a heat sink until the ultimate heat sink is available.

With respect to core cooling, the SAFW pumps are credited FLEX components, as outlined in DA-ME-15-006. Consequently, ER-SC.2 requires Operations to evaluate if city water should be aligned to the SAFW pumps during Level 1 and Level 2 flooding conditions. It should be noted that the SAFW DI Water Storage Tank is the credited source of water for the SAFW pumps. Similarly, the SAFW pumps are credited for core cooling during a tornado event. The installation of ECP-14-000749, *SAFW AB Cross Tie (Fukushima)* (Reference 45), ensures the capability to provide flow to both Steam Generators from either SAFW pump.

The required flood barriers used by Ginna are stored immediately adjacent to the openings in which they are to be installed. The installation of these barriers is performed on an annual frequency for testing. Ginna has also validated that the barriers can be installed rapidly during a reasonable simulation (Reference 56) performed per Recommendation 2.3 of the March 12, 2012 50.54(f) letter (Reference 7). Additional barriers were purchases for defense-in-depth protection of the Diesel Generator Rooms and the Battery Rooms. These are not required to mitigate a flood, and are stored in a storage building on-site.

Connection points for portable equipment remain viable for flooded conditions as specified in NEI 12-06, Section 6.2.3.2, Consideration 5. With respect to core cooling, the SAFW pumps are credited FLEX components (DA-ME-15-006, Reference 30). Prior to flooding conditions an operator will be staged in the SAFW Building to operate the SAFW Pump as needed. It should be noted that the credited source of water during a beyond design basis external flooding event is the SAFW DI Water Storage Tank (TCD05). Neither the SAFW DI Water Storage Tank nor the SAFW Pumps are impacted by an external flood. In the event that both SAFW Pumps and both Fukushima/NFPA Diesel Generators (KDG08 and KDG09) fail, a portable FLEX pump could be installed to provide flow directly to the Steam Generators. This is considered an N+1 scenario and as a result is not time critical. Therefore, an adequate amount of time would have elapsed following the event such that floodwaters would have receded and debris would be removed prior to installing a portable FLEX pump.

There is no adverse change to the alternate Residual Heat Removal (RHR) strategy during an external flooding scenario. All equipment utilized for alternate RHR is located in the Auxiliary Building Subbasement, which is not impacted by an external flood. Similarly, the connection points and equipment deployment areas to supply Lake Ontario water to an RHR Heat Exchanger are not impacted by an external flooding event. Considering floodwaters recede within 10 hours of the event and NSRC equipment does not arrive for 24 hours following the event, adequate time would be available to remove debris from equipment deployment areas and connection points prior to equipment arrival and installment.

Per DA-ME-15-006, all equipment responsible for RCS makeup and the associated connection points are protected during a beyond design basis external flooding event.

To maintain Containment integrity during ELAP conditions, long term cooling will be established using NSRC equipment. This equipment will provide flow to the Containment Recirculation Fan Coolers (CRFCs) through Service Water (SW) connection points located in the Intermediate Building Basement. While the Intermediate Building Basement is subject to flooding, Containment cooling is not needed for at least 36 hours, which is well past the 10 hour flood duration.

Spent Fuel Pool (SFP) makeup will be accomplished using a portable FLEX pump with water supplied from Lake Ontario. Connection points for SFP makeup exist at the pool and in the basement of the Auxiliary Building. Since SFP makeup is not required until at least 21 hours after the event and floodwaters recede within 10 hours of the event, neither of these connection points are impacted by external flooding conditions.

2.1.3 Severe Storms with High Winds:

Per Figure 7-1 of NEI 12-06, Ginna has a 1 in 1 million chance per year of a hurricane induced peak-gust wind speed of < 120 miles per hour (mph). Thus, the site does not need to assess the impact of extreme straight winds.

Per Figure 7-2 of NEI 12-06, Ginna has a 1 in 1 million chance of tornado wind speeds of 169 mph. As this is greater than the threshold of 130 mph, the site assessed tornadoes and tornado missiles impact.

In accordance with NEI 12-06, Section 7.3.1, protection of FLEX equipment from high wind hazards can be accomplished by storing equipment in a structure that meets the plant's design basis for high wind hazards (e.g., existing safety-related structure); or in storage locations designed to or evaluated equivalent to American Society of Civil Engineers (ASCE) 7-10, Minimum Design Loads for Buildings and Other Structures, given the limiting tornado wind speeds from Regulatory Guide 1.76 (Reference 61); or in evaluated storage locations separated by a sufficient distance that minimizes the probability that a single event would damage all FLEX mitigation equipment such that at least N sets of FLEX equipment would remain deployable following the high wind event. Consistent with this guidance, Ginna takes the following approach to protect installed plant equipment and FLEX equipment from high wind hazards, specifically tornados and tornado missiles:

- For conservatism, Ginna designed the structural walls and roof of the new "robust structure" housing the "N" set of FLEX mitigation equipment to the Regulatory Guide 1.76 tornado wind speed and suite of tornado missiles. However, the building's entranceway and openings (e.g., as needed for ventilation) are designed to withstand the plant's design basis tornado (i.e., 132 miles per hour wind speed) and tornado missile spectrum. This is consistent with NEI 12-06, Section 7.3.1.1.a.
- Furthermore, the "+1" equipment and support equipment will generally be housed in a New York State (NYS) Building Code commercial structure, in an "evaluated storage location" per NEI 12-06, Section 7.3.1.1.c. Distance separation is not applicable in this situation, since the means used to minimize the probability that a single event would damage all FLEX mitigation equipment is the use of a robust structure to house the N sets. Any stored mitigation equipment exposed to the wind will be adequately tied down to prevent it from being damaged or becoming airborne, in accordance with NEI 12-06, Section 7.3.1.1.b.

- Other plant structures and equipment (e.g., fuel or water tanks) which are needed to withstand tornados and tornado missiles will be designed/evaluated to Ginna's current licensing basis tornado: a 132 miles per hour (mph) wind speed (Updated Final Safety Analysis Report (UFSAR) Sections 2.3.2.2 & 3.3.4.1, Reference 25), and missiles consisting of an eight pound steel rod, 1-inch diameter and 3-feet long, traveling at 60% of the tornado wind speed and a 1490 pound wooden utility pole, 13.5-inch diameter and 35-feet long, traveling at 40% of the tornado wind speed (UFSAR Section 3.3.3.1). As demonstrated in a Structural Upgrade Program submittal to the NRC (Reference 69) and approved in the Safety Evaluation Report on the Structural Upgrade Program (Reference 70), wind speeds lower than approximately 150 mph cannot provide the necessary aerodynamic lift required for a utility pole to become an airborne missile (UFSAR Section 3.3.5.4.1); therefore impact considerations for the utility pole are at grade level only.

The above tornado protection design criteria are consistent with Ginna's current design basis, and therefore meets the requirements of NEI 12-06, Section 7.3.1.1. (Commitment in Reference 65: Clarification to April 7, 2014 Supplemental 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)). Ginna has designed tornado protection based on these design criteria.

2.1.4 Snow, Ice, and Extreme Cold:

The guidelines provided in NEI 12-06 (Section 8.2.1) generally include the need to consider extreme snowfall at plant sites above the 35th parallel. Ginna is located at latitude 43°16.7'N and longitude 77°18.7'W. Ginna is located above the 35th parallel (Reference 25, Section 2.1.1); thus, the capability to address hindrances caused by extreme snowfall with snow removal equipment is provided. Per Section 8.2.1 of NEI 12-06, "It will be assumed that this same basic trend applies to extremely low temperatures." The lowest recorded temperature for the site region is -16°F (Reference 63).

Ginna is located within the region characterized by the Electric Power Research Institute (EPRI) as ice severity level 5 (Reference 4, Figure 8-2).

Thus, Ginna screens in for assessing snow, ice, and extreme cold.

2.1.5 High Temperatures:

Per NEI 12-06 Section 9.2, all sites will address high temperatures for impact on deployment of FLEX equipment. The maximum temperature observed for the site region has been 100°F (Reference 63). Extreme high temperatures are not expected to impact the utilization of off-site resources or the ability of personnel to implement the required FLEX strategies.

Thus, Ginna screens in for assessing High Temperatures.

FLEX equipment can operate under extreme hot and cold temperatures. Flex Pumps (3), the portable Alternate RCS Injection pump, the air compressors (2), and the Flex 100 KW Diesel Generator are all equipped with engine block heaters and battery tenders. Two FLEX Pump units, the portable Alternate RCS Injection pump, an air compressor, and the 100 KW D/G are stored in a commercial structure with the 3rd Flex Pump stored in a robust structure (SAFW Annex) that is protected from floods, tornados, and earthquakes. One compressor is stored in a robust structure. The robust structures are temperature controlled as well.

For the 100 KW D/G the design temperature specifications for the control unit indicate a range of minus 40°F to 158°F with an Engine Derate indicated for ambient temperatures greater than 122°F. This temperature range bounds those experienced at Ginna.

For the Flex Pump engine there is no max ambient temperature indicated in the specifications. Only if the operating (coolant) temperature indicates greater than 234°F is it recommended that load be reduced on the engine. For cold weather concerns a block heater is recommended for temperatures down to 0°F, which is currently used.

2.2 Key Assumptions

Key assumptions associated with implementation of FLEX Strategies for Ginna are described below:

- The event impedes site access as follows: (NEI 12-01, Reference 5).
  - Post event time: 6 hours – No site access. This duration reflects the time necessary to clear roadway obstructions, use different travel routes, mobilize alternate transportation capabilities (e.g., private resource providers or public sector support), etc.
  - Post event time: 6 to 24 hours – 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).
  - Post event time: 24+ hours – 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.
- The normal emergency response capabilities are used as defined in the facility emergency plan, as augmented by NEI 12-01, Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities.
- Following plant conditions exist for the baseline ELAP case:
  - Seismically designed Direct Current (DC) battery banks are available.
  - Seismically designed Alternating Current (AC) and DC distribution available.
  - Entry into Extended Loss of AC Power (ELAP) will occur by the one hour point.
  - Best estimate decay heat load analysis and decay heat is used to establish operator time and action.
  - All installed emergency and Station Blackout (SBO) AC sources are not available.
  - No additional failure of Structures, Systems, or Components (SSCs) is assumed.
- Portable FLEX components were procured commercially.

  FLEX equipment was purchased commercially that would be transportable and inherently rugged. Power Prime Pumps (Flex Pumps) are currently in use at FRAC sites and oil fields worldwide and subject to extreme conditions. The maximum temperature observed for the site region has been 100°F. From the John Deere Operators manual section, "Operating in Warm temperature Climates – John Deere engines are designed to operate using glycol base engine coolants." From the Cummins Operators Manual (100 KW D/G) – if operation in high temperature environments is anticipated, increase the frequency of coolant level checks. Neither of these sections place any limits on operation with high temperatures. The air compressors are designed to operate in ambient temperature ranges of -20°F to 125°F. During hot weather operation, engine coolant should be checked daily or before each shift.

From the John Deere Operators manual – "John Deere engines are designed to operate effectively in cold weather". From the Cummins Operators Manual – use of a coolant heater will help provide reliable starting under adverse weather conditions. All Ginna Flex designated diesel engines have "battery conditioners" and "block heaters". The "N" designated "Flex Portable Pump" is stationed in an environmentally controlled building to allow for immediate use. Designated N+1 equipment are stored in a structure that protects the equipment from weather hazards. This ensures reliable starting of equipment under extreme weather conditions.

It is desirable for diverse mitigation equipment to be commonly available such that parts and replacements can be readily obtained. The functionality of the equipment may be outside the manufacturer's specifications if justified in a documented engineering evaluation.

- 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 beyond-design-basis event by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities. Though specific strategies are 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 were incorporated into the unit 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 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 beyond-design-basis event may place the plant in a condition where it cannot comply with certain Technical Specifications and/or with its Security Plan, and, as such, may warrant invocation of 10 CFR 50.54(x) and/or 10 CFR 73.55(p) (Reference 67).
- Normal operating ranges for pressure, temperature, and water level for the appropriate plant conditions were assumed or conservative values were used, such as with existing analyses. All plant equipment is assumed to be either normally operating or available from the standby state as described in Ginna's design and licensing basis.
- The following additional boundary conditions are applied for the reactor transient:
  - Following the loss of all ac power, the reactor automatically trips and all rods are inserted (a stuck rod is not assumed for analyses).
  - The main steam system valves (such as main steam isolation valves, turbine stops, atmospheric dumps, etc.), necessary to maintain decay heat removal functions operate as designed. (If functions are not robust to the event, they are assumed to fail.)

- Safety/Relief Valves (S/RVs) or Power Operated Relief Valves (PORVs) initially operate in a normal manner if conditions in the RCS so require. Normal valve reseating is also assumed. (If functions are not robust to the event, they are assumed to fail.)
- No independent failures, other than those causing the ELAP/LUHS event, are assumed to occur in the course of the transient.

- Maximum environmental room temperatures for habitability or equipment availability are based on NUMARC 87-00 (Reference 47).
- The fire protection ring header is not considered robust with respect to all events and is not relied upon as a water source.

2.3 Extent to which the guidance is being followed

Ginna has several deviations to the guidance in JLD-ISG-2012-01 and NEI 12-06:

NEI 12-06 initial condition 3.2.1.3(2) states "All installed sources of emergency on-site ac power and SBO Alternate ac power sources are assumed to be not available and not imminently recoverable" and in Section 2.1 that initial approaches to FLEX strategies will take no credit for ac power supplies. Credit is being taken for an installed 1 MW FLEX D/G, which is not connected to, and is not connectable to the offsite or onsite emergency ac power systems (and thus is not defined as an alternate AC source). This D/G is able to be connected to a SAFW pump to provide Phase 1 makeup to a steam generator (S/G) for Reactor Coolant System (RCS) cooling and heat removal. These modifications were made due to the assumed failure of the Turbine Driven Auxiliary Feedwater (TDAFW) Pump and water supply in a BDBEE. Additional details are provided under safety strategy Maintain Core Cooling and Heat Removal (Steam Generators Available).

In Reference 68 the NRC staff considered the design features of the 1 MW FLEX D/G, especially its independence from other plant systems and structures, and found that crediting that D/G is an acceptable alternative to the NEI 12-06 guidance. The NRC staff also noted that the Ginna has an alternate Phase 2 strategy for feeding the S/Gs for decay heat removal. This strategy utilizes a diesel driven portable FLEX pump, aligned to take suction from the new SAFW DI Water Storage Tank, with the capacity to maintain the required level in the S/Gs with the S/Gs at the target pressure of 260 psig, which corresponds to about 410 degrees Fahrenheit (°F) in the cold legs of the RCS. This alternate strategy does not use the SAFW D/G or the SAFW pumps.

The NRC staff also considered if Ginna would need a relaxation from Order EA-12-049 to credit the use of the SAFW D/G. The order states, in part, that:

> *These strategies must be capable of mitigating a simultaneous loss of all alternating current (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 this Order.*

The NRC staff found that Ginna's proposed strategies could demonstrate compliance with the order (assuming satisfactory resolution of the confirmatory items), and therefore that no relaxation to the order is required in order to credit the use of the 1 MW FLEX D/G.

Exelon proposed the following alternative approaches to NEI 12-06 Revision 0 (Reference 4) and provided the basis for the alternative approach in the August 2015 Six-Month Status Report (Reference 72):

Exelon proposed an alternate approach to NEI 12-06 for having an auto start feature for the new 1 MW FLEX D/G in the SAFW Annex, which automatically energizes its associated bus.

Proposed Alternative:

In this alternate approach, upon loss of normal yard 12.47 KV power to the SAFW Building loads and D/G auxiliary load equipment (i.e., block heaters, engine battery, chargers, etc.) an automatic transfer switch (ATS) will automatically initiate a command to start the 1 MW FLEX D/G and, once stable, swap the source power from the normal yard power to the SAFW switchgear power and take on the loads connected to new panel ACPDPAF04 and, through it, to a new 120/208V Power Transformer (PXAF02) to supply new power panel ACPDPAF05.

Basis for the alternative approach:

The existing normal power to the SAFW pump motors is 480VAC, 3-phase, 60 Hz power from safety-related Bus 14 and Bus 16. With implementation of modification ECP-12-000459, *DDSAFW Project Electrical Design and Installation* (Reference 75), upon loss of normal bus power, the operators are able to manually transfer the power source to the SAFW pump motors from their normal power source to the 1 MW FLEX D/G via Class 1E manual transfer switches 43/PSF01A and 43/PSF01B (Figure 1). ECP-12-000459 supplies the 1 MW FLEX D/G Non-Safety Related Emergency source of power to these switches. For use in emergencies, the Operators will start the D/G manually if it has not started prior to this time due to the loss of normal yard 12.47 KV power. With the generator bus voltage achieving a nominal 480V within 10 seconds, the operator can then manually start the SAFW pumps and other FLEX loads. The newly installed D/G and electrical distribution system is completely independent, and physically separated from the plant electrical distribution system except at the connection to the Manual Transfer Switches. When normal yard power recovers, the automatic transfer switch is inhibited from transferring back to normal yard power until operator action is taken.

Use of the 1 MW FLEX D/G to power the SAFW pumps as a FLEX strategy was previously accepted as an alternative approach to NEI 12-06 (ML14007A704, Reference 68). While the D/G auto start feature was not identified prior to the ISE review, the auto start feature does not automatically power the SAFW pumps and other FLEX loads. The auto start feature is used to repower the 1 MW FLEX D/G auxiliary load equipment to maintain generator readiness for a BDBEE. Providing power to mitigation equipment from the 1 MW FLEX D/G must be performed manually as previously described. Exelon requests NRC Staff review and approval of this auto start feature as an acceptable alternative to the NEI 12-06 guidance.

Electrical isolations and interactions are addressed as follows: The FLEX Generators (Fixed and Portable) will initially be connected to a dead bus and will be isolated from the bus. Other sources of power to that bus will be verified to be unavailable and de-energized. This will preclude the possibility that the other potential power sources will also attempt to repower the same equipment. Overcurrent protection and electrical isolation is evaluated for the fixed FLEX generators installed per electrical design change package ECP-12-000459.

Procedure ECA-0.0, Loss of All AC Power (Reference 22) and Procedure FSG-4 (Reference 76) provides necessary actions to prolong essential equipment and control power long enough to deploy and use FLEX equipment for plant recovery.

See Figure 4: 480 VAC Single Line Diagram BDBEE Flow Path.

Exelon proposed an alternate approach to NEI 12-06 for protection of FLEX equipment as stated in Section 5.3.1 (seismic,) Section 7.3.1 (severe storms with high winds), and Section 8.3.1 (impact of snow, ice and extreme cold).

Proposed Alternative:

This alternate approach will be to store "N" sets of equipment in fully robust buildings and the +1 set of equipment in a commercial building. For all hazards scoped in for the site, the FLEX equipment will be stored in a configuration such that no one external event can reasonably fail the site FLEX capability (N).

Basis for the alternative approach:

To ensure that no one external event will reasonably fail the site FLEX capability (N), Exelon will ensure that N equipment is protected in robust buildings. To accomplish this, Exelon will develop procedures to address the unavailability allowance as stated in NEI 12-06 Section 11.5.3., (see Maintenance and Testing section below for further details). This section allows for a 90-day period of unavailability. If a piece of FLEX equipment stored in the robust building were to become or found to be unavailable, Exelon will impose a shorter allowed outage time of 45 days. For portable equipment that is expected to be unavailable for more than 45 days, actions will be initiated within 24 hours of this determination to restore the site FLEX capability (N) in the robust storage location and implement compensatory measures (e.g., move the +1 piece of equipment into the robust building) within 72 hours where the total unavailability time is not to exceed 45 days. Once the site FLEX capability (N) is restored in the robust storage location, Exelon will enter the 90-day allowed out of service time for the unavailable piece of equipment with an entry date and time from the discovery date and time.

Maintenance and Testing

- The unavailability of equipment and applicable connections that directly performs a FLEX mitigation strategy for core, containment, and SFP should be managed such that risk to mitigating strategy capability is minimized.
  - o 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.
  - o 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.
  - o The duration of FLEX equipment unavailability, discussed above, does not constitute a loss of reasonable protection from a diverse storage location protection strategy perspective.
  - o 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.

- o 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.

For NEI 12-06 Section 5.3.1, seismic hazard, Exelon will also incorporate these actions:

- Large portable FLEX equipment such as pumps and power supplies should be secured as appropriate to protect them during a seismic event (i.e., Safe Shutdown Earthquake (SSE) level).
- Stored equipment and structures will be evaluated and protected from seismic interactions to ensure that unsecured and/or non-seismic components do not damage the equipment.

For NEI 12-06 Section 7.3.1, severe storms with high winds, Exelon will also incorporate this action:

- For a 2-unit site, (N+1) of on-site FLEX equipment are required. The plant screens in per Sections 5 through 9 for seismic, flooding, wind (both tornado and hurricane), snow, ice and extreme cold, and high temperatures.
  - o To meet Section 7.3.1.1.a, either of the following are acceptable:
    - All required sets (N+1) in a structure(s) that meets the plant's design basis for high wind hazards, or
    - (N) sets in a structure(s) that meets the plant's design basis for high wind hazards and (+1) set stored in a location not protected for a high wind hazard.

For NEI 12-06 Section 8.3.1, impact of snow, ice and extreme cold, Exelon will also incorporate this action:

- Storage of FLEX equipment should account for the fact that the equipment will need to function in a timely manner. The equipment should be maintained at a temperature within a range to ensure its likely function when called upon. For example, by storage in a heated enclosure or by direct heating (e.g., jacket water, battery, engine block heater, etc.).

Exelon will meet all of the requirements in NEI 12-06 Section 6.2.3.1 for external flood hazard and Section 9.3.1 for impact of high temperatures.

Exelon proposed an alternative approach to the N+1 requirement applicable to hoses and cables as stated in Section 3.2.2 of NEI 12-06. NEI 12-06, Section 3.2.2 specifically states that a site will have FLEX equipment to meet the needs of each unit on a site plus one additional spare. This is commonly known as N+1 where N is the number of units at a given site. The relevant text from NEI 12-06 is as follows: "In order to assure reliability and availability of the FLEX equipment required to meet these capabilities, the site should have sufficient equipment to address all functions at all units on-site, plus one additional spare, i.e., an N+1 capability, where "N" is the number of units on-site. Thus, a two-unit site would nominally have at least three portable pumps, three sets of portable ac/dc power supplies, three sets of hoses & cables, etc."

NEI 12-06, Section 11.3.3 states: "FLEX mitigation equipment should be stored in a location or locations informed by evaluations performed per Sections 5 through 9 such that no one external event can reasonably fail the site FLEX capability (N)."

Typically the hoses utilized to implement a FLEX strategy are not a single continuous hose but are composed of individual sections of a smaller length joined together to form a sufficient length. In the case of cables, multiple individual lengths are used to construct a circuit such as in the case of 3-phase power.

Proposed Alternative:

NEI 12-06 currently requires N+1 sets of hoses and cables. As an alternative, the spare quantity of hose and cable is adequate if it meets either of the two methods described below:

Method 1: Provide additional hose or cable equivalent to 10% of the total length of each type/size of hose or cable necessary for the "N" capability. For each type/size of hose or cable needed for the "N" capability, at least 1 spare of the longest single section/length must be provided.

- Example 1-1: An installation requiring 5,000 ft. of 5 in. diameter fire hose consisting of 100 50 ft. sections would require 500 ft. of 5 in. diameter spare fire hose (i.e., ten 50 ft. sections).
- Example 1-2: A pump requires a single 20 ft. suction hose of 4 in. diameter, its discharge is connected to a flanged hard pipe connection. One spare 4 in. diameter 20 ft. suction hose would be required.
- Example 1-3: An electrical strategy requires 350 ft. cable runs of 4/0 cable to support 480 volt loads. The cable runs are made up of 50 ft. sections coupled together. Eight cable runs (2 cables runs per phase and 2 cable runs for the neutral) totaling 2800 ft. of cable (56 sections) are required. A minimum of 280 ft. spare cable would be required or 6 spare 50 ft. sections.
- Example 1-4: An electrical strategy requires 100 ft. of 4/0 cable (4 cables, 100 ft. each) to support one set of 4 kv loads and 50 ft. of 4/0 (4 cables, 50 ft. each) to support another section of 4 kv loads. The total length of 4/0 cable is 600 ft. (100 ft. x 4 plus 50 ft. x 4). One spare 100' 4/0 cable would be required representing the longest single section/length.

Method 2: Provide spare cabling and hose of sufficient length and sizing to replace the single longest run needed to support any single FLEX strategy.

- Example 2-1 – A FLEX strategy for a two unit site requires 8 runs each of 500 ft. of 5 in. diameter hose (4000 ft. per unit). The total length of 5 in. diameter hose required for the site is 8000 ft. with the longest run of 500 ft. Using this method, 500 ft. of 5 in. diameter spare hose would be required.

For either alternative method, both the N sets of hoses or cables and the spare set of hoses or cables would all be kept in a location that meets the reasonable protection requirements for the site.

Basis for the alternative approach:

The NRC has endorsed (ML15125A442, Reference 77) the NEI position paper (ML15126A135, Reference 78) for the above stated alternate approach. If using Method 2, per the endorsement letter, Exelon will ensure that the FLEX pumps and portable generators are confirmed to have sufficient capability to meet flow and electrical requirements when a longer spare hose/cable is substituted for a shorter length. Exelon acknowledges the NRC staff has not reviewed and is not endorsing the specific examples included in the NEI endorsement request dated May 1, 2015. If necessary, Exelon will provide additional justification regarding the acceptability of various cable and hose lengths with respect to voltage drops, and fluid flow resistance, rather than merely relying on the additional, longest length cable/hose as implied by Example 1-4 in the subject letter.

Hoses and cables are passive devices unlikely to fail provided they are appropriately inspected and maintained. The most likely cause of failure is mechanical damage during handling provided that the hoses and cables are stored in areas with suitable environmental conditions (e.g., cables stored in a dry condition and not subject to chemical or petroleum products). The hoses and cables for the FLEX strategies will be stored and maintained in accordance with manufacturers' recommendations including any shelf life requirements. Initial inspections and periodic inspections or testing will be incorporated in the site's maintenance and testing program implemented in accordance with Section 11.5 of NEI 12-06.

Therefore, the probability of a failure occurring during storage is minimal, resulting in the only likely failure occurring during implementation. Mechanical damage will likely occur in a single section versus a complete set of hose or cable. Therefore, the N+1 alternative addresses the longest individual section/length of hose or cable.

Providing either a spare cable or hose of a length of 10% of the total length necessary for the "N" capability or alternatively providing spare cabling or hose of sufficient length and sizing to replace the single longest run needed to support any single FLEX strategy is sufficient to ensure a strategy can be implemented. Mechanical damage during implementation can be compensated for by having enough spares to replace any damaged sections with margin. It is reasonable to expect that an entire set of hoses or cables would not be damaged provided they have been reasonably protected.

Exelon proposed an alternate approach to NEI 12-06 for having primary and alternate injection points to the S/Gs for the portable FLEX S/G injection pump, as specified by NEI 12-06, Section 3.2.2 and Table D-1.

<u>Proposed Alternative:</u>

This alternate approach will be to have one connection point for the portable FLEX S/G injection pump. The portable FLEX S/G injection pump is located in the SAFW Building Annex and will be staged outside of this building if used. There is one connection point for the portable FLEX S/G injection pump discharge hose, which is inside the SAFW Building. An alternate injection point is not planned due to the multiple and diverse methods of delivering water to the S/Gs using the SAFW pumps powered by the SAFW D/G using the previously accepted alternative approach (ML14007A704, Reference 68) to NEI 12-06.

<u>Basis for the alternative approach:</u>

Ginna has multiple and diverse methods to deliver water to the S/Gs from a SAFW pump powered by the SAFW D/G. Only one of the two SAFW pumps is needed for performing the heat removal function. Either SAFW pump is capable of being powered by the SAFW D/G and can be aligned to feed both S/Gs through their discharge headers and one of two normally isolated cross connections between their discharge headers (See Figure 2 attached: FLEX SAFW System Pumps and Connections). One cross connection is located in the SAFW Building and the other cross connection is located in the Auxiliary Building.

The multiple and diverse methods of delivering water to the S/Gs using a SAFW pump or a portable FLEX S/G injection pump meets the intent of NEI 12-06 Section 3.2.2 and Table D-1. Exelon requests NRC Staff review and approval of this alternative approach as an acceptable alternative to the NEI 12-06 guidance.

2.4 Sequence of Events

Ginna has developed detailed timelines for each external event during all modes of operation (Reference 79). The detailed timelines describe the operator action time required, equipment deployment times, equipment operation times, and is resource loaded showing the number of resources used for each task. These timelines are used in conjunction with thermal hydraulic analysis to document the duration of each phase for each critical function, and the basis for the duration.

Ginna is relying on CLB analysis and where necessary, performing additional thermal hydraulic calculations using RELAP5 Modification 3.3 and GOTHIC versions 7.2 and 8.0. The timelines themselves serve as a basis for the FLEX strategies. This includes addressing the unresolved issue regarding the RCP seal leakage rates.

Ginna intends to utilize a scenario based transition to FLEX rather than a duration based transition. As an example, the transition to FLEX Auxiliary Feedwater will occur immediately after it has been determined that the normal Auxiliary Feedwater sources are not available.

See Attachment 1, Sequence of Events Timeline for an ELAP/ LUHS.

2.5 WCAP-17601-P Recommendations

WCAP-17601-P, *Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs,* (Reference 19) was reviewed and its guidance utilized to assist with development of the Ginna Integrated Plan. WCAP-17601-P was prepared to address the Pressurized Water Reactor Owners Group (PWROG) member's Nuclear Steam Supply Systems (NSSS) response to an extended loss of AC power (ELAP) event. The report documents studies that embraced a range of conditions and sensitivities associated with the ELAP event. This report includes information intended to assist the PWROG in understanding how each of their plant types will be able to cope with an ELAP. Analysis cases were developed to produce results that would be useful toward other industry initiatives and regulations that affect emergency preparedness including NEI 12-06 (Reference 4) and NRC Order EA-12-049, *Order to Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,* (Reference 1).

WCAP-17601-P Section 3.1 'Westinghouse' provides 10 recommendations for consideration in developing the FLEX mitigation strategies. Ginna's positions on these recommendations are as follows:

- The recommendation to minimize RCP seal leakage rates is applicable to Ginna. The ELAP mitigation strategy will utilize the ECA-0.0, *Loss of All AC Power,* (Reference 22) guidance to direct a cooldown of the RCS early in the event to reduce RCP seal leakage. Symmetric RCS cooldown will be performed utilizing both steam generators for RCP seal package temperature considerations.

- The recommendation to develop inventory coping times beyond the reference case by installing low leakage RCP seals was evaluated by Ginna, but will not be implemented due to the 10 CFR Part 21 issue that was identified by Westinghouse for their low leakage seals. As documented in WCAP-17601 Section 5.3.1.6, Ginna has the added benefit of coping time with its Model 93 RCPs (Reference 80) due to the leak donor locations being significantly elevated with respect to the Model 93A RCPs.
- Regarding the WCAP-17601 high level list of instrumentation for the RCS, in order to confirm / maintain adequate core cooling, Ginna is crediting instrumentation that has been previously evaluated as acceptable for coping with seismic, flooding, tornados, and loss of AC power events and are part of Ginna's current licensing basis. These instruments are described in the Integrate Plan and meet the NEI 12-06 guidance for PWR instrumentation in Section 3.2.1.10. These instruments support the key actions identified in plant procedures and/or guidance. This approach was accepted in the R. E. Ginna Nuclear Power Plant – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Reference 68), Section 3.2.1.5, Monitoring Instrumentation and Controls. FSG-7, *Loss of Vital Instrumentation or Control Power* (Reference 81), provides Operators the ability to obtain system parameters should the power to the instruments be lost or wiring damage that precludes the instrument from being read in the Control Room. The Operator will be able to obtain a reading in the Control Room (wiring intact) or at the Containment Penetration (field wiring not intact).
- The recommendation for maintaining a subcritical condition in the reactor core is applicable to Ginna. FLEX specific cycle generated curves will not be used for maintaining subcritical conditions. To supplement the existing cycle specific curves, bounding actions to maintain subcritical conditions are implemented in procedures. CALC-2014-0002, *Cycle 38 Reactor Engineering Calculations* (Reference 20), adds a new Section 8.23 and Attachment 11 for FLEX Boration Strategies. Depending on the scenario evaluated, a 40% or 15% uncertainty was applied to bound the calculation for elevated boron concentrations that may be applicable to future core designs. Since makeup to the RCS is required to maintain adequate inventory for natural circulation cooling, expectations are that the borated makeup strategy will provide adequate shutdown margin (Keff less than 0.99) for the realistic conditions and assumptions cited in WCAP-17601.
- The recommendation to supply 40 gpm of RCS makeup at 1500 psia is applicable to Ginna. A modification installed Alternate RCS Injection makeup capability of 75 gpm at 1500 psig. Makeup will be initiated prior to the transition from two-phase natural circulation to reflux boiling and with sufficient time to maintain shutdown margin with an hour margin for natural circulation conditions.
- As stated under recommendation 2 above, the recommendation to install low leakage seals was evaluated by Ginna but will not be implemented due to the 10 CFR Part 21 issue that was identified for the Westinghouse low leakage seal design.
- The recommendation to consider the prioritization of pre-staging a FLEX strategy for alternate feedwater additions, when time and resources permit, is applicable to Ginna. The primary FLEX strategy for alternate feedwater additions relies upon a SAFW pump powered by the SAFW D/G, which is an approved alternative in the *R. E. Ginna Nuclear Power Plant – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049* (Reference 68). In addition, the alternate strategy for feedwater addition relies upon one portable diesel driven FLEX pump and associated hoses stored in the new SAFW Annex (robust structure)

capable of feeding the steam generators. Deployment involves hooking up the suction and discharge hoses to the new condensate storage tank and AFW lines respectively, which are in close proximity to the portable diesel driven pump, and then perform the valve alignment, start the pump, and begin feeding. To prevent S/G overfill when the TDAFW pump is available, ECA-0.0 (Reference 22) directs the operators to monitor intact S/G levels and when narrow range level is GREATER THAN 7% [25% adverse CNMT] and to control AFW by throttling TDAFW flow control valves, or by throttling TDAFW pump discharge MOV-3996, or by locally throttling TDAFW flow control valves, or by starting and stopping the TDAFW pump.

- The recommendation to have a low pressure portable feedwater system capable of feeding the steam generators is applicable to Ginna. Ginna's flow and pressure requirements differ from the generic numbers provided in the recommendation, but it is noted that the recommended requirements may vary from one plant to another. The flow and pressure applicable to Ginna, which is stated in the Overall Integrated Plan, is 215 gpm and 290 psig. The pressure value is based on the ECA-0.0 Appendix A (Reference 22) direction to cooldown the RCS when establishing low pressure S/G feed by reducing steam generator pressure to 290 psig; and the flow value is based on the design flow for a SAFW pump, which meets decay heat removal requirements. As stated under recommendation 1 above, symmetric RCS cooldown will be performed utilizing both steam generators for RCP seal package temperature considerations.
- The recommendation to evaluate the strategy for accumulator makeup capability and isolation / venting to prevent gas injection is applicable to Ginna. ECA-0.0 Appendix A (Reference 22) directs operators to Depressurize Intact S/Gs to 290 psig when establishing low pressure S/G feed and then Perform FSG-10, *Passive RCS Injection Isolation* (Reference 82), to isolate or vent the SI Accumulators, thereby preventing N2 injection to the RCS. Boration requirements have been determined and are discussed under recommendation 4 above and are implemented in procedures ECA-0.0 (Reference 22) and FSG-1, *Long Term RCS Inventory Control*, (Reference 83).
- The recommendation to consider the prioritization of staging portable equipment that may be required to isolate/vent the accumulators when certain cooldown maneuvers are necessitated is applicable to Ginna. Following an ELAP event, there is a procedural requirement to cooldown/depressurize the RCS to reduce RCP seal leakage and to inject borated water from the SI Accumulators. SI Accumulator injection replaces fluid lost from the RCP seals and increases shutdown margin. It is also important to ensure that nitrogen in the SI accumulators does not enter the RCS because that could impede natural circulation. The plan to avoid injecting nitrogen into the RCS is to isolate or vent the SI Accumulators as follows:
    - FSG-10 (Reference 82) provides actions to isolate or vent the SI accumulators to prevent nitrogen injection. For ELAP events where electrical power is available from either the SAFW D/G or portable 100 KW D/G, and both MCC 'C' and MCC 'D' are accessible, power is restored to MCC 'C' and MCC 'D' by opening all input and output breakers and powering the MCC's via a battery charger breaker. Once MCC 'C' and MCC 'D" are energized, the SI Accumulator isolation valve breakers for MOV-841 and MOV-865 are closed and MOV-841 and MOV-865 are closed from the Control Room.
    - If both MCC 'C' and MCC 'D' cannot be repowered due to the ELAP event, or if the SI Accumulator isolation valves cannot be closed, then Instrument Air is established to Containment to vent the SI Accumulators. In this case a

portable diesel air compressor is staged, AOV-5392, Instrument Air Containment Isolation Valve, is removed, and the air hose is connected to the union of the instrument air pipe entering containment. Once Instrument Air is restored to Containment, the SI Accumulators can be vented from the Control Room by opening SI Accumulator N2 Fill/Vent AOVs 834A and 834B, and by opening the common SI Accumulator Vent Valve HCV-945.

2.6 RCP Seal Leakoff Line Integrity

Leakoff line integrity has been evaluated by design engineering under OPEX response to IG-15-1 AR 2463300-07. The Design temperature and pressure of the seal leak off line up to the flow limiting venturi flow meters per the associated isometric drawings C-381-357 series is 650°F and 2485 psig. The line segments were originally analyzed for a worst case transient of 552.5°F and 2485 psig under analyses SDTAR-80-05-118, 119, and 035 (References 84, 85, and 86). These analyses apply equations 11, 13, and 14 of ASME B31.1 -1973 to analyze pressure, deadweight, and thermal stresses in the piping. Equation 12 of B31.1 deals with pipe stresses from earthquakes. The stresses generated from an event described herein are independent from earthquakes so that equation 12 is not required to be considered.

Equation 11 of B31.1 evaluates the piping for pressure and deadweight stresses. The pressure used by all three analyses for Equation 11 was 2485 psig. The allowable stress that the stress output values were compared to was Sh = 16,600 psi (allowable stress of A376 TP316 steel @ 650°F). The allowable stresses that were applied to equation 11 were based on a 650°F design temperature. Based on the pressure and allowable stresses used by the analyses, these bound the conditions of the BDB Event discussed herein. Equation 11 remains satisfied.

Equations 13 and 14 of B31.1 consider thermal stresses to the piping. The worst case transient conditions that were applied to the piping for all three analyses for these equations were 2485 psig at 552.5°F. The piping meets the prescribed pressure for the BDB Event (applies to Eqn. 14 only). However, the temperature of the piping is expected to exceed the prescribed temperature by 7.5°F. This will cause stresses to the piping and supports to exceed those which were previously qualified by the following amount (70°F considered as ambient).

$[(560°F - 70°F) / (552.5°F - 70°F) - 1] \times 100 = +1.554\%$

The allowable stress that was considered by the analyses for equation 13 was SA = 26,255 psi. This is less than the actual allowable (SA = 27,525 psi) of A376 TP316 steel at 650°F (bounding) for use by Equation 13. Since the allowable stress that is considered for Equation 14 is (SA + Sh), the allowable stress that was considered for equation 14 is also bounded. The allowable stresses used by Equations 13 and 14 in the analyses meet the conditions of the described BDB Event.

Pipe supports are evaluated using an absolute summation of forces for all events and comparing the stresses that are generated to the code allowable stresses. Applied forces to the system pipe supports will not increase by more than 1.544% as was previously calculated.

NEI 12-06 is the implementation guide for Flex Strategies. Since this scenario is a Beyond Design Basis Event, NEI 12-06 may be invoked. The guidance in NEI 12-06, Section 7.3.1 indicates that code stress limits may be exceeded as long as the function of the structure or component is maintained. Since the seal leak-off piping and support stresses are not expected to increase by more than 1.554%, these may reach a point that is beyond the code allowable limits. However, based on this minimal increase the stresses will not reach the yield point since the code limits maintain stresses well below the yield point. The piping and supports will not fail and will maintain their function during the event.

In addition, the SDTAR analyses and associated Pipe Support analyses were reviewed for margin. Despite the increase in temperature, code allowable stress limits are expected to be met for the Piping and Supports during the described BDB Event.

The piping downstream of the breakdown orifices is not qualified to withstand RCS pressures and temperatures. If the pipe were to rupture beyond the orifices, then RCS leakage would still be maintained since the breakdown orifices would remain intact.

Since all piping and components upstream of the breakdown flow meters is high pressure/temperature rated, no operator action is credited for isolating any low pressure piping portions.

No modifications to the Seal Leakoff (SLO) piping are necessary as structural integrity will be maintained.

The components downstream of the flow meters past the piping class break as identified on the piping isometrics may be susceptible to over pressurization. Since these components are downstream of the flow restricting flow meters which provide choked flow. The seal leak rate would not worsen.

2.7 RCP Seal O-Ring Integrity

The NRC Flex Audit in April 2015 requested that Ginna make available for audit a list of where the B type O-ring (Seals Eastern 7228-B) are located and provide an evaluation of the impact of high temperatures on those O-rings. The concern is that the 7228-B high temperature O-rings are only qualified to 550°F. These O-rings may be exposed to 556.3°F RCS water during BDB ELAP scenarios. Westinghouse has qualified the current generation O-ring (7228-C) to 582°F (The material specification is the same for the 7228-B and 7228-C compound O-rings. High temperature performance (e.g., extrusion resistance) is expected to be the same for both O-rings.). The "A" RCP contains all 7228-C O-rings. The NRC is requesting an evaluation of the impact of high temperatures on 7228-B compound O-rings and the plan to replace these O-rings by the Flex Compliance date (November, 2015).

The following list shows the locations of the "B" compound O-ring (7228-B);

- RCP A – All O-rings are 7228-C compound
- RCP B – Six 7228-B compound O-rings are currently installed in the B RCP seal package and are scheduled to be replaced in 4/2017.

The 4/2017 refueling outage will provide the normally scheduled PM maintenance window for the major inspection of the B RCP seal package. The following provides justification for use of the 7228-B compound O-ring in the B RCP until replacement during the 4/2017 seal maintenance. Note: The current stock of RCP O-rings (Seal Service Kit – Item # G9111263 and the Seal Rebuild Kit – Item # G9111271) only contain 7228-C O-rings. All future RCP seal maintenance will only use 7228-C compound or 7228-D compound O-rings.

Discussion

The 7228-B compound O-rings in the #1 seal ring and runner (Westinghouse P/N 4389B72X72) are located between the ceramic faceplates and the corresponding stainless steel seal support housing. These are stationary O-rings that create a seal on the bottom side of the precision machined ceramic faceplate and associated housing. Failure of these O-rings would result in increased leakage to the inlet of the number 2 seal. This leakage would be contained (and limited) by the number 2 seal and the flow restricting venturi in the seal return line. The clearance between the ceramic faceplate and the corresponding stainless steel seal support housing is approximately 0.002 inch as shown in Table 6-1 of WCAP-10541 Revision 2 (Reference 87).

The remaining four 7228-B compound O-rings (Westinghouse P/N 4389B72E75, 620B492E79 and 4395B55E06) are all located in stationary locations in the #2 seal housing or downstream of the #2 seal. The clearance at these locations ranges from 0.0 inches to approximately 0.018 inches (WCAP-10541 Revision 2). There are no 7228-B compound O-rings in the most critical locations which are the #1 and #2 channel seals.

WCAP-10541 Revision 2 discusses qualification testing for the early generation of High Temperature O-rings (Seals Eastern 7228 and 7228-A compound) in Section 6. The qualification testing of the 7228 series compound was completed using the 1-F and 2-D locations shown in Table 6-1 and Figure 6-1 of WCAP-10541. Testing was completed at 0.018 inch gap and 550°F/1800psid and 0.031 inch gap and 550°F/1200psid for a minimum of 18 hours.

WCAP-10541 highlights that 4 of the most critical parameters affecting extrusion failure are: 1) differential pressure, 2) temperature, 3) extrusion gap and 4) time at elevated temperature and pressure.

The qualification of the 7228-B compound was completed in the same manner as the 7228-A compound. The 7228-B compound O-rings were tested to 1800 psid. From PWROG-14015-P (Reference 88), Table 6, Category 1 plants (includes Ginna) have a maximum pressure at the pump outlet (i.e., outlet of the #1 seal) of 951 psia at a cold leg pressure of 2250 psia. Based on this information, the following conclusions are made for the 7228-B compound O-rings installed in the Ginna B RCP:

1. The differential pressure across the two 7228-B compound O-rings in the #1 seal ring and runner would be 1299 psid (2250 psia – 951 psia = 1299 psid). Since the gap at these locations (0.002 inch) and differential pressure (1299 psid) are considerably less than the test conditions (0.018 inch/1800 psid and 0.031 inch/1200 psid), and since these are considered two critical parameters that significantly influence extrusion failure (WCAP-10541 page 6-7). Ginna considers the worst case ELAP conditions to be bounded by the qualification test parameters. This conclusion is also based on the maximum expected time (10

minutes (Qualification testing has shown that the 7228-B O-rings will last in excess of 18 hours at 550°F) and temperature above the qualification limit (6.3°F) as detailed in the temperature discussion below.

2. From PWROG-14015-P, Table 6, Category 1 plants (includes Ginna) have a maximum pressure at the pump outlet (i.e., outlet of the #1 seal) of 951 psia at a cold leg pressure of 2250 psia during ELAP conditions. The maximum RCS cold leg temperature during ELAP conditions based on the lowest SG Relief valve setting for Ginna of 1085 psig at saturation conditions equates to 556.3°F. The enthalpy at this condition (2250 psia/556.3°F) is 555 Btu/lbm. Assuming isenthalpic expansion of the fluid through the #1 seal, the following conditions will exist at the outlet of the #1 seal (inlet to #2 seal): P = 951 psia, H = 555 Btu/lbm, T = 539°F. This shows that the highest expected temperature at the #2 seal ring and downstream locations would be less that the 550°F qualification test temperature. Therefore, there is no elevated temperature concern for these O-rings.

Maximum Possible Time at Elevated Temperatures

The maximum RCS cold leg temperature during ELAP conditions based on the lowest SG Relief valve setpoint (saturated conditions at 1085 psig) is 556.3°F. During an ELAP event, the RCS average temperature is assumed to be the no load temperature of 547°F. This is achieved by local operator action (ECA-0.0 Step 3 RNO, per Phase 2 staffing study) completing at T+30 minutes. The Tcold at these conditions will be approximately 530°F. It is important to note that the Model 93 RCP includes a 54.5 gallon volume of 120°F cold water that will last for approximately 27 minutes before RCS water at 556.3°F reaches the #1 seal. This time assumes the historical value of 2 gpm seal leak-off from the B RCP.

Based on this sequence, the maximum time the #1 seal O-rings may be exposed to RCS water above 550°F is estimated to be 10 minutes (3 minutes from depletion of PV until the start of operator action to establish 547°F plus 7 minutes to establish 547°F). This assumption is conservative since heat capacitance of the thermal barrier, main flange, seal housing, pump shaft and bearing will likely prevent the temperature from exceeding 550°F.

Conclusion

Based on the bounding condition expected during ELAP events, there is reasonable assurance that O-ring extrusion failure will not occur. Therefore, Ginna considers it acceptable to operate with 7228-B O-rings installed in the B RCP until the next scheduled maintenance window in April of 2017 as supported by the following facts;

- Ginna will take prompt action (ECA-0.0 Step 3) to establish RCS Tavg at 547°F during ELAP scenarios
- The #1 seal O-rings may be exposed to the elevated temperatures for no more than 10 minutes
- The temperature at the #2 seal O-rings will not exceed 550°F
- The maximum possible temperature (556.3°F) is only 6.3°F above qualification test conditions
- The extrusion gap and postulated differential pressures are less than or equal to test conditions
- Testing has shown that the O-rings will last in excess of 18 hours at 550°F

2.8 RCP Seal Leakage

At this time the PWROG continues to resolve issues over the amount of RCP seal leakage that would be expected during an extended loss of ac power (ELAP) for reactors with the standard Westinghouse seals. The Ginna RCP seal leak rate profile and the analysis to validate the capability to maintain natural circulation core cooling used plant specific values/analyses, which are more conservative than those generic values listed in Westinghouse WCAP-17601-P, *Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs* (Reference 19).

NSAL-14-1 Revision 1 (Reference 89) was issued on 09/08/2014. Since its issuance, the PWROG has issued report PWROG-14015-P Revision 2 (April 2015) *No. 1 Seal Flow Rate for Westinghouse Reactor Coolant Pumps Following Loss of All AC Power-Task 2: Determine Seal Flow Rates* (Reference 88). This document provides much greater detail for the expected seal leakage values expected during a loss of all AC power compared to the generic information provided in NSAL 14-1. Ginna station is considered a "Category 1" plant within PWROG-14015-P Rev 2. The category signifies the seal leak-off line piping configuration that was analyzed within the document to summarize the expected leak rates for that configuration. Categorization of the different plants is documented within PWROG-14008-P (Reference 90). Ginna Isometric drawings of the seal leak-off piping along with engineered drawings of the flow meter venturis were provided to Westinghouse to assist in classification of the seal leak off line into category 1. Ginna has since reviewed the categorization and installed plant configuration and concurs in the categorization within PWROG-14008-P subsequently used within PWROG-14015-P.

PWROG-14027-P, *No. 1 Seal Flow Rate for Westinghouse RCPs following Loss of All AC Power, Task 3: Evaluation of Revised Seal Flow Rate on Time to Enter Reflux Cooling and Time at which the Core Uncovers*, (Reference 91) also classifies Ginna as a Category 1 plant. Compared to the Category 1 leak rate model input from the Westinghouse documents, Ginna has schedule 160 2" pipe, (ID of 1.689 therefore more conservative than 2.067-ID of Sch 40 pipe). Ginna piping is greater than 2 feet in length; therefore conservative. Ginna has more than one globe valve (valves 270 A, B and 293 A, B); therefore conservative. Ginna has more than 1 90 degree bend (5 between valve 293A and venturi 175, 3 between valve 293B and venturi 176); therefore conservative. Ginna flow element is 0.2321 inches; therefore conservative. Downstream piping is ¾ inch and exceeds 2 feet in length; therefore conservative. (Isometric drawings C-381-357 sheets 28, 29, and 34)

The maximum flow results within PWROG-14015-P for category 1 identify that 21 gpm is a conservative bounding value since the calculated maximum for category 1 is 17.5 gpm. (Note that for added conservatism Ginna assumed a 25 gpm leak rate per seal in RWA-1323-003 *Ginna RELAP5 ELAP analysis for Mode 1* (Reference 57); though Ginna agrees with the 17.5 gpm within the PWROG report).

Even given the increase in RCP seal leakage shown in NSAL-14-1 at lower pressures, Ginna's conservative RCP seal leakage assumptions provides significant margin to bound final resolution of NSAL-14-1 impact and thus, NSAL-14-1 has no impact on Ginna's strategies.

During Plant events that result in loss of reactor coolant pump (RCP) seal cooling; such as station blackout, extended loss of AC power, or fires that affect power supplies, the leakage through the RCP No. 1 seal increases. During the aforementioned event, without there being power to the CCW or Charging systems to provide seal water/cooling to the pumps, it would be possible for RCS water to enter the RCP No. 1 seal leak-off line piping. During such an event, this piping would be required to resist the worst-case design temperatures and pressures of the RCS so that the pressure boundary of the piping is not compromised.

For beyond design basis events, where RCP seal water is lost, the system is designed to withstand RCS cold leg pressure and temperature while maintaining RCS leakage below the analyzed limits. The system must withstand these temperatures and pressures from the RCP seal to the final set of Venturi breakdown orifices. These breakdown orifices (FE-175 and FE-176) have the most limiting diameter for the system and control system flow. The seal leak-off piping downstream of the seals, to the last break down orifices, has been reviewed to ensure that its design meets the required conditions that would be experienced during loss of RCP seal cooling.

Ginna's high pressure seal leak-off lines were originally analyzed to a transient value of 552.5°F and 2485 psig under the seismic upgrade program. (Note the drawings of the seal leakoff (SLO) lines identify the design conditions as 650°F and 2485 psig). PWROG-14015-P analyzes the leak rates for a temperature above 552.5°F but below 2485 psig. PWROG-14015-P Table 18 provides the recommended pressure and temperature to verify seal leak off line piping integrity. Due to Ginna's existing design condition of 2485 psig for the SLO piping, Ginna shows significant margin to the expected 2045 psia within Table 18. Ginna structural engineering has reviewed the stress analysis for the seal leak off piping and supports, this review has concluded the piping and supports are adequate for the estimated maximum temperatures and pressures for the Ginna SLO piping.

The seal leak-off piping for the "A" RCP, from the RCP seal to valve 385A (downstream of FIT-175) was qualified as part of Gilbert line segments CVC-225 and CVC-250. The seal leak-off piping for the "B" RCP, from the RCP seal to valve 385B (downstream of FIT-176) was qualified as part of Gilbert line segment CVC-200, fluid line CV-21. CVC-200, CVC-225, and CVC-250 are respectively qualified to withstand thermal stresses by the following Gilbert Analyses: SDTAR-80-05-119, SDTAR-80-05-118 and SDTAR-80-05-035. All subsequent changes and revisions to these analyses have maintained the same design temperature and pressure.

The set pressure for the common seal leak off header piping relief valve (Ginna EIN valve 314) is 152 psig (148-156 psig allowable band). The relief has a J orifice which corresponds to 1.287 square inches. For detailed view of the common heater piping see the isometric drawings in the C-381-357 series.

Ginna has reviewed the most recent maintenance work orders for the RCP seals and has identified that the part numbers for the #1 Runner and #1 Ring correspond to the silicon nitride material. Part numbers 4D00542G03 and 4D00541G03 are shown on Westinghouse Drawing 4D00544 rev 4 under notes B and C as having silicon nitride faceplates.

To address concerns with the ability of the RCP O-rings to withstand high temperatures during an ELAP event, operations personnel will take action per procedure ECA-0.0, *Loss of All AC Power* (Reference 22). Step 3 of ECA-0.0 directs operators to adjust S/G ARVs to control Tavg at 547°F (~530°F Tcold). The Phase 2 staffing study determined that an operator can be dispatched to locally operate ARVs and control Tavg to 547°F within 30 minutes of event initiation. With this operator action performed in the early stages of the ELAP event, the period of time in which the O-rings within the RCP seals would be above 550°F is minimized.

At approximately 2 hours from event initiation, a longer-term cooldown is initiated per ECA-0.0 to reduce RCS cold leg temperature to approximately 438°F via manual/local operation of the ARVs. This cooldown is expected to achieve an RCS cold leg temperature of less than 450°F in four hours from event initiation. A second RCS cooldown will be initiated to achieve an RCS temperature and pressure of less than 350°F and 400 psig within 24 hours of event initiation.

Margins to the PWROG analysis that could compensate in the event that RCP seal leakage is greater than the PWROG analysis are achieved by comparing the Ginna plant specific values/analyses to the PWROG RCP seal leak rates for a Category 1 plant, including the reflux cooling analysis methodology and WCAP 17601-P coping times:

1. For conservatism RWA-1323-003, using plant-specific parameters, assumed a 61 gpm RCS leak rate (25 gpm per seal AT 2250 psia + 10 gpm worst case tech spec identified leakage + 1 gpm worst case tech spec unidentified leakage). For the PWROG-14027-P Category 1 plant, RCP seal leakage at 2250 psia is 16 gpm, at 2000 psia it is 17.2 gpm, at 1850 psig it is 17.3 gpm at 1500 psia it is 17.5 gpm, at 1250 psia it is 15.7 gpm, at 850 psia it is 12.0 gpm, at 600 psia it is 9.3 gpm and at 385 psia it is 6.7 gpm. RWA-1323-003 treats the seals as an orifice for leakage reduction as RCS pressure drops. Due to the conservative RCP seal leakage assumptions, Ginna's assumed RCP seal leakage is conservatively greater than the PWROG-14027-P provided data points. At 1500 psia Ginna's RCP seal leakage is calculated as ~ 21 gpm, at 1250 psia leakage is calculate as ~ 19.5 gpm, at 600 psia leakage is calculated as ~ 12.5 gpm, and at 385 psia leakage is calculated as ~ 9 gpm.
2. RWA-1323-003 determined that two-phase loop flow will be less than single-phase loop flow at approximately 15.5 hours from the start of the event in place of the generic time to enter reflux cooling of 24.2 hours (PWROG-14027-P). To comply with NRC endorsement of the boron mixing generic concern, ECA-0.0 directs charging at 8 hours into the event per FSG-1, *Long Term RCS Inventory Control* (Reference 83), to ensure subcriticality is maintained. However, it is likely that charging will commence earlier per FSG-1 based on RVLIS and/or Pressurizer levels. The NEI 12-01 Phase 2 Staffing Assessment determined that FSG-1 can be implemented in 1 hour from ELAP initiation to restore RCS Inventory using the alternate makeup strategy when an ELAP is in progress, PRZR level is less than 13% [40% adverse CNMT] and time and personnel are available to perform this strategy.
3. If signs of increased RCS leakage are detected such that RVLIS indicates less than 93% and RCS pressure is less than 500 psig, operators are directed to perform FSG-1.
4. The Technical Specification (Reference 26) minimum RWST borated water volume of ≥ 300,000 provides an abundant supply of onsite borated water for

RCS makeup. The new Alternate RCS Injection System is capable of pumping 75 gpm from the RWST into the RCS at 1500 psi. A portable diesel engine driven high pressure pump provides alternate borated makeup capability to the RCS. This pump is also capable of pumping 75 gpm of borated water from the RWST to the RCS at 1500 psi. A Charging Pump provides the capability to provide 60 gpm to an alternate injection point if the Alternate RCS Injection connection is not available. These RCS makeup rates provide margin to the conservative RCS leakage rates assumed in RWA-1323-003 and significantly more margin to the expected leakage rates in PWROG-14027-P.

In summary, the FLEX strategy for RCS makeup provides the capability to initiate FSG-1 in 1 hour from start of the ELAP event, provides for RCS makeup rates that are well above expected RCS and RCP seal leakage rates, and in conjunction with RCS cooldown/depressurization and SI Accumulator injection provides the capability to maintain natural circulation cooling conditions in the RCS even if RCP seal leakage rates are unexpectedly high.

2.9 Decay Heat Model

The decay heat model for existing thermal hydraulic analyses that are used to support mitigation strategies at Ginna depends on the engineering / current licensing basis requirements in effect at the time of the analysis. Generally, conservatisms are applied for assumed decay heat values, but in all cases, the decay heat model assumptions are provided.

For new thermal hydraulic analyses performed specifically for FLEX, the decay heat model in UFSAR Chapter 6 (Reference 25) will be used: The ANS Standard 5.1 has been used for the determination of decay heat energy in the Loss of Coolant Accident (LOCA) Mass and Energy (M&E) release model for the Ginna Extended Power Uprate (EPU) Program. This standard was balloted by the Nuclear Power Plant Standards Committee (NUPPSCO) in October 1978 and subsequently approved. The official standard was issued in August 1979. UFSAR Table 6.2-4 lists the decay heat curve used in the Ginna EPU Program M&E release analysis. Significant assumptions in the generation of the decay heat curve for use in the LOCA M&E release analysis include the following:

- The decay heat sources considered are fission product decay and heavy element decay of U-239 and Np-239
- The decay heat power from fissioning isotopes other than U-235 is assumed to be identical to that of U-235
- The fission rate is constant over the operating history of maximum power level
- The factor accounting for neutron capture in fission products has been taken from ANSI/ANS-5.1 1979
- The fuel has been assumed to be at full power for 10^8 seconds
- The total recoverable energy associated with one fission has been assumed to be 200 MeV/fission
- Two sigma uncertainty (two times the standard deviation) has been applied to the fission product decay

Based upon NRC staff review, Safety Evaluation Report of the March 1979 evaluation model, use of the ANS Standard 5.1 decay heat model was approved for the calculation of mass and energy releases to the containment following a LOCA.

In the NRC Safety Evaluation (SE) Related to Extended Power Uprate at R.E. Ginna Nuclear Power Plant (ML061380249), the NRC noted that Ginna has also used American Nuclear Society (ANS) Standard 5.1 with a 2σ uncertainty band and other assumptions that maximize the decay heat added to the coolant, and as noted in Section 2.6.3 of this SE, the licensee uses the ANS 5.1 decay heat model with a 2σ uncertainty band included. This is conservative and acceptable.

Because the existing SG dryout, RCS Thermo/Hydraulic, and SG makeup analyses did not adequately address the unique conditions of a Beyond-Design-Basis External Event, new analyses were performed using RELAP5/ MOD3.3 Patch 03 with the ANS Standard 5.1 decay heat model with an included 2 sigma uncertainty band from UFSAR Chapter 6:

- RWA-1323-003, *Ginna RELAP5 ELAP Analysis for Mode 1*, (Reference 57)
- RWA-1323-002, *Ginna RELAP5 Steady-Initialization for Mode 5*, (Reference 92)
- RWA-1323-004, *Ginna RELAP5 ELAP Analysis for Mode 5*, (Reference 93)
- RWA-1403-001, *GOTHIC FLEX Containment Analysis*, (Reference 94)

Existing analyses that were used to develop the original OIP strategies and are superseded by, or may be used to supplement, the new analyses include:

- 109682-M-026, *Steam Generator Dry-out Time Assuming No Feedwater Addition Under EPU Conditions* (Reference 95)
- DA-NS-2006-019, *Loss of RHR Cooling During Mid-Loop for EPU* (Reference 32)
- NSL-0000-005, *Thermal Hydraulic Analysis of the Loss of RHR Cooling While the RCS is Partially Filled* (Reference 34)
- 109682-M-021, *Spent Fuel Cooling System EPU Evaluation*, Updated by Engineering Change Notice (ECN) ECP-2008-0100 109682-M-021-000 (Reference 44)
- DA-ME-98-115, *Time to Boil Following Loss of RHR During Shutdown (18 Month Cycle)* (Reference 73)

For the key SG dryout time, RWA-1323-003, Case 3 determined that the SGs dryout between 2587 and 2623 seconds. For Ginna's revised timeline, 43 minutes is considered the time at which SG dryout occurs assuming no feedwater addition. Information from RWA-1323-003 is used to provide the RCS Thermo/Hydraulic information necessary to determine the ELAP strategies for Mode 1, including SG makeup, and RWA-1323-004 is used to determine the Mode 5 and 6 strategies.

2.10 Use of Non-Safety-Related Installed Equipment for Mitigation Strategies

With the exception of the SBAFW and charging pumps, all of the FLEX equipment is considered non-safety-related. All "N" equipment is located in robust structures and secured so as not to be affected by seismic motion. All support equipment is either located within a robust structure or is separated by the site specific tornado width, accounting for the prevailing tornado direction, so as not to be affected by the same tornado. "N+1" equipment is located in a commercial structure meeting ASCE 7-10 and is not separated from the buildings where the N equipment is located. All support and "N+1" equipment is secured so as not to be affected by seismic events.

For non-safety-related installed equipment that is used in the mitigation strategies, Ginna has installed a 1 MW SAFW D/G along with a 160,000 Gallon SAFW DI Water Storage Tank. Although installed in a Seismic / Tornado and Flood proof structure, the SAFW D/G is classified as non-safety. The tank is also classified as non-safety (connection points and piping penetrations are protected by design or orientation). It is seismically mounted and provides a suction source to the two safety related SAFW Pumps. During an ELAP, the SAFW D/G will start and manual transfer switches operated to provide power to the two safety-related SAFW Pumps, which will then provide feed water to the S/Gs. Ginna has also installed a non-safety related high pressure positive displacement Alternate RCS Injection pump with power being supplied by the SAFW D/G through a breaker on its associated load center. The Alternate RCS Injection pump is installed in the existing SAFW Building, which is safety related. The suction source is from the RWST.

Alternate RHR uses the Reactor Coolant Drain Tank (RCDT) Pumps to circulate water from the RCS hot leg, through both RHR heat exchangers, and back to the RCS cold leg. The RCDT Pumps are augmented quality.

2.11 Provision of N+1 FLEX Equipment

Provision of at least N+1 sets of portable on-site equipment stored in diverse locations or in structures designed to reasonably protect from applicable BDBEEs provides reasonable assurance that N sets of FLEX equipment will remain deployable to assure success of the FLEX strategies. Procedures and guidance to support deployment and implementation, including interfaces to EOPs, special event procedures, abnormal event procedures, and system operating procedures, are coordinated within the site procedural framework.

All "N" equipment used to mitigate post Extended Loss of Alternate AC Power (ELAP)are either permanently installed in a robust structure and properly anchored, capable of resisting Beyond Design Basis External Events (BDBEE), or are portable equipment anchored in place on robust armored Sea Vans which can resist flooding, seismic forces, and tornado winds/missiles.

The "N+1" equipment provides a portable means of providing redundant/diverse means of accomplishing post-ELAP functions. This equipment is stored in a commercial building analyzed in accordance with ASCE 7-10.

There is also certain equipment used to support post-ELAP functions. This equipment consists of a tow truck, a debris remover, two hose trailers, and two fuel trailers. This support equipment is stored in areas which are separated by the width of a site-specific tornado (1040 feet), accounting for the prevailing tornado path for the region (southwest to northeast).

The following are the functions for which Ginna has provided FLEX equipment, together with a description of the "N" and "N+1" equipment and their storage locations:

1. Provide Auxiliary Feedwater to the steam generators

- The "N" means employs permanently installed SAFW pumps, taking suction from a robust 160,000 gallon DI Water Storage Tank, powered by a permanently installed 1 MW SAFW D/G. The D/G, switchgear, and pumps/ piping are all located within robust structures. FLEX "N+1" equipment can provide the water to the S/Gs following S/G depressurization, either from the 160,000 gallon tank DI Water Storage Tank, or directly from Lake Ontario. The FLEX pump and hoses are stored in a commercial ASCE 7-10 building.

2. Isolate Safety Injection Accumulators
   - The "N" function is performed by repowering a cubicle in MCC "C" and one in MCC "D" from the SAFW D/G, then closing the isolation valves. In the event a tornado damages MCC "C", an air compressor is connected to an instrument air line, allowing the accumulator to be vented. All necessary cables, connectors, hoses, and the air compressor are stored in robust locations. Comparable equipment is used for the "N+1" strategy, substituting the 100 kW D/G for the SAFW D/G. This 100 kW D/G, as well as necessary hoses, cables, and connections are stored in the commercial ASCE 7-10 building.
3. Repower the battery chargers.
   - This "N" function is performed by repowering a cubicle in MCC "C" and one in MCC "D" from the SAFW D/G. In the event a tornado damaged MCC "C", the SAFW D/G would be connected directly to affected battery charger. All cables and connection required for these functions are stored in robust locations. The "N+1" strategy is comparable, substituting the 100 kW D/G for the SAFW D/G. The 100 kW D/G, as well as the necessary cables and connections are stored in the commercial ASCE 7-10 building.
4. Primary Inventory/Reactivity Control
   - The "N" function is performed by powering the installed Alternate RCS Injection pump, taking suction from the robust RWST, and injecting into the SI lines. A booster pump can be installed, and powered from the 1 MW FLEX D/G or the 100 kW portable diesel generator, to allow full use of the RWST contents. All pumps, piping, diesel generator, hoses, cables, and connectors are stored in a robust structure. There are two means of providing the "N+1" function. A portable diesel driven Alternate RCS Injection pump can connected in parallel with the electric Alternate RCS Injection pump. Also, a diverse means of providing RCS inventory/reactivity control is by powering an installed charging pump from the SAFW D/G. The portable Alternate RCS Injection pump, as well as all necessary hoses, cabling, and connections are stored in the commercial ASCE 7-10 building.
5. Spent Fuel Pool Cooling/ inventory Control
   - The "N" function is provided by employing a portable FLEX diesel driven pump taking suction from the discharge canal and filling directly to the SFP. This pump can provide flow to refill the 160,000 gallon DI Water Storage Tank, as well as the SFP, using a manifold. The FLEX pump and manifold are stored in a robust structure. The hoses are stored in hose trailers, separated from each other by the width of a site-specific tornado (1040 feet), accounting for the prevailing tornado direction for the region. The "N+1" function is provided by another diesel driven FLEX pump taking suction from the discharge canal. This pump can also provide flow directly to the S/Gs following depressurization, concurrently with refilling of the SFP. Another connection point to the SFP is via valve 8662. The pump is a redundant

counterpart to the one employed for the "N" strategy and is stored with another manifold in the commercial ASCE 7-10 building.

6. Mode 5 Containment Venting
   - The "N" function is performed by opening installed valve 7444. If valve 7444 is not available due to a flooding event, the air compressor is used to open the containment purge valve. The compressor, fittings, hoses, and tools are stored in a robust structure. The "N+1" strategy can be the same as the "N" strategy, using a redundant air compressor. The air compressor and necessary fittings, hoses and tools are stored in the commercial ASCE 7-10 building. An alternative strategy is to open the containment personnel and equipment airlock outer doors, and open the equalizing valves.
7. Dewatering Auxiliary Building Sub-basement (Steam Generators unavailable) for Mode 5 RHR
   - In the event a tornado missile damages susceptible tanks on the Auxiliary building operating floor, flooding the RHR and Reactor Coolant Drain Tank (RCDT) area, the area must be dewatered prior to reinitiating forced RCS flow. The "N" strategy deploys a submersible sump pump, powered from the SAFW D/G, to remove the water from the sub-basement. This water is pumped outside the Auxiliary Building. The sump pump, DG, hoses, cables, and connectors are all stored in robust locations. The "N+1" strategy is comparable, substituting the 100 kW D/G for the SAFW D/G. The necessary diesel, pump, hoses, cables, and connectors are stored in the commercial ASCE 7-10 building.
8. Mode 5 Residual Heat Removal
   - Following dewatering of the sub-basement, forced flow RCS recirculation can be attained. The "N" strategy is to provide power to the installed RCDT Pump "B" from the SAFW D/G (the RCDT pumps can operate after being submerged). All cables, connectors, and junction boxes are stored in a robust structure. The "N+1" strategy provides for the "A" RCDT pump to be powered for the 100 kW D/G. The 100 kW D/G as well as all necessary connectors, cables, and junction boxes are stored in the commercial ASCE 7-10 building.
9. Heat Sink for Mode 5 RHR
   - A means to remove the heat being circulated by the RCDT pumps is necessary. The "N" strategy is to align a diesel driven FLEX pump from the discharge canal to valve 760A and B bonnet-to-hose adapters. This flow would cool the RCDT flow. The water circulating from the FLEX pump would be discharged via hose to outside the Auxiliary Building. The FLEX pump and all hoses, fittings, connections, and flanges are located in robust structures. The "N+1" strategy is comparable except that the redundant FLEX pump, as well as the necessary hose, fittings, connectors, and flanges are stored in the commercial ASCE 7-10 building.
10. Communication
   - There is a permanently installed satellite dish to provide satellite communication between the station and the EOF as well as the state and county officials. In the event a BDBEE damaged the permanent satellite dish, a portable dish is provided. The portable dish, trailer, UPS system, cabling, and portable diesel generator are stored in a robust structure. A repeater system is installed to facilitate radio communication onsite during an event. In the event the permanently installed system would be damaged by a BDBEE, a redundant repeater would be deployed. The repeater, antenna, tripod, generator, and cable are all installed in a robust structure.

11. Refueling
    - Redundant sources of diesel fuel are available for refueling the SAFW D/G, 100 kW D/G, the diesel driven FLEX pumps, the diesel driven portable Alternate RCS Injection pump, and the smaller diesel generators. Two fuel trailers, each with 990 gallons of ultra-low sulfur fuel, are stationed at the site. They are stored so as to be separated by the width of the site-specific tornado (1040 feet), accounting for the prevailing tornado direction for the region. Each fuel trailer has the necessary fuel transfer equipment. Once deployed, the trailers can be refilled from the onsite fuel oil storage tanks.
12. Debris Removal/ Equipment Transportation
    - The site has a Case 621 pay loader, as well as a Ford F-350 pickup truck with a snow plow, to remove debris caused by a BDBEE. Each vehicle is also equipped with equipment to check for live wires in downed power lines. Each vehicle is also equipped with a pintle hitch, which can be used to transport mitigation equipment, such as the 100 kW D/G, the portable satellite trailer, the FLEX pumps, the fuel trailers, the hose trailers, and the air compressors to their deployment points. There is also an electric Trailer caddy, capable of moving any of the FLEX mitigation equipment, stored in a robust structure.

The following table shows the primary and alternate strategies and connection points required by NEI 12-06:

Safety Function	Method	Connection	External Hazard Protection	Procedure(s) Drawings
Core Cooling (P)	SAFW Pump Powered from SAFW D/G Located in SAFW Building/SAFW Annex	One SAFW Pump (two available) can supply its respective S/G or both S/Gs via a cross connect valve. Suction is from the SAFW DI Storage Water Tank.	Seismic, Tornado, Flooding	ATT-5.5, *Attachment SAFW With Suction From DI Water Storage During SBO* (Ref. 97) Dwg. 33013-1238, *Standby Aux Feedwater P&ID* (Ref. 98)

Safety Function	Method	Connection	External Hazard Protection	Procedure(s) Drawings
Core Cooling (P)	Diesel Driven FLEX pump located in SAFW Annex Hoses stored in Portable Trailers +1 pump stored in "L" Building	Used to refill SAFW DI Water Storage Tank. FLEX Pump and Hose Trailer are moved to west of Screenhouse with suction for pump from Lake Ontario. Discharge hoses are run up east side roadway to distribution manifold then from manifold to V-9782 (located in SAFW Annex). In addition, manifold allows branch lines to be laid into Auxiliary Building (AB) to fill SFP.	Seismic, Tornado (Protected from, but not available or needed during Flood)	FSG-6, *Alternate SAFW DI Water Storage Tank Makeup* (Ref. 99) Dwg. 33013-1238
Core Cooling (A)	Diesel Driven FLEX Pump located in SAFW Annex along with suction and discharge hoses.	Located in SAFW Annex and connect to SAFW cross connect line in SAFW Building. Suction is from SAFW DI Storage Water Tank or Lake Ontario. Pump is moved into position outside SAFW Annex. Suction hose is connected to fitting at V-9772 at base of tank. Discharge hose is run into SAFW Annex, through door 63 to V-9757 (to be installed) on discharge cross-tie line for SAFW Pumps.	Seismic, Tornado (Protected from, but not available or needed during Flood)	FSG-3, *Alternate Low Pressure Feedwater* (Ref. 100) Dwg. 33013-1238

Safety Function	Method	Connection	External Hazard Protection	Procedure(s) Drawings
RCS Makeup (P)	Alternate RCS Injection from motor driven pump powered by SAFW D/G Located in SAFW Building	Supplied from RWST with discharge to either or both SI lines. Piping transitions from AB Basement / Middle Level to SAFW Annex to SAFW Pump Room. Valves / piping / Power supply located inside protected structures.	Seismic, Tornado, Flood	FSG-,1 *Long Term RCS Inventory Control* (Ref. 83) FSG-8, *Alternate RCS Injection* (Ref. 101) ECP-14-000169-CN-090, *Alternate Charging System* (Ref. 102) Dwg. 33013-1230, *Alternate RCS Injection System (BDB P&ID* (Ref. 96)
RCS Makeup (A)	Alternate RCS Injection diesel driven pump relocated from the "L" Building to east of the SAFW Building near door #99.	Connectable to the alternate RCS injection suction and discharge lines penetrating wall near door #99 to take suction from the RWST and discharge to either or both SI lines.	Seismic, Tornado (Protected from, but not available or needed during Flood)	FSG-1 FSG-8 ECP-14-000169-CN-090 Dwg. 33013-1230
RCS Makeup (A)	Repower Charging Pump 'B' from the SAFW D/G using temporary power cables.	Manually lineup to inject from the RWST to the RCS through AOV-392A (Charging Valve to Regenerative Heat Exchanger to Loop B Hot Leg) which opens at a 250 psig differential pressure to allow flow to the RCS.	Seismic, Tornado, Flood	FSG-1 FSG-8

Safety Function	Method	Connection	External Hazard Protection	Procedure(s) Drawings
SFP Makeup (P)	Diesel Driven FLEX pump located in SAFW Annex Hoses stored in Portable Trailers +1 pump stored in "L" Building	FLEX Pump and Hose Trailer are moved to west of Screenhouse with suction for pump from Lake Ontario. Discharge hose is run up east side roadway to distribution manifold. From distribution manifold hose can be run to the edge of SFP and tied down.	Seismic (While the AB Operating Floor is not protected from a Tornado, access to the SFP is still expected to be available.) (Protected from, but not available or needed during Flood)	FSG-11, *Alternate SFP Makeup and Cooling* (Ref. 103) Dwg. 33013-1248, *Auxiliary Cooling Spent Fuel Pool Cooling P&ID* (Ref. 104)
SFP Makeup (A)	Diesel Driven FLEX pump located in SAFW Annex Hoses stored in Portable Trailers +1 pump stored in "L" Building	FLEX Pump and Hose Trailer are moved to west of Screenhouse with suction for pump from Lake Ontario. Discharge hose is run up east side roadway to distribution manifold. From distribution manifold hose can be run to the Blitz fire nozzles located within 75 ft. of SFP.	Seismic (While the AB Operating Floor is not protected from a Tornado, access to the SFP is still expected to be available.) (Protected from, but not available or needed during Flood)	FSG-11 Dwg. 33013-1248
SFP Makeup (A)	Diesel Driven FLEX pump Located in SAFW Annex Hoses stored in Portable Trailers +1 pump stored in "L" Building	FLEX Pump and Hose Trailer are moved to west of Screenhouse with suction for pump from Lake Ontario. Discharge hose is run up east side roadway to distribution manifold. From distribution manifold hose can be run to the flanged connection point at V-8662 in the SFP Cooling system located in the AB Basement.	Seismic, Tornado (Protected from, but not available or needed during Flood)	FSG-11 Dwg. 33013-1248

Safety Function	Method	Connection	External Hazard Protection	Procedure(s) Drawings
Battery Chargers (P)	SAFW D/G is used to power Battery Chargers A & B through "protected connection points" in the SAFW Annex and AB using installed junction boxes with cables that are stored in the Waste Gas Compressor Room (AB Middle Level)	Fed from SAFW D/G through ACPDPAF07. Cable run from Junction Box "A" to Junction Box "B" all located in SAFW Annex. Transition to "9 Box" in AB Middle level via conduit (hard wired) to Waste Gas Compressor Room. Cable run from "9 Box" to MCC C and MCC D to feeder breakers for Battery Chargers A & B.	Seismic, Flood	FSG-*4, ELAP DC Bus Load Shed/Management* (Ref. 76) Dwg. 33013-3131,1, *480 VAC Single Line Diagram SAFW & NFPA805 1000KW Standby Diesel Generator Sets* (Ref. 105) Dwg. 33013-2539, *AC System Plant Load Distribution One Line Wiring Diagram* (Ref. 106)
Battery Chargers (P)	SAFW D/G is used to power Battery Charger B through "protected connection points" in the SAFW Annex and AB using installed junction boxes with cables that are stored in the SAFW Annex and AB; and to power Battery Charger A through "protected connection points in Battery Room "A" using cables that are stored in the Waste Gas Compressor Room (AB Middle Level)	Fed from SAFW D/G through ACPDPAF07. Cable run from Junction Box "A" to Junction Box "B" all located in SAFW Annex. Transition to "9 Box" in AB Middle level via conduit (hard wired) to Waste Gas Compressor Room. Cable run from "9 Box" to MCC D to feeder breakers for 'B' Battery Chargers. In lieu of powering MCC C, cable is run from the SAFW Annex through Door 63 and 99 outside to TSC Hallway Door and down to Battery Room "A" with connection made directly to battery charger.	Tornado	FSG-4 Dwg. 33013-3131 Dwg. 33013-2539

Safety Function	Method	Connection	External Hazard Protection	Procedure(s) Drawings
Battery Chargers (A)	100KW D/G relocated from "L" Building to outside the SAFW Annex overhead door is used to power Battery Chargers A & B through "protected connection points" in the SAFW Annex and AB, using installed junction boxes with cables that are stored in the Northeast Sea Land.	Fed from 100 KW D/G by cable run from 100 KW D/G to Junction Box "B" located in SAFW Annex. Transition to "9 Box" in AB Middle level via conduit (hard wired) to Waste Gas Compressor Room. Cable run from "9 Box" to MCC C and MCC D to feeder breakers for Battery Chargers A & B.	Seismic (Protected from, but not available or needed during Flood)	FSG-4 Dwg. 33013-3131 Dwg. 33013-2539
Battery Chargers (A)	100 KW D/G relocated from "L" Building to the east outside entrance to the TSC is used to power Battery Chargers A & B through "protected connection points" in the Battery Rooms, using cables that are stored in the Northeast Sea Land.	Fed from 100 KW D/G by cables run from 100 KW D/G to portable FLEX Junction box and then lay out cables from the Junction Box to the selected battery charger(s) in the associated Battery Room.	Tornado (Protected from, but not available or needed during Flood)	FSG-4 Dwg. 33013-3131 Dwg. 33013-2539

2.12 Generic Concerns

Ginna intends to comply with the NRC endorsement of the following applicable generic concerns:

- Battery Life (ML13241A188)
- Shutdown / Refueling Modes (ML13267A382)
- Maintenance and Testing (ML13276A224)
- Boron Mixing (ML13276A183)

2.13 Staffing and Communications Response to a BDBEE

Responding to BDBEEs presents new challenges and new requirements for personnel actions to mitigate the BDBEE.

In the Letter from J.A. Spina (Constellation Energy Nuclear Group, LLC (CENG)) to Document Control Desk (NRC), dated May 11, 2012, *Sixty-Day Response to 10 CFR 50.54(f) Request for Information* (Reference 8), CENG committed to provide an assessment of the onsite and augmented staff needed by Ginna to respond to a large scale natural event meeting the conditions described in Enclosure 5 to the NRC's March 12, 2012 Request for Information (Reference 7). In Reference 8 and the Letter from M.G. Korsnick (CENG) to Document Control Desk (NRC), dated June 6, 2012, *Supplemental Information for the Sixty-Day Response to 10 CFR 50.54(f) Request for Information* (Reference 9), CENG committed to provide the onsite and augmented staffing assessment for Ginna considering functions related to NTTF Recommendation 4.2 (Reference 12) to the NRC 4 months prior to the beginning of the second refueling outage scheduled for October 2015. This staffing assessment is complete and was submitted to the U.S. Nuclear Regulatory Commission Document Control Desk in a letter dated June 8, 2015 (Reference 107).

Ginna addressed communications needs in its response to the 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 (ML12073A348). Ginna's plans regarding communications can be found in the letter from M.G. Korsnick (CENG) to the Document Control Desk (NRC), Response to NRC Letter on Technical Issues for Resolution Regarding Communications Submittals Associated with Near Term Task Force Recommendation 9.3, dated February 22, 2013 (ML13066A710). As documented in the NRC staff analysis provided in letter dated April 30, 2013 (ADAMS Accession No. ML 13109A264), the staff has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained.

A communications modification was developed under ECP-14-000756, *Installation of FLEX Satellite Communications system to provide FLEX and NARs phone service to Control Room and TSC* (Reference 108). This project included installation of a satellite network that provides a secondary path for the EMNet and NTTF Recommendation 9.3: Communications phones. This network provides essential communications in the Main Control Room (MCR) and in the Technical Support Center (TSC) during an extended loss of ac power due to a BDBEE. An emergency power source for the secondary satellite network will be made available at a minimum of 8 hours following a loss of ac power. Satellite network connectivity provides three (3) Voice-Over Internet Protocol (VOIP) phones for FLEX communication in the MCR. Satellite connectivity for six (6) VOIP phones for FLEX communication are provided for the TSC. The installed satellite dish antenna may not survive an event; therefore, there is a portable satellite dish in protected storage.

A separately available Rapid Case with its own portable satellite dish (in case the installed satellite dish does not survive the event) and network is available and powered by its own portable generator. This system can operate standalone or can interface with the fixed system described above.

FSG-5, *Initial Assessment and FLEX Equipment Staging* (Reference 109), contains information on emergency communications equipment. Onsite communications will use station radios in talk-around mode and will deploy a portable radio repeater for better radio reception. Iridium satellite phones are already in the MCR. Chargers for radio batteries can be powered from small 3.3 KW diesel generators.

2.14 Deployment Strategies

Primary and alternate deployment routes for Phase 2 portable FLEX equipment are identified in GN-WP-01, *BDBEE Debris Removal for Ginna Station* (Reference 110). CC-GI-118, *Ginna Implementation of Diverse and Flexible Coping Strategies (FLEX) and Spent Fuel Pool Instrumentation Program* (Reference 111), specifies the deployment path maintenance and availability requirements.

When two or more deployment path options are available, temporarily blocking one path to support plant operations is acceptable. Compensatory actions will be in place for durations longer than 5 business days. A-52.12, *Nonfunctional Equipment Important to Safety* (Reference 113), will track the deployment paths blocked time. When only one deployment path is available, temporarily blocking this path to support plant operations is acceptable. Compensatory actions SHALL be in place for any duration beyond a single shift. OPG-IWS-SUPPORT, *Operations Support of the Integrated Work Schedule* (Reference 114), directs SRO review of scheduled work to determine if it will involve blocking FLEX deployment paths.

O-6.1, *Equipment Operator Rounds* (Reference 36), directs checking FLEX deployment paths clear each shift.

On-Shift Operations personnel carry security door access keys that, in the situation that the card reader system becomes disabled, will have unrestricted access to plant areas required for mitigating actions of a BDBEE. (SY-AA-101-120-F-01, Reference 115)

An assessment to ensure consideration of NEI-12-06, Section 5.3.2, consideration 4, has been performed for all current strategies. There is no planned movement or deployment of equipment that specifically requires electrical power, such that consideration for a power supply strategy is required. Any such movement of gates, doors, fences, etc. can be performed by manual action.

Ginna has two dewatering pumps for removing water from the Auxiliary Building sub-basement in the event of a tornado that damages tanks on the operating level of the Auxiliary Building. Ginna has 550 feet of 2-1/2" hose available for the dewatering pumps. There is no other area requiring dewatering since all other areas with FLEX response equipment are protected both from internal and external flooding.

In-plant storage areas are uniquely identified to ensure equipment is available at all times to support the associated FLEX strategy. Identification of FLEX equipment, connections, and storage locations is with labels of black lettering on a green background to highlight the unique uses for this equipment and facilities.

2.15 Maintenance and Testing

Ginna has established a system designation for emergency portable equipment and will manage this system in a manner consistent with procedure WC-AA-104, *Integrated Risk Management* (Reference 40). All elements of the program described in Section 11 of NEI 12-06, including recommended "should" items will be included in the station program. A system engineer is assigned the responsibility for configuration control, maintenance and testing. The FLEX equipment have unique identification numbers. Installed structures, systems and components pursuant to 10 CFR 50.63(a) (Reference 6) will continue to meet the augmented quality guidelines of Regulatory Guide 1.155, *Station Blackout* (Reference 13). Preventive Maintenance procedures (PMs) were established and testing procedures developeded with frequencies established based on type of equipment, original equipment manufacturer (OEM) recommendations and considerations made within EPRI Technical Report 3002000623, *Nuclear Maintenance Applications Center: Preventative Maintenance Basis for FLEX Equipment* (Reference 116).

2.16 Brief Description of Procedures/ Strategies/ Guidelines

Ginna utilized industry developed guidance from the PWROG, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06. These procedures and/or guidelines support (not replace) the existing symptom based command and control strategies in the current EOPs. Clear criteria for entry into FLEX Support Guidelines (FSGs) ensures that FLEX strategies are used only as directed for BDBEE conditions, and are not used inappropriately in lieu of existing procedures. The existing command and control procedure structure are used to transition to SAMGs if FLEX mitigation strategies are not successful.

FLEX strategies in the FSGs were evaluated for integration with the appropriate existing procedures. As such, FLEX strategies are implemented in such a way as to not violate the basis of existing procedures. Where FLEX strategies rely on permanently installed equipment, such as the new SAFW DG, changes were made to the AOPs and EOPs, as appropriate. FSGs are controlled under the site procedure control program.

FSGs were reviewed and validated by the involved groups to the extent necessary to ensure the strategy is feasible. Validation may have been accomplished via walk-throughs or drills of the guidelines.

Human factors are built into the processes for design and procedure development. These are primarily based on INPO Good Practice 06-002. These processes are followed throughout the project stages. Electrical cables are color coded as necessary in order to ensure proper connection.

Validation and verification was performed for the FLEX Support Guidelines and followed the NEI APC 14-17 Guidance Document, *FLEX (Beyond Design Basis) Validation Process.*

When plant systems are restored, exiting the FSGs and returning to the normal plant operating procedures are addressed by the plant's emergency response organization and operating staff, dependent on the actual plant conditions at the time.

The existing hierarchy for operating plant procedures remains relatively unchanged:

- ECA-0.0, *Loss of All AC Power* (Reference 22), provides actions to respond to a loss of all AC power.
- New procedure AP-ELEC.4, *Loss of All AC Power while on Shutdown Cooling* (Reference 117), provides actions to respond to a complete loss of all AC power while on shutdown (RHR) cooling.
- ECA-0.0 and AP-ELEC.4 are the entry points for ELAP/LUHS events. FSGs are entered from ECA-0.0, AP-ELEC.4 and if appropriate, other procedures.

Phase 3 FLEX Procedures – FSG-5, *Initial Assessment and FLEX Equipment Staging* Reference 109) discusses evaluation of long-term strategies using NSRC equipment. This includes support of RHR pump operation (Attachment I, section B); makeup to the RWST using the boration skid (Attachment J); use of the DI Water Processing unit (FSG-6 (Reference 99), Attachment D); and Containment Cooling (FSG-12 (Reference

118), Attachment C). When the equipment from the NSRC is a duplicate of site equipment (e.g., 480 volt generator) no explicit steps are provided in the FSGs.

2.17 Training

SAFW D/G Modification Training was given during Training Cycle 14-06 to all Operations personnel. All Operations personnel received FLEX Training during cycles 15-1 through 15-6 in 2015. Chemistry and RP personnel received FLEX Training prior to the 2015 Refueling Outage (RFO). All Site Employees received "Generic Basic FLEX Initial" during 2015. Select Employees received "Generic Advanced FLEX" during 2015. TSC personnel received FLEX training prior to the 2015 RFO. The Advanced FLEX training has been added to the qualifications required for select ERO personnel and Operations personnel.

New training of general station staff and Emergency Planning personnel was completed prior to the compliance date. Training programs and controls are implemented in accordance with the Systematic Approach to Training (Reference 71).

2.18 Synchronization with Off-Site Resources

Exelon has signed contracts and issued purchase orders to Pooled Inventory Management (PIM) for participation in the establishment and support of two (2) National SAFER Response Centers (NSRCs) through the Strategic Alliance for FLEX Emergency Response (SAFER). Each NSRC holds five (5) sets of equipment, four (4) of which are able to be fully deployed when requested. The fifth set of equipment will be in a maintenance cycle. The contract with PIM addressed the items in NEI 12-06, Section 12.2. Off-site equipment is procured through the SAFER organization. The NSRC plans to align with the EPRI templates for maintenance, testing and calibration of the equipment.

The two NSRCs are located in Phoenix Arizona and Memphis Tennessee. There are no designated alternate equipment sites; however, each site has agreed to enter portable FLEX equipment inventory into the Rapid Parts Mart, which is an internet based search capability currently used for other spare part needs. This capability provides a diverse network of potential alternate equipment sites for portable FLEX equipment.

The Ginna playbook for delivery of portable FLEX equipment from the NSRC to the site has been developed and approved (CC-GI-118-1001 Reference 119 and CC-GI-118-1002 (Reference 112)). The Ginna SAFER Response Plan contains information on the specifics of generic and site specific equipment obtained from the NSRC (summarized in FIP Table 1). It also contains the logistics for transportation of the equipment, staging area set up, and other needs for ensuring the equipment and commodities sustain the site's coping strategies. Routes were evaluated for post-event conditions, and provisions for alternative transportation, such as airlifting, was considered in the plans.

The NSRC will provide requested portable FLEX equipment to a local staging area where the equipment will be serviced (e.g., fuel and lubricating oil) and made ready for transport to the site. The criterion for the local staging area is identified in the Ginna SAFER Response Plan, Sections 5 and 8. Suitable local staging areas have been established for portable FLEX equipment to be delivered from the NSRC to the site. Staging Area 'A' is located onsite and consists of multiple areas for portable equipment staging (Figure 6). Staging Area 'B' is located in the currently named contractor parking lot, as well as the area to the west (Figure 7). Staging Area 'C' is located on Rochester International Airport property (Figure 8). The NSRC will support initial portable FLEX equipment delivery to the site within 24 hours of a request for deployment.

3 Maintain Core Cooling & Heat Removal (S/Gs Available; Modes 1 – 4 and Mode 5 with Loops Filled)

3.1 Objectives

Reactor core cooling and heat removal requires S/G makeup sufficient to maintain or restore S/G level to provide core cooling. Baseline capabilities include the use of installed equipment and FLEX equipment for Phase 1 and Phase 2 coping strategies. Performance attributes include depressurizing the S/Gs for makeup with portable injection sources utilizing primary and alternate injection points to inject through separate divisions/ trains, i.e., should not have both connections in one division/ train. Analysis should demonstrate that the guidance and equipment for combined S/G depressurization and makeup capability supports continued core cooling. Sustained sources of water are available and sufficient to supply water indefinitely including consideration of concurrent makeup or spray of SFP. (Reference 4)

3.2 Acceptance Criteria

No core damage will occur. Coping times will be calculated such that they preclude core damage. The codes used will ensure no core damage occurs including maintaining saturation conditions in the core region, keeping peak clad temperature below core melt limits, preventing clad rupture and maintaining two-phase water level above the top of the active fuel.

3.3 Strategies

Under a loss of all AC power, Operators will initiate a controlled plant cooldown and depressurization as per procedure ECA-0.0, *Loss of All AC Power*, (Reference 22) and consistent with recommendations in PA-PSC-0965, *PWROG Core Cooling Position Paper* (Reference 41). Natural circulation will transfer heat from the Reactor Coolant System (RCS) to the S/Gs. S/G pressure and steam releases will be controlled by means of the Atmospheric Relief Valves ARV(s). By maintaining appropriate S/G water inventory, successful implementation of the FLEX strategy during Phases 1, 2 and 3 will prevent core damage.

Under Phase 1 (using installed equipment) the operators may have the TDAFW pump taking suction from the CSTs available to maintain S/G water inventory. Since the TDAFW pump may not survive a BDBEE, Operators can utilize one of two installed SAFW pumps powered from the new SAFW D/G, taking suction from the new protected SAFW DI Water Storage Tank. This strategy provides the unit with a 24 hour coping time.

The 1 MW SAFW D/G and 160,000 gallon (nominal) DI Water Storage Tank have been installed on a 3' thick concrete foundation with caissons to bedrock. The diesel generator is mounted on the foundation and housed within the SAFW Bldg. Annex. The DI Water Storage Tank is mounted on the foundation with all piping to and from the tank enclosed in a steel plate structure. All structures on the foundation are designed to withstand flooding, seismic and tornado wind loads and tornado missile impact. The SAFW Building Annex is also capable of withstanding a flood, as all wall penetrations are either above the design flood level or are flood-protected. Therefore, the 1 MW SAFW D/G and a 160,000 gallon (nominal) DI Water Storage Tank meet the reasonable protection requirements of NEI 12-06. (References 120, 121, 122, and 123)

Electrical isolation is maintained such that:

- Class 1E equipment is protected from faults in portable/FLEX equipment as follows:
    - The new SAFW D/G will power the SAFW pump motors. The normal Bus feed to the SAFW pumps will be isolated by manual disconnect switches which are mechanically linked to the connection switch feed from the SAFW D/G, preventing any possible backfeed to the SR Bus. The disconnect is rated for fault current and the feed from the new SAFW D/G is protected from fault current by overcurrent and overvoltage relay devices in the new switchgear. There is no robust alternate power supply to the SAFW D/G to feed the SAFW pumps. The alternate is a diesel driven pump.
    - The new SAFW D/G will power the 125 VDC Battery Chargers. The normal Bus feed to the 125 VDC Battery Chargers will be isolated by a manual disconnect switch rated for fault current. Cables will be run and connected to quick connects installed at the new switchgear and at the Battery Charges. This will be protected from fault current by overcurrent and overvoltage relay devices in the new switchgear.
    - The alternate feed to the 125 VDC Battery Chargers is the 100KW portable diesel generator. This will be manually isolated and connected to the battery charges in a similar manner as the 1 MW D/G. Overcurrent and overvoltage protection will be provided by overcurrent and overvoltage relay devices.
    - Power to the SI Accumulator Isolation Valves (MOV-841 and MOV-865) is the same source used to power the 125 VDC Battery Chargers as described above, and fault protection is also the same.
    - The new SAFW D/G will power the B charging pump. The normal feed to B charging pump will be isolated by opening the Bus 16 supply breakers. Cables will be run and connected from the load bank docking station (DISC/SAFW) to Bus 16 bus bar. This will be protected from fault current by overcurrent devices in the new switchgear.
    - For CRFC power during Phase 3, manual disconnect and connect is required. Fault Protection to be via relaying provided with the D/G from the NSRC, or will be added by Ginna as required.
- Multiple sources do not attempt to power electrical buses is described as follows:
    - The SAFW pump motors are protected from being connected to multiple sources as noted above by the mechanically linked SR disconnect switch and the new SAFW D/G feed connect switch.
    - The 125 VDC Battery Chargers are protected from being connected to multiple sources by the procedures which will manually disconnect the normal power supply and connect the FLEX power.

- The SI Accumulator Isolation Valves (MOV-841 and MOV-865) are protected from being connected to multiple sources by the procedure which ensures the associated Motor Control Center supply breakers are open and all associated Motor Control Center breakers are opened prior to connecting FLEX power.
- Charging Pump B is protected from being connected to multiple sources by the procedures which will manually open the supply/crosstie breakers on Bus 16 and open all load breakers on Bus 16 prior to connecting FLEX power.
- The CRFC cable and motors are protected from being connected to multiple sources by procedures which will manually disconnect the normal power supply and connect the FLEX power.

A summary of the sizing calculation for the FLEX generators and details of loads connected to show that they can supply the loads assumed in Phases 2 and 3 is as follows:

- Load on the 1MW SAFW DG (480VAC, 1250KVA) is 747KW per EDOC-MISC-2013-0044, *Electrical I&C Impact Analysis Form for ECP-12-000459, ECP-13-000424, ECP-13-000995, ECP-14-000169* (Reference 124). Section 5.5.9 presents the load in KVA. A review of the subsections feeding into the KVA rating were reviewed and quantified to be 747KW.
- Loads on the 100KW D/G (480VAC, 125KVA 120.42 Amps) are 2 Battery Chargers and a Booster Pump, with single phase 1.5 HP motor. The full load current of each battery charger is 56 Amps. The single phase 1.5 HP Booster Pump draws less than 2 Amps. The 100 KW D/G will be able to supply required full load current of 114 Amps.
- The Phase 3 loading is evaluated as 1127 amps (480 volts) per EDOC-MISC-2015-0042, *Fukushima FLEX Phase 3 Electrical Support Evaluation* (Reference 125), and is derived from the operation of an SI pump (410 amps), Containment Recirculation fan (351 amps), an RHR pump (232 amps), and a charging pump (134 amps). The total of 1127 amps, with a 0.8 power factor, results in a load of 750 kW.

Powering an existing SAFW Pump from the new SAFW D/G can be started within 43 minutes of event initiation and continue to operate through Phase 2. The feedwater flow path is manually realigned to take suction from the new 160,000 gal SAFW DI Water Storage Tank and use existing SR piping to feed the S/Gs. S/G level will be maintained by throttling SAFW Pump manual valves as directed by the control room. ARVs will be manually/locally operated to remove heat from the system as directed by the control room.

Natural circulation will be maintained via heat removal performed by the S/Gs using a SAFW pump or a portable FLEX pump. Operators will ensure that the new protected SAFW DI Water Storage Tank is being replenished from several water supplies; Lake Ontario providing the ultimate and indefinite water source, with the SAFW pump providing the S/G make-up capability.

The primary Phase 2 coping strategy is to resupply the new SAFW DI Water Storage Tank from Lake Ontario, the UHS, using a portable diesel driven pump and hoses. Core cooling and heat removal will be sustained indefinitely, or until long term recovery actions are determined, using a SAFW pump powered by the new SAFW DG, with provisions for refilling the new SAFW DI Water Storage Tank and the SAFW DG fuel tank.

The alternate Phase 2 strategy is to utilize a diesel driven high capacity portable pump to supply the SGs with water from the new SAFW DI Water Storage Tank, or directly from Lake Ontario, should the SAFW pump become unavailable. The new SAFW DI Water Storage Tank could be resupplied from Lake Ontario using an additional portable diesel driven pump (if available) and hoses. This strategy has the capacity to maintain the required level in the SGs with the SGs at the target pressure of 290 psig, which corresponds to about 419 degrees Fahrenheit (°F) in the cold legs of the RCS. Core cooling and heat removal can be sustained indefinitely, or until long term recovery actions are determined, using the portable diesel driven pump, with provision for refilling the new SAFW DI Water Storage Tank and portable diesel driven pump fuel tank.

The Ginna procedure for responding to a station blackout is ECA-0.0, *Loss of All AC Power* (Reference 22). ECA-0.0 steps are ordered to provide the best sequence of operator actions to respond to station blackout events. ECA-0.0 directs the operators to verify the TDAFW pump starts and if it has not, to attempt to start the TDAFW pump. As the preferred and procedurally directed source of water to the S/Gs, if the equipment is available, it will be used. This proceduralized sequence of events is consistent with Ginna's current licensing basis and, since a beyond-design-basis external event may not be readily apparent to the operators, using/crediting available plant equipment for responding to events is preferred and provides operating margin for a beyond-design-basis external event.

If the TDAFW pump or CSTs are not available, procedural direction is to use the new SAFW D/G to power a SAFW pump and feed the S/Gs is via a "response not obtained" step in ECA-0.0.

To elaborate on use of the new SAFW D/G, the resulting strategy is considered to be a method of extending Phase 1. The strategy includes a combination of the use of existing equipment and newly installed and isolated equipment (Attachment 2, Figure 3). The two existing SAFW pumps with a newly installed (and electrically isolated) SAFW D/G and a newly installed 160,000 gallon (usable capacity), robustly designed SAFW DI Water Storage Tank, capable of supplying 24 hours of inventory will supply, by manual operator action within 43 minutes, condensate from the tank to a SAFW pump to both S/Gs. The FLEX portion of the strategy is to use a dedicated FLEX pump to refill the SAFW DI Water Storage Tank from Lake Ontario, and continue to supply the S/Gs via the SAFW pumps. Also, a fuel trailer will be used to resupply the SAFW D/G. While the new D/G fuel tank and SAFW DI Water Storage Tank (with the planned cooldown) capabilities may be less than 24 hours, timelines show that adequate response time is available to refill the tanks during an ELAP event.

The Phase 3 strategy for core cooling, including what equipment will be needed and how, when and where it will be deployed is basically the Phase 2 strategy supplemented by equipment available from the NSRC. Natural circulation will continue to be maintained via heat removal performed by the S/Gs using a SAFW pump taking suction on the new SAFW DI Water Storage Tank; or a portable diesel driven pump connected to the SAFW system will be used to provide make-up water to the S/Gs from the new SAFW DI Water Storage Tank or Lake Ontario.

To refill the SAFW DI Water Storage Tank, any existing source of demineralized water on site will be preferentially used until the NSRC water treatment system arrives. The bounding FLEX scenario to refill the SAFW DI Water Storage Tank will be to deploy a FLEX diesel driven portable pump with a hard suction hose to take suction from Lake Ontario and, via a discharge hose connected to the SAFW DI Water Storage Tank, refill the SAFW DI Water Storage Tank. When the NSRC water treatment system arrives, water will be pumped from the discharge canal through the water treatment system to the SAFW DI Water Storage Tank. Alternatively, water can be pumped from the discharge canal through the water treatment system directly to the S/Gs via a SAFW system connection point. NSRC delivered portable diesel driven pumps provide backup capability to the on-site FLEX pumps.

Connections are available to supply the 480 Volt vital buses from an NSRC supplied D/G and for connecting NSRC supplied portable pumps and the NSRC supplied water processing unit.

A graphic representation of the Phase 1 to Phase 3 FLEX strategies for maintaining Core Cooling and Heat Removal safety functions, with Steam Generators (S/Gs), available is shown below.

Maintain Core Cooling & Heat Removal (S/Gs Available)
___ Phase 1 (TDAFW – time 0 up to 2 hrs)
____________________________Phase 1 (SAFW D/G – 43 minutes to 24 hours; must refill storage tank)
____Phase 2
____________________________________Phase 3
0 6 12 18 24 30 36 42 48 54 60 66 72 + hrs

3.4 Phase 1

At the initiation of the ELAP/LUHS event in Modes 1, 2 and 3, Operators will enter the existing emergency operating procedure ECA-0.0, *Loss of All AC Power*, (Reference 22) either directly or from E-0, *Reactor Trip or Safety Injection*, (Reference 23) on the indication that both Bus 14 and Bus 16 are de-energized. In Modes 4, 5, and 6 Operators enter AP-ELEC.4, *Loss of All AC Power while on Shutdown Cooling* (Reference 117).

Per ECA-0.0, steps are taken to verify reactor trip, maintain S/G inventory, minimize RCS leakage, and reduce DC loads on the unit's batteries. Heat removal from the RCS is accomplished by supplying feed water from the CST to the S/Gs using the TDAFW Pump or a SAFW Pump, powered by the new SAFW D/G, taking suction on the new 160,000 gallon SAFW DI Water Storage Tank (References 43, 75, and 122). ECA-0.0 has the Operators verify adequate TDAFW flow to the S/Gs. If adequate TDAFW flow to the S/Gs is not verified and cannot be established, the Operators are directed to initiate SAFW using the SAFW D/G by referring to ATT-5.5, *Attachment SAFW with Suction from DI Water Storage Tank during SBO* (Reference 97). S/G dryout conditions will be reached within 43 minutes with no feedwater supplied (RWA-1323-003, Reference 57). The feed rate can be controlled by use of either manual operation of Auxiliary Feedwater

(AFW) pump discharge valves, flow control valves, or by starting and stopping the SAFW pump. Steam is released from the S/Gs to the atmosphere through the ARV(s). Natural circulation transfers the heat from the RCS to the S/Gs. This method is used to maintain RCS temperature at approximately 547^{0}F.

3.4.1 Auxiliary Feedwater

For other than the Tornado Missile, Seismic, and Flooding ELAP/LUHS events, the TDAFW Pump automatically starts and valves automatically align to supply water to the S/Gs from the CSTs. AFW flow is controlled by throttling the TDAFW Pump discharge MOV, which is powered from a DC bus. Throttling of feedwater flow will prevent overfilling of the S/Gs and overcooling of the RCS.

The TDAFW pump initially takes suction from a CST. CST level can be replenished from various sources. Although the TDAFW pump can operate long term and supply adequate AFW flow to the S/Gs for core cooling and decay heat removal, the Phase 1 strategy will be to commence feeding the S/Gs from a SAFW pump powered from the new SAFW D/G and taking suction from the new SAFW DI Water Storage Tank.

ECA-0.0 Step 11 RNO states: IF the TDAFW pump is feeding S/Gs, THEN monitor CST level. WHEN CST level lowers to 5 feet, THEN initiate SAFW feed to the S/Gs, refer to ATT-5.5, *Attachment SAFW with Suction from DI Water Storage Tank during SBO*. ECA-0.0 Step 22b (continuous action step) directs the operators to Monitor CST Level - GREATER THAN 5 FEET. The RNO column states: Dispatch EO to initiate SAFW using the SAFW or NFPA D/G, refer to ATT-5.5, *Attachment SAFW with Suction from DI Water Storage Tank during SBO*.

The normal water source for the TDAFW pump is the Condensate Storage System. However, the Condensate Storage System and the TDAFW pump are not considered "robust" as defined in NEI 12-06 for protection from seismic, flood, or tornado events. Therefore, Ginna installed a new robust SAFW DI Water Storage Tank and SAFW D/G to power the SAFW pumps to provide cooling water to the S/Gs in the event that the TDAFW pump and CST are lost. The bounding strategy assumes that no switchover occurs, but rather that the Auxiliary Feedwater flow is stopped as a result of the event. The new SAFW D/G is automatically started upon loss of normal yard 12.47 KV power, or can be manually started from the SAFW Building Annex. The SAFW Pumps are manually realigned to take suction from the new SAFW DI Water Storage Tank and manually realigned to be fed power from the new SAFW D/G. SAFW pump flow is manually controlled using a local throttle valve to maintain S/G level as directed to the local operator from the Control Room. The new SAFW DI Water Storage Tank has local level indication and the SAFW pumps have local pressure indication.

- In the event Beyond Design Basis External Event (BDBEE) conditions completely destroy the TDAFW/CST:
  - Instrumentation to switch injection from the TDAFW/CST system to the new SAFW DI Water Storage Tank/SAFW system, remains operational as follows:
    - Instrumentation for the new D/G and SAFW DI Water Storage Tank is local and is powered from the new D/G.
    - Control Room instrumentation is safety-related (SR), redundant and powered by SR DC batteries.
    - Communications equipment is stored in a robust protected location.
  - Switchover function will be accomplished in a timely manner:

  - Modes 1 through 4, and Mode 5 Loops Filled timeline shows restart of flow to the Steam Generators within 43 minutes. Steam Generator dryout is expected to occur at 43 minutes (RWA-1323-003, Reference 57) and existing procedures and analysis support refill of dry Steam Generators.
  - The switchover function is carried out manually at the new SAFW Building Annex, having communications with the Control Room.
- o Makeup rate to S/Gs is sufficient to prevent fuel damage:
  - These SAFW pumps are the same pumps, with the same capacity, as are currently used in the Ginna accident analysis to ensure that sufficient flow will be provided to the Steam Generators to prevent fuel damage.
  - Steam generator level and pressure information will be provided to personnel in the Annex to make adjustments to the injection flow rate, if needed.
- o The new SAFW Building Annex is designed to be a robust structure per NEI 12-06 and will be accessible following BDBEE phenomena.
- o The switchover function is fail-safe:
  - The mechanical alignment for switchover is manual valves, the electrical alignment to the new D/G is a manual disconnect, and
  - The function logic, software, hardware, related piping, valves, systems, structures and components (SSCs), and system water level instrumentation to support the switchover function, either manually or automatically, are qualified for all potential ELAP events including seismic, tornado/high winds, flooding and missiles.
  - The existing SAFW pumps, motor and piping are SR. The new D/G, Electrical, pipe and SAFW DI Water Storage Tank are not SR but are being designed to meet all the requirements of NEI 12-06. They will be able to be operated following an SSE, Probable Maximum Flood (PMF), or a Design Basis Tornado Missile.

ECP-14-000749, *Standby AFW Cross-Tie (Fukushima)* (Reference 45), implemented a SAFW cross connect modification in the Auxiliary Building to ensure that SAFW flow can be provided downstream of potentially damaged (from a tornado) SAFW piping. Installation included a valve to ensure that back flow to the upstream damaged piping cannot occur. ECP-13-000483, *DDSAFW Project SAFW Piping Tie-In Design and Installation* (Reference 126), installed a single FLEX connection to the SAFW cross-tie line in the SAFW Pump Room (V-9757). These two ECPs together allow for the discharge of the FLEX pump to provide flow to both SGs.

3.4.2 Depressurize S/G for Makeup with Portable Injection Source

With the implementation of ECP-14-000727, *Harden Masonry Walls Surrounding Cable Tunnel Entrance to Protect Vital Instrumentation Following a Seismic Event or Tornado* (Reference 127), S/G ARVs are available to control S/G pressure / Tave following BDBEEs. ECP-14-000727 reinforced/ protected the IB walls from a Tornado/ Missile event thereby protecting both S/G ARVs from Tornado Missiles to allow for a symmetric RCS cooldown. Protected S/G ARVs allow reducing S/G pressure for RCS Natural Circulation Cooldown and connecting and feeding the S/Gs with a portable FLEX pump in Phase 2, if necessary.

In order to ensure RCP seal component temperature limitations are maintained, Westinghouse Technical Bulletin TB-15-1, *Reactor Coolant System Temperature and*

Pressure Limits for the No 2 RCP Seal (Reference 128), recommends that a RCS cooldown be performed following all loss of all seal cooling events. The cooldown should be initiated within 2 hours after a loss of seal cooling occurs. The cooldown rate should be the typical emergency response guideline (ERG) rate of 50 to 100°F/hr. to a cold leg temperature of less than 450°F in 4 hours and after 24 hours, an RCS temperature and pressure of less than 350°F and 400 psig should be achieved.

The S/Gs will be depressurized by opening the ARVs as directed in ECA-0.0 to maintain a RCS cooldown rate of < 100°F/hr. until S/G pressure reaches 360 psig (RCS Cold Leg Temperature ~438°F). This will reduce RCS cold leg temperatures for maintaining the integrity of the RCP seals and to inject the SI Accumulators for RCS inventory control and long term subcriticality.

In order to comply with the recommendation to perform an extended cooldown to support the integrity of the second stage RCP seal; within 24 hours, Ginna will perform the extended cooldown, with direction in ECA-0.0 Step 31, with a Note that directs the need for cooldown and depressurization to less than 350°F and less than 400 psig within 24 hours of event initiation.

One train of S/G pressure instrumentation is reasonably protected from a tornado missile event. Attachments A & B of FSG-7, *Loss of Vital Instrumentation or Control Power* (Reference 81), attempt to restore MCB readings of S/G's A & B pressure. If the S/G pressure instrumentation was damaged, use of FSG-7 Attachment P would direct an operator to take local readings of that parameter from a protected location in the Intermediate Building. Also, FSG-7 Attachments I, J, M and N provide a means of obtaining RCS Thot and Tcold temperatures, if needed, to allow a symmetric cooldown to be effected.

PA-PSC-0965, *PWROG Core Cooling Position Paper*, (Reference 41) states: "If local control of S/G feed and/or steam relief is required, this approach should demonstrate adequate manpower and communication. This needs to include habitability requirements. Otherwise, capability to maintain control of S/G feed and steam relief from the control room will be required." Local control of S/G ARVs is credited to maintain core cooling and heat removal. The Phase 2 Staffing Study (Reference 107) concluded that Ginna has adequate resources/ staffing to locally operate ARV's in the Intermediate Building Cold Side (IB) in the event of an ELAP. ECA-0.0 provides actions to open doors in the IB that provide a "chimney effect" in order to stabilize and then lower surrounding area temperatures in the vicinity of the ARV's. ECP-14-000727 (Reference 127) reinforced/ protected the IB walls from a Tornado/ Missile event thereby maintaining the IB in a condition that the ARV's will remain accessible following an event. Communications upgrades performed in accordance with NTTF Recommendation 9.3 Communications include a portable radio repeater, satellite phones and a rapid case. Operators will exit the IB to communicate with the Control Room and reenter the IB to operate the ARVs as needed.

3.4.3 Sustained Source of Water

The existing CSTs and/or the new 160,000 gallon SAFW DI Water Storage Tank are the initial water source(s) for feeding the S/Gs, providing 24 hours of core cooling and heat removal during Phase 1. Procedures provide guidance on maintaining a minimum level for the new SAFW DI Water Storage Tank to ensure 24 hours of water supply is available (AR-AA-3, *STDBY Aux FW DI Stor Tank Hi Hi / Lo Lo*, Reference 129) (T-44.7, *SAFW DI Water Storage Tank (TCD05) System Alignment and Operation*, Reference 130).

The new SAFW DI Water Storage Tank is a flat bottom, stainless steel de-ionized water tank and meets the definition of robust in accordance with the guidance in NEI 12-06 as follows:

- Seismic: The tank is anchored to a caisson foundation which has been seismically evaluated using a time history analysis scaled to Ginna's safe-shutdown earthquake (SSE). The extracted floor response spectra was then utilized to seismically qualify the tank in accordance with API-650. The tank is therefore qualified to the SSE and is seismically robust.
- External Flooding: When filled, the tank is not buoyant. Tank discharge is routed to flood protected areas. There are no flood induced failure mechanisms. The tank is robust with regards to external flooding.
- High Wind: In accordance with calculation 175180-000-SP-CL-00001 (Reference 131) the tank has been evaluated for external wind load of 132 miles per hour (mph). This wind speed meets the current design basis tornado wind speed for Ginna. The tank is robust with regards to high winds.
- Tornado Missile: In accordance with calculation 12574-1 the tank is qualified to withstand the current design basis missile suite. Nozzles are provided localized protection from tornado missiles from barriers and surrounding buildings. The tank is robust with regards to tornado missiles.
- Extreme Cold: The tank is provided with insulation and a tank heater located in the new enclosure building. The tank temperature will be continuously maintained. The tank heater is also capable of being fed from the new 1 MW D/G during a loss of power. The tank is robust with regards to cold temperatures.
- Snow: In accordance with calculation 175180-000-SP-CL-00001, the tank has been evaluated for a snow load of 84 pounds per square foot (psf) (Corresponds to ground snow load of 100 psf). This exceeds the design basis ground snow load of 40 psf. The tank is robust with regards to postulated snowfall.

3.4.4 Mode 5, Loops Filled

Technical Specification Basis for the R.E. Ginna Nuclear Power Plant B3.4.7, RCS Loops – MODE 5, Loops Filled, (Reference 27) states that loops filled is based on the ability to use a S/G as a backup to Residual Heat Removal (RHR) cooling. To be able to take credit for the use of one S/G, the ability to pressurize the RCS to 50 psig and control pressure must be available. This is to prevent flashing and void formation at the top of the S/G tubes which may degrade or interrupt the natural circulation flow path. In this mode, the secondary side of at least one S/G is required to be ≥ 16%.

An ELAP / LUHS event during Mode 4 and Mode 5, Loops Filled, will result in RCS temperature increasing until S/G heat removal capability matches reactor decay heat. Since the RCS is normally water solid with the Pressurizer filled during this mode of operation, the Pressurizer Power Operated Relief Valves (PORVs) will be cycling to limit RCS pressure. On loss of power and Instrument Air, nitrogen backup to the PORVs enables normal operation. However, there are a limited number of cycles with the existing Nitrogen backup.

Ginna does not plan to provide a long term source of nitrogen and/or air to the PORV's for mode 4/5 loops filled BDBEE event. A PORV can be cycled 50 times given 300 psig N2 accumulator pressure per DA-NS-92-014, *RCS Overpressurization Protection System Nitrogen Accumulator Tanks TRC03A & TRC03B Low Pressure Limit* (Reference 132). However, the Nitrogen accumulators are maintained at greater than 725 psig per AR-AA-15, *N2 Accum B Lo Press 725 psi* (Reference 133). At the normal accumulator tank pressure, 360 cycles are available as shown below for a single PORV. The UFSAR (Reference 25) indicates 40 cycles in 10 minutes is typical and this is consistent with 86-1234820, *Low Temperature Overpressure Analyses Summary Report* (Reference 134). This results in about 90 minutes of PORV cycle time for a single PORV ([360 / 40] x 10min = 90 min). Two PORV's are expected to be available and SAFW is expected to be aligned in approximately half an hour. Consequently, adequate nitrogen is available to allow continued PORV function until well after SAFW heat transfer is established.

3.5 Key Reactor Parameters

- SG Pressure – PI-468, PI-469, PI-482, PI-478, PI-479, and PI-483
- SG Level Narrow Range (NR) – LI-461 and LI-472; Wide Range (WR) – LI-505 and LI-507
- RCS Hot Leg Temperature – TI-410A-1 and TI-409A-1
- RCS Cold Leg Temperature – TI-410B-1 and TI-409B-1
- RCS Pressure Wide Range (WR) – PI-420-2
- Core Exit Thermocouple (CET) – CETA and CETB
- Pressurizer Level – LI-426 and LI-428
- Reactor Vessel Level Indication System (RVLIS) – LI-490B and LI-490A
- Source Range Detectors N-31 and N-32
- DC Bus Voltage – EI/PG and EI/PA

Procedure FSG-7, *Loss of Vital Instrumentation or Control Power* (Reference 81), identifies instrumentation to take field (local) readings (i.e. containment splice boxes) of necessary parameters, along with guidance to repower instruments of necessary parameters at the instrument racks if field wiring is intact.

3.6 Phase 2

Operators will continue to use S/G ARV(s) to reduce and/or maintain S/G pressures by manual or local operation depending on the BDBEE. The S/G ARVs have nitrogen bottles to provide initial control and may be supplemented by the instrument air system, which can be supplied by a FLEX air compressor, already purchased and onsite.

Primary Strategy

The Operations Staff will monitor the new SAFW DI Water Storage Tank level. ECP-13-000424, *DDSAFW Project Piping Design and Installation* (Reference 135), installed V-9782, "DI Water Tank Supply Hose Connection Isolation Valve," as part of the modification that allows filling of the SAFW DI Water Storage Tank from a portable diesel driven pump. This allows the new SAFW DI Water Storage Tank to be refilled from a variety of sources including the Lake Ontario and fire water systems. FSG-6, *Alternate SAFW DI Water Storage Tank Makeup* (Reference 99), provides a method of refilling the SAFW DI Water Storage Tank using a FLEX pump taking suction from Lake Ontario, Condenser Hotwell (if available) or the Outside Condensate Storage Tank (if available) and discharging through a fill connection at the tank. This will allow SAFW Pumps to continue operation.

The primary Phase 2 coping strategy is to resupply the new SAFW DI Water Storage Tank from the Discharge Canal using a portable diesel driven pump and hoses. (See the Safety Functions Support section for a discussion on a protected source of water from the UHS.) Core cooling and heat removal will be sustained indefinitely, or until long term recovery actions are determined, using a SAFW pump powered from the SAFW D/G, with provision for refilling the new SAFW DI Water Storage Tank and SAFW D/G fuel tank. (See the Safety Functions Support section for a discussion on the protected means of refilling the SAFW D/G fuel tank.)

The portable diesel driven pump will be deployed on the West side of the Screenhouse. From there hoses will be run from the suction of the pump either into the discharge canal directly or through a removable grating and into the water. The current plan is to submerge the hose below the surface of the water. A spin-on Suction Strainer is provided for the 6 inch suction hose. Procedure Guidance for filling the DI Water Storage Tank is per FSG-6 (Reference 99).

Alternate Strategy

The alternate Phase 2 strategy is to utilize a diesel driven high capacity portable pump to supply the S/Gs with water from the new SAFW DI Water Storage Tank, or Lake Ontario, should the SAFW Pump become unavailable. The diesel driven high capacity portable pump is sized to supply adequate feedwater flow (215 gpm) to restore and maintain S/G level at the target S/G pressure to prevent nitrogen injection from the SI Accumulators. The diesel driven high capacity portable pump is connected to the SAFW system at a protected connection point in the SAFW Building. The location of this connection is provided in a diagram in Attachment 2, Figure 1.

A low-pressure portable pump is required to supply 215 gpm to the S/Gs to provide adequate heat removal (Reference 64). The portable FLEX pump capability to feed the S/Gs is evaluated in DA-ME-15-005, *FLEX RHR/CCW/SW Hydraulic Model* (Reference 136). Calculation 617.1, *R. E. Ginna FSG Setpoints* (Reference 137), Setpoint H.17 determined that the minimum pressure which prevents injection of accumulator nitrogen into the RCS for ELAP conditions, plus allowances for normal channel accuracy, was 290 psig. ECA-0.0, *Loss of All AC Power,* Appendix A (Reference 22) directs operators to Depressurize selected S/G(s) to 290 psig when establishing low pressure S/G feed and then refer to FSG-10, *Passive RCS Injection Isolation* (Reference 82), to isolate or vent the SI Accumulators to prevent nitrogen injection into the RCS.

DA-ME-15-005 predicts FLEX SAFW pump performance feeding S/Gs while drafting from the lake. The analysis predicts that the pump is capable of delivering 232 gpm split to both generators (116 gpm each) if the S/Gs are at 305 psia. 305 psia was chosen as a reasonable S/G target pressure after approximately 6 hours of effective SAFW flow per the Mode 1 RELAP analysis RWA-1323-003, *Ginna RELAP5 ELAP Analysis for Mode 1* (Reference 57).

<u>Cooldown to Mode 5</u>

If cooldown to Mode 5, or remaining in Mode 5, Loops Filled, is desired, procedure ER-FIRE.3, *Alternate Shutdown for Aux Building Basement/Mezzanine Fire,* Section 6.7, Water Solid S/G Cooldown (Reference 35), provides guidance that can be modified for use. Water solid cooldown requires both SAFW pumps and S/Gs to be available for cooldown. A high flow portable diesel driven pump can also be used in place of the SAFW pumps. R.E. Ginna Nuclear Power Plant Fire Protection Program (Reference 39) Section 5.1.6.1, Water-Solid Steam Generator Operation, documents that water solid S/G operation can cool the RCS to less than 200°F in less than 72 hours.

3.7 Phase 3

The Phase 3 strategy for core cooling, including what equipment will be needed and how, when, and where it will be deployed is basically the Phase 2 strategy supplemented by equipment available from the NSRC.

Under Phase 3 natural circulation will continue to be maintained via heat removal performed by the S/Gs using a SAFW pump taking suction on the new SAFW DI Water Storage Tank; or a portable diesel driven pump connected to the SAFW system will be used to provide make-up water to the S/Gs from the new SAFW DI Water Storage Tank or the Discharge Canal.

To refill the SAFW DI Water Storage Tank, any existing source of demineralized water on site will be preferentially used until the NSRC water treatment system arrives. The bounding FLEX scenario to refill the SAFW DI Water Storage Tank will be to deploy a FLEX diesel driven portable pump with a hard suction hose to take suction from the Discharge Canal and, via a discharge hose connected to the SAFW DI Water Storage Tank, refill the SAFW DI Water Storage Tank. When the NSRC water treatment system arrives, water will be pumped from the discharge canal through the water treatment system to the SAFW DI Water Storage Tank. Alternatively, water can be pumped from the discharge canal through the water treatment system directly to the S/Gs via the SAFW system connection point. NSRC delivered portable diesel driven pumps provide backup capability to the on-site FLEX pumps.

Connections are available to supply the 480 Volt vital buses from an NSRC supplied D/G and for connecting NSRC supplied portable pumps and the NSRC supplied water processing unit.

4 Maintain RCS Inventory Control/Long Term Subcriticality (Modes 1 – 4 and Mode 5 with Loops Filled)

4.1 Objectives

Extended coping without RCS makeup is not possible without minimal RCS leakage. Plants must evaluate use of low leakage RCP seals and / or providing borated high pressure RCS makeup. Analysis is required to determine RCS makeup requirements. Letdown may be required to support required makeup and ensure subcriticality. (Reference 4)

4.2 Acceptance Criteria

There will be no return to criticality once the loss of all AC power has occurred. To ensure that the reactor remains subcritical, a limit of Keff less than 0.99 (subcritical) is set. The level of 0.99 for subcriticality was chosen because it will provide some margin to account for the best estimate reactor physics parameters assumed in the analysis.

4.3 Strategies

The general RCS makeup strategy is to deliver the necessary amount of borated water to maintain natural circulation flow in the RCS and maintain adequate Shutdown Margin. For low to no RCS leakage conditions, the need to borate to maintain subcriticality bounds the need for RCS inventory control early in the ELAP / LUHS event. For the highest applicable RCS leakage rate of 61 gpm (SBO-PROGPLAN, Reference 32), the need to provide RCS makeup is the bounding condition.

Under Phase 1 (using installed equipment) the Operators initially rely on increasing negative core reactivity due to the buildup of Xenon to maintain the reactor subcritical. The Operators will initiate a controlled plant cooldown and depressurization as per procedure ECA-0.0, *Loss of All AC Power* (Reference 22), and consistent with recommendations in PA-PSC-0965, *PWROG Core Cooling Position Paper* (Reference 41). This will result in injecting borated water from the SI Accumulators.

Under Phase 2 (using on-site FLEX equipment) the Operators will be able to inject borated water from the RWST via a newly installed Alternate RCS Injection Pump, powered from the SAFW D/G, to maintain RCS inventory above that required to maintain natural circulation cooling, and to ensure the reactor remains subcritical during the controlled cooldown directed by ECA-0.0.

Under Phase 3 (using off-site NSRC supplied equipment), portable equipment and consumables will be used to reinforce and secure for an indefinite coping time the measures implemented during Phase 2, mainly additional boric acid and the ability to re-power equipment.

A graphical representation of the Phase 1 to Phase 3 strategies for maintaining RCS Inventory Control and Long Term Subcriticality (Modes 1 – 4 and Mode 5 with Loops Filled) is shown below.

Maintain RCS Inventory Control / Long Term Subcriticality (Modes 1 – 4 and Mode 5 with Loops Filled)

Phase 1 (Xenon and SI Accumulators – time 0 up to ~ 8 hrs.)

~1 hr ____ Phase 2

________________________________ Phase 3

0 6 12 18 24 30 36 42 48 54 60 66 72 + hrs.

4.3.1 RCP Seals with Regard to Inventory

As a result of the 10 CFR Part 21 report regarding the Westinghouse low leakage RCP seals, Ginna does not intend to utilize low leakage RCP seals for its beyond-design-basis external event mitigation strategies. The WCAP-17601 (Reference 19) Section 5.7.1 discussion of Westinghouse Generic Case Results with safe shutdown/low leakage seals is not applicable. This strategy addresses the need for additional borated makeup for RCS inventory control for the assumed RCP Model 93 seal leakage.

To account for the boration requirements for the highest applicable leakage rate for the RCP seals and unidentified RCS leakage, a newly installed Alternate RCS Injection pump powered from the new SAFW D/G, taking suction from the RWST and discharging to the RCS, will be used to provide borated makeup to the RCS. The Alternate RCS Injection pump is located in the SAFW Building. This arrangement includes a discharge line routed through a protected portion of the Auxiliary Building to newly installed SI line connections on both trains. The new Alternate RCS Injection pump will be manually aligned as required. The alternate FLEX strategy is to use a diesel driven portable FLEX Alternate RCS Injection pump taking suction from the RWST, connected at the SAFW Building via a high pressure hose, to a staged connection to the newly installed SI line connections, or repower Charging Pump 'B' from the SAFW D/G using temporary power cables.

To provide sufficient capacity of borated water makeup to the RCS, the new Alternate RCS Injection pump is capable of pumping 75 gpm from the RWST into the RCS at 1500 psig. The portable diesel engine driven Alternate RCS Injection pump is also capable of pumping 75 gpm of borated water from the RWST to the RCS at 1500 psig.

The timing for RCS makeup is variable. At the maximum expected RCS and RCP seal leak rates, it is expected that natural circulation will transition from single-phase loop flow to two-phase loop flow at 2.8 hours (RWA-1323-003, Reference 57) from the start of the event and that two-phase loop flow will be less than single-phase loop flow at approximately 15.5 hours from the start of the event (Reference 57). To comply with NRC endorsement of the boron mixing generic concern (ML13276A183), Alternate RCS Injection is currently directed to commence at 8 hours into the event.

4.3.2 RCS Makeup with Regard to Subcriticality

Regardless of whether the RCS is cooled down or not, boration capability is necessary to maintain the reactor subcritical once Xenon has decayed away. The modification to install protected FLEX Alternate RCS Injection capability provides the ability to restore and maintain RCS inventory and keep the reactor subcritical.

According to WCAP-17601-P Section 5.8, Re-Criticality with Lowered RCS Temperatures, (Reference 19) Ginna will need to borate to maintain Keff less than 0.99

throughout the entire Cycle 36. The limiting time to start boration is end-of-life when boration must start within 14 hours of Reactor Trip. Because it is necessary to place some constraints on this scenario, WCAP-17601-P recommends that the low end of RCS temperatures be limited to no less than hot shutdown, i.e., 350°F.

PA-PSC-0965, *PWROG Core Cooling Position Paper* (Reference 41), states: "If xenon greater than equilibrium is required to maintain reactor subcritical at 350°F, then initiate boration prior to peak xenon of 8 hours post trip. Otherwise, initiate boration prior to xenon decay to level that may cause re-criticality at 350°F."

The rate of boric acid injection must be sufficient to offset the maximum addition of positive reactivity from decay of peak Xenon associated with 100% power history. UFSAR Section 3.1.1.5.4, "Reactivity Hold-Down Capability," (Reference 25) states "Sufficient boric acid from the Refueling Water Storage Tank (RWST) can also be injected to compensate for xenon decay beyond the equilibrium level, with one charging pump operating at its minimum speed, and thereby delivering in excess of the required minimum flow of approximately 9 gpm into the reactor coolant system." This required flow rate is checked on a cycle specific basis. Calculation CALC-2014-0002, *Cycle 38 Reactor Engineering Calculations* (Reference 20), Section 8.18, Minimum Charging Flow Required from RWST, documents that one charging pump, delivering a minimum of 9 gpm into the RCS, can keep up with xenon decay. Nine gpm is based on a charging pump delivery rate of 17 gpm, minus a maximum seal leakoff of 8 gpm. The basis for this flow rate (from the Technical Requirements Manual for the R. E. Ginna Nuclear Power Plant (Reference 28) and ACB 2009-0005, (Reference 29)) assumes that boration from the RWST does not start until post-trip Xenon equals pre-trip Xenon (20 hours from 100% Pre-Trip RTP from BOL per CALC-2014-0002).

CALC-2014-002 shows that letdown is required to support borating to the RCS to maintain subcriticality with no RCS leakage. If at some point letdown is desired, the Reactor Head Vents are the preferred method.

RCS venting is a contingency action if RCP seal leakage remains unexpectedly low. With expected RCS leakage following an ELAP event, SI Accumulator injection will occur during the cooldown directed by ECA-0.0, *Loss of All AC Power* (Reference 22), and is necessary to maintain sufficient RCS inventory for single-phase natural circulation flow (two-phase flow is acceptable if greater than the single phase flow rate) in the RCS. Should RCP seal leakage remain unexpectedly low, RCS cooldown will reduce RCS pressure and pressurizer level but may result in sufficient SI Accumulator injection to provide adequate shutdown margin. FSG-1, *Long Term RCS Inventory Control* (Reference 83), and FSG-8, *Alternate RCS Injection* (Reference 101), provide tables to determine the volume of boration required to maintain subcriticality, Xenon-Free at 350°F, and direction to inject additional borated water to the RCS.

If venting the RCS is required, then two parallel reactor vessel head vent paths are available. Each path is capable of venting 9 gpm of makeup down to a RCS pressure of 380 psig. With both reactor vessel vent paths open, borated makeup at 9 gpm can be accommodated down to 190 psig (DA-ME-15-013, *FLEX Miscellaneous Calculations*, Reference 138). Less than 9 gpm boration would normally be required given that the shutdown margin calculation (CALC-2014-0002, Reference 20) assumed the 9 gpm boration started at 20 hours. The two available reactor head vent paths provide defense in depth for venting.

As documented in the Technical Evaluation Report on Reactor Coolant System Vents for Ginna in the Safety Evaluation by the Office of Nuclear Reactor Regulation, dated September 28, 1983, the non-condensable gases, steam, and/or liquids vented from the reactor vessel head are piped and discharged directly to the refueling cavity and the discharges from the pressurizer are piped to the pressurizer relief tank. The staff found that the vent system at Ginna is acceptable and in conformance with the requirements of 10 CFR 50.44 paragraph (c)(3)(iii) and the guidelines of NUREG-0737 Item II.B.1, and NUREG-0800 section 5.4.12.

The Alternate RCS Injection System utilizes positive displacement pumps capable of injecting RWST water into the RCS at 75 gpm and 1575 psig. FSG-1 checks RCS pressure LESS THAN 1575 psig then directs aligning and establishing RCS Injection flow. Operators are directed to control RCS Injection flow to maintain pressurizer level BETWEEN 13% [40% adverse containment] AND 75% [65% adverse containment]. FSG-1 directs the operators to FSG-8 if RCS pressure is NOT LESS THAN 1575 psig.

If necessary to support RCS makeup and boration strategies, FSG-1 directs Operators to Open reactor head vent valve to depressurize the RCS for additional boration. If a reactor head vent valve cannot be opened, then Operators are directed to an attachment to lower RCS pressure using a PORV. This attachment cautions Operators that a PORV should only be used if no other means for RCS depressurization is available. If pressurizer level is greater than 95%, then Operators are to contact the Technical Support Center to evaluate opening a pressurizer PORV to allow water release as needed to provide a boration letdown path.

FSG-8 directs Operators to align an available RCS Injection Pump, establish RCS conditions sufficient for injection with RCS Pressure LESS THAN 1575 psig and Pressurizer Level LESS THAN 75%, and (if RCS Pressure is not LESS THAN 1575 psig and Pressurizer Level is not LESS THAN 75%) then open reactor vessel head vent valves (two valves in series for both trains) to depressurize RCS for boration. IF head vent valves are not available, then Operators are directed to an attachment to lower RCS pressure using a PORV. This attachment cautions Operators that a PORV should only be used if no other means for RCS depressurization is available. If the reactor vessel head vent valves are opened, Operators are directed to close the head vent valves IF Pressurizer level decreases below 13% [40% adverse containment] OR Alternate RCS Injection pump fails. Alternate RCS Injection flow is established when RCS pressure is less than 1575 psig and Pressurizer level is less than 95% OR RLVIS upper range is less than 97%.

CALC-2014-0002 provides shutdown margin input for the tables in FSG-1 and FSG-8 to maintain subcriticality, Xenon-Free conditions at 350°F in the RCS.

A water-solid RCS is not permitted with boration termination criteria in FSG-1 and FSG-8.

4.3.3 Boron Addition/Mixing

Section 4.3.2 of WCAP-17601 states: "There shall be no return to criticality once the loss of all AC power has occurred. To ensure that the plants remain subcritical, a limit of Keff less than 0.99 (subcritical) is set. The exact needed level of subcriticality is somewhat subjective, but 0.99 was chosen because it provides some margin to account for the best estimate or generic reactor physics parameters assumed in this analysis."

1. A uniform boron mixing model is assumed in the ELAP analysis. This is in compliance with the recommendations discussed in the Pressurized Water Reactor Owner's Group (PWROG) white paper related to the boron mixing model, and the NRC clarifications, as discussed under bullet #3 below. Ginna takes credit for boron mixing during two phase flow. As documented in the Extended Power Uprate RAI response *Supplemental Response to Requests for Additional Information Regarding Topics Described by Letters Dated August 24, 2005 and October 28, 2005*, RCS mass flow rate increases during two-phase flow (Figure 8). Additional details on the two-phase RCS mass flow increase are documented in proprietary Westinghouse Calculation CN-LIS-05-163, *SBLOCA Cooldown Calculation Results for R.E. Ginna (RGE) Extended Power Uprate and 422V+ Fuel Upgrade Program* (Reference 139). With a rather large change in mixture density throughout the core/hot leg/SG uphill tube side relative to the downhill side (from SG heat removal), the flow velocity increases. This continues with increasing void fraction until makeup to the RCS and the decline of decay heat allows the RCS return to a subcooled state. RCS boration to support cooldown will credit the buildup of xenon, and the necessary boration will be completed with at least a one hour margin to the minimum shutdown margin (Keff less than 0.99) to preclude criticality and accounting for the added time necessary for the added borated water to mix with the water in the RCS.
2. A plant specific boron analysis was performed as part of CALC-2014-0002, *Cycle 38 Reactor Engineering Calculations* (Reference 20), to determine boration requirements to ensure that the core remains subcritical throughout the ELAP event for the limiting condition with respect to shutdown margin. Fifteen percent or greater uncertainties were applied to bound the boron concentration calculations for future core designs. Mitigation strategies ensure that the core remains sub-critical (Keff less than 0.99) throughout the ELAP event for the limiting condition with respect to shutdown margin, considering both no RCP seal leakage and the maximum RCP seal leakage postulated value. If no RCP leakage occurs during the ELAP event, procedures direct the operators to establish conditions sufficient for RCS boration by opening a reactor head vent valve or a Power Operated Relief Valve.
3. Ginna follows the generic approach identified in the PWROG position paper on boron mixing that was submitted to the NRC on August 15, 2013, subject to the clarifications in the NRC letter to the PWROG, dated January 8, 2014 (ML13276A183). Specifically:
    a. Strategy timeline will complete boration with at least 1 hour margin to preclude criticality (Keff less than 0.99) in the most limiting conditions.
    b. Injection will be to the RCS cold legs.
    c. Boration will be concluded well within 100 hours after shutdown.
    d. Boration targets for subcriticality (Keff less than 0.99) will be based on the most limiting scenario considering no RCS leakage.
    e. All steam generators will be fed until the required minimum boron injection to support subcriticality (Keff less than 0.99) has been achieved.
    f. The required timing for providing borated makeup to the primary system will consider conditions with no reactor coolant system leakage and with the highest applicable leakage rate for the reactor coolant pump seals and unidentified reactor coolant system leakage.
    g. For the condition associated with the highest applicable reactor coolant system leakage rate, adequate borated makeup will be provided such that the loop flow

rate in two-phase natural circulation does not decrease below the loop flow rate corresponding to single-phase natural circulation.

Ginna abides by the generic approach described in the PWROG August 15, 2013 position paper related to modeling the timing and uniformity of boric acid mixing within the RCS under natural circulation conditions potentially involving two-phase flow. The shutdown margin calculation is CALC-2014-0002, *Cycle 38 Reactor Engineering Calculations* (Reference 20), which analyzes for the most limiting conditions (xenon free, largest cooldown, both zero and max seal leakage). RE-103, *Control of Reload Core Design* (Reference 140), ensures that adequate shutdown margin checks are performed for future operating cycles. For the boration strategy:

- A newly installed (and electrically isolated) Alternate RCS Injection Pump powered from the new SAFW D/G, taking suction from the RWST (300,000 gallons) and discharging to the RCS, is used to provide borated makeup to the RCS. This Alternate RCS Injection pump is located in the SAFW Building (SAFWB). This arrangement includes a discharge line routed through a protected portion of the Auxiliary Building to newly installed Safety Injection (SI) line connections on both trains. The new Alternate RCS Injection pump will be manually aligned as required. The alternate FLEX strategy is to use a diesel driven portable Alternate RCS Injection Pump taking suction from the RWST, connected at the SAFW Building Wall adjacent to Door 99 via a high pressure hose, to a staged connection to the newly installed SI line connections, or repower Charging Pump 'B' from the SAFW D/G using temporary power cables.
- To provide sufficient capacity of borated water makeup to the RCS, the new Alternate RCS Injection pump is capable of pumping 75 gpm from the RWST into the RCS at 1500 psi. A portable diesel engine driven high pressure Alternate RCS Injection pump provides alternate borated makeup capability to the RCS. This pump is also capable of pumping 75 gpm of borated water from the RWST to the RCS at 1500 psi.
- The timing for RCS makeup is variable. At the maximum expected RCS and RCP seal leak rates, it is expected that natural circulation will transition from single-phase loop flow to two-phase loop flow at 2.8 hours (RWA-1323-003, *Ginna RELAP5 ELAP Analysis for Mode 1*, Reference 57) from the start of the event and that two-phase loop flow will be less than single-phase loop flow at approximately 15.5 hours from the start of the event (RWA-1323-003). To comply with NRC endorsement of the boron mixing generic concern, ECA-0.0, *Loss of all AC Power*, (Reference 22) directs charging at 8 hours into the event (Setpoint ID J.23; WOG Footnote ID V.08) per FSG-1, *Long Term RCS Inventory Control* (Reference 83), to ensure subcriticality is maintained. However, it is likely that charging will commence earlier per FSG-1 based on RVLIS and/or Pressurizer levels. Therefore, the boration time requirement is bounded by the requirement to maintain RCS inventory.
- Prior to depleting the RWST inventory, a mobile boration unit supplied from the NSRC can be utilized to provide an indefinite source of water for Phase 3 boron control/RCS injection.

4.4 Phase 1

As discussed in Maintain Core Cooling & Heat Removal (Steam Generators Available) cooldown is initiated to lower RCS cold leg temperatures for maintaining the integrity of the RCP seals and to inject the SI Accumulators for RCS inventory control and long term subcriticality.

4.5 Key Reactor Parameters

- SG Pressure – PI-468, PI-469, PI-482, PI-478, PI-479, and PI-483
- SG Level Narrow Range (NR) – LI-461 and LI-472; Wide Range (WR) – LI-505 and LI-507
- RCS Hot Leg Temperature – TI-410A-1 and TI-409A-1
- RCS Cold Leg Temperature – TI-410B-1 and TI-409B-1
- RCS Pressure Wide Range (WR) – PI-420-2
- Core Exit Thermocouple (CET) – CETA and CETB
- Pressurizer Level – LI-426 and LI-428
- Reactor Vessel Level Indication System (RVLIS) – LI-490B and LI-490A
- Source Range Detectors N-31 and N-32
- Refueling Water Storage Tank (RWST) Level – LI-920 and LI-921
- DC Bus Voltage – EI/PG and EI/PA

Procedure FSG-7, "*Loss of Vital Instrumentation or Control Power,*" (Reference 81) identifies instrumentation to take field (local) readings (i.e. containment splice boxes) of necessary parameters, along with guidance to repower instruments of necessary parameters at the instrument racks if field wiring is intact.

4.6 Phase 2

<u>Borated Water Source</u>
To maintain RCS Inventory Control and Long Term Subcriticality, the borated water source for RCS makeup and boration is the RWST. Heating of the RWST is not required. At the maximum boron concentration of 3050 ppm, the RWST solubility limit is below 32°F.

The RWST meets the definition of robust in accordance with NEI 12-06 as follows:
The RWST is a flat bottom, stainless steel tank located in the Auxiliary Building, a Safety-Related, Seismic Category (SC) I structure.

- Seismic: The tank is evaluated within DA-CE-95-125 (Reference 141) and is shown to withstand design basis SSE loadings.
- External Flooding: The Auxiliary Building is flood protected to withstand external flood events. The tank is not susceptible to external flooding events.
- High Winds: The Auxiliary Building structure is evaluated to withstand the effects of external wind loads developed by design basis tornado wind. The structure utilizes backdraft dampers (Tornado dampers) in order to eliminate the effects of differential pressure associated with design-basis tornado (UFSAR Section 3.3.5.7, Reference 25). The RWST was subsequently evaluated for wind pressure effects due to a tornado (UFSAR Section 3.3.3.3.1).
- Tornado Missile: In accordance calculation 428-4824-034-1C (Reference 142), the tank is qualified to withstand the current design basis missile suite. There are no exposed nozzles that could cause the tank to drain if struck by a tornado missile.
- Extreme Cold: The tank is located within the Auxiliary Building, which has minimum allowable temperature of 50°F per UFSAR Table 3.11-1 (Reference 25). Ginna has

completed a GOTHIC calculation for extreme minimum temperature of the Auxiliary Building.

- Snow: The tank is located within the Auxiliary Building which has been evaluated for 40 psf design basis ground snow loadings. The tank is not susceptible to snow loads.

Primary Strategy

RCS make-up will be achieved through a new Alternate RCS Injection System, with injection into the cold leg via the Safety Injection (SI) System. The Alternate RCS Injection System (33013-1230, *Alternate Charging System*, P&ID Reference 96), was installed prior to the fall 2015 refueling outage, with final system tie-ins made during the outage. The overall design strategy is to draw on the RWST and pump the borated water, using a high pressure positive displacement pump located in the SAFW Building, into the cold leg of the RCS, via the SI lines.

The Alternate RCS Injection FLEX pump suction piping is tied into the RWST recirculation pump suction line that takes suction off the bottom of the tank (el. 237' 8"). The 3" Alternate RCS Injection FLEX pump suction piping is run through the Auxiliary Building to buried lines between the Auxiliary Building and the SAFW Annex, to the Alternate RCS Injection pump in the SAFW Building. The Alternate RCS Injection FLEX pump is mounted on an 8" concrete pad. The positive displacement pump is powered by the 1MW diesel generator housed in the SAFW Annex. It can provide a flow of 75 gpm at 1500 psig, through a 2" pump discharge line that parallels the suction line into the Auxiliary Building basement, west of the RWST, and into the Safety Injection "A" and "B" headers. The entire system is manually operated and controlled, making it impervious to Auxiliary Building fires or floods.

Since the Alternate RCS Injection System interfaces with the Safety Injection pump discharge headers, safety related isolation valves were installed to provide a boundary. Each Alternate RCS Injection branch line feeding into the SI "A" and "B" headers is equipped with a safety related normally closed ball valve. The common line feeding the two branch lines also has a safety related normally closed ball valve to provide double isolation for each header. These valves are classified as Containment Isolation Valves (CIVs). Additionally, a check valve in the common line has been added to ensure that contaminated water does not migrate through the Auxiliary Building to the SAFW Building or SAFW Annex, which are not Radiologically Controlled Areas (RCA).

Since the Alternate RCS Injection FLEX pump is a positive displacement pump, a flow of 75 gpm from the pump is constant. A regulating valve on the pump skid ensures downstream pressure does not exceed the valve setting. Downstream pressure above the setting will cause a portion of the flow to be bypassed back to the pump suction. The regulating valve setting of 1575 psig ensures that the required flow of 75 gpm can be fed into the reactor pressurized to 1500 psig. Additionally, a relief valve on the pump skid is set at 1775 to 1875 psig to ensure that the pressure remains well below the pressure/temperature rating of the downstream piping.

ECA-0.0, *Loss of All AC Power* (Reference 22), has the Operators monitor the Reactor for subcriticality as a continuous action step that is performed immediately after S/G depressurization (RCS cooldown) is commenced. If unable to verify subcriticality using nuclear instrumentation and an ELAP is in progress, then FSG-1, *Long Term RCS Inventory Control* (Reference 83), can be performed.

Alternate Strategies

A trailer-mounted diesel driven Alternate RCS Injection FLEX pump is being provided as a redundant pump to the permanently mounted pump. Hose connections, at valves 9056 and 9072 on P&ID 33013-1230 (Reference 96), provide the ability to connect the trailer mounted pump to the hard-piped Alternate RCS Injection System.

An additional alternate strategy for alternate RCS injection has been developed with an alternate injection point as specified by NEI 12-06, Section 3.2.2 and Table D-1. In addition to the new Alternate RCS Injection system to inject borated water from the RWST through the SI Headers into the RCS (with portable diesel driven backup), an alternate means of providing RCS injection through an alternate injection point is available. This alternate means of injecting borated water into the RCS involves repowering Charging Pump 'B' from the SAFW D/G utilizing temporary power cables and manually lining up to inject from the RWST to the RCS through AOV-392A (Charging Valve Regenerative Heat Exchanger to Loop B Hot Leg), which opens at a 250 psig differential pressure to allow flow to the RCS.

FSG-1 provides actions to restore RCS inventory. To use the Alternate RCS Injection Diesel Driven FLEX Pump, it is moved from its storage location to east of the SAFW Building and connected to the Alternate RCS Injection System via high pressure suction and discharge hoses. Pump suction is aligned to the RWST and discharge to the SI headers.

4.7 Phase 3

The Phase 3 strategy for RCS makeup, including postulated flow paths, is basically the Phase 2 strategy supplemented by equipment available from the NSRC.

Prior to depleting the RWST inventory, a mobile boration unit supplied from the NSRC can be utilized to provide an indefinite source of water for Phase 3 boron control/RCS injection. The preferred source of water to supply the mobile boration unit will be the new SAFW DI Water Storage Tank. To refill the SAFW DI Water Storage Tank, any existing source of demineralized water on site will be preferentially used until the NSRC water treatment system arrives. The bounding FLEX scenario to refill the SAFW DI Water Storage Tank will be to deploy a FLEX diesel driven portable pump with a hard suction hose to take suction from the Discharge Canal and, via a discharge hose connected to the SAFW DI Water Storage Tank, refill the SAFW DI Water Storage Tank. When the NSRC water treatment system arrives, water will be pumped from the discharge canal through the water treatment system to the SAFW DI Water Storage Tank. Boron supplied from the NSRC with the mobile boration unit will be available to mix with the preferential water source for RCS boration/makeup. NSRC delivered portable diesel driven pumps provide backup capability to the on-site FLEX pumps.

Connections are available to supply the 480 Volt vital buses from an NSRC supplied D/G and for connecting NSRC supplied portable pumps and the NSRC supplied mobile boration and water processing units.

5 Maintain Core Cooling & Heat Removal (S/Gs Not Available; Modes 5 & 6)

The boundary conditions for core cooling and containment strategies assume all reactors on the site are initially at power because this is more challenging in terms of core protection, and containment integrity. The FLEX strategies have been designed for this condition. However, the FLEX strategies are also "diverse and flexible" such that they can be implemented in many different conditions as it is not possible to predict the exact site conditions following a BDBEE. As such, the strategies can be implemented in all modes by maintaining the portable FLEX equipment available to be deployed during all modes.

Although NEI 12-06 states that the FLEX strategies are not explicitly designed for outage conditions due to the small fraction of the operating cycle that is spent in an outage condition, generally less than 10%, consideration is given in the requirements of this document that support outage conditions as follows:

- Provision of primary and alternate connection points provides higher reliability and helps address equipment being out of service.
- Specific makeup rates and connections will be sized to support outage conditions, i.e., connection points for RCS makeup will be sized to support core cooling.

Exelon corporate document OU-AA-103, *Shutdown Safety Management Program*, (Reference 143) gives guidance to follow the NRC endorsement (ML13267A382) of the NEI position paper on shutdown modes (ML13273A514). Ginna will follow this document. Ginna procedures AP-ELEC.4, *Loss of all AC Power While on Shutdown Cooling* (Reference 117), and FSG-14, *Shutdown RCS Makeup* (Reference 144), provide guidance. Ginna also follows PWROG-14073-P, *Supplemental Information for Operator Response to Extended Loss of AC Power in Modes 4, 5 and 6* (Reference 145).

Ginna addresses outage conditions in this strategy.

5.1 Objectives

Borated RCS makeup using diverse makeup connections to sustain residual heat removal to vented RCS must be provided. Diverse injection points or methods are required to establish capability to inject through separate divisions/ trains, i.e., should not have both connections in one division/ train. Connection to RCS for makeup should be capable of flow rates sufficient for simultaneous core heat removal and boron flushing (combined makeup flow exceeding 300 gpm, subject to generic or plant specific analysis). On-site pump (portable or installed) is available for RCS makeup. In order to address the requirement for diversity, if re-powering of installed charging pumps is used for this function, then either (a) multiple power connection points should be provided to the charging pump, or (b) provide a single power supply connection point for the charging pump and a single connection point for a portable makeup pump. A source of borated water is required to support RCS makeup. This can be an on-site tank, or can be provided by off-site resources. (Reference 4)

5.2 Acceptance Criteria

No core damage will occur. Coping times will be calculated such that they preclude core damage. The codes used will ensure no core damage occurs including maintaining saturated conditions in the core region, keeping peak clad temperature below core melt limits, preventing clad rupture, and maintaining two-phase water level above the top of the active fuel.

There will be no return to criticality once the loss of all AC power has occurred. To ensure that the reactor remains subcritical, a limit of Keff less than 0.99 (subcritical) is set. The level of 0.99 for subcriticality was chosen because it will provide some margin to account for the best estimate reactor physics parameters assumed in the analysis.

5.3 Strategies

When operating in Modes 5 and 6, RCS cooling is accomplished using the, Residual Heat Removal (RHR) System. The S/G's may not be available for natural circulation cooldown of the RCS during these modes. Once the RCS is opened, forced feed and spill cooling is relied upon for core cooling. Once the reactor head is removed and the refueling cavity is flooded, a significant amount of time exists before boiling of the coolant would occur following a loss of the operating RHR pump. There is ample time to deploy a portable diesel driven pump for refueling cavity makeup.

Technical Specification Basis for the R.E. Ginna Nuclear Power Plant (Reference 27) B3.4.8, RCS Loops – MODE 5, Loops Not Filled states that the S/Gs are not available as a heat sink when the loops are not filled.

Only borated water should be added to the RCS to maintain adequate shutdown margin (SDM). CN-TA-98-148, *R.E. Ginna (RGE) Cycle 28 Reload Safety Evaluation – Mode 6 Boron Dilution*, (Reference 21) documents that the critical boron concentration is 1330 ppm with all the (Rod Cluster Control Assemblies (RCCAs) in the core during refueling (UFSAR Section 15.4.4.4.10.1, Reference 25).

Potential borated water sources and paths are:

- Gravity drain from the RWST to the RCS via the RHR System.
- RWST using the paths described in strategy Maintain RCS Inventory Control/ Long Term Subcriticality.

Design Analysis DA-NS-2006-019, *Loss of RHR Cooling during Mid-Loop for EPU*, (Reference 33) documents that two charging pumps supplying 72.5 gpm can supply boil off for a shutdown time of 48 hours or greater and that one charging pump supplying 60 gpm can supply boil off for a shutdown time of 80 hours or greater. (Maximum Charging Pump capacity is 60 gpm.)

NUREG/IA-0181, *Assessment of RELAP5/MOD3.2 for Reflux Condensation Experiment*, (Reference 38) states "In case of the LORHR during mid-loop operation in nuclear power plants, the reflux condensation heat transfer in the riser part of the U-tube is an effective heat removal mechanism without the loss of coolant inventory... The heat transfer coefficients near the tube inlet increase as the inlet steam flow rate and the system pressure increase. In the presence of noncondensible gas, the heat transfer capability is dramatically decreased."

5.4 Phase 1

AP-ELEC.4, *Loss of All AC Power While on Shutdown Cooling,* (Reference 117), provides the actions necessary for maintaining core cooling, containment integrity, and spent fuel cooling in the event of a complete loss of all AC power while on RHR cooling.

Should an ELAP occur in the window between exiting Mode 5, Loops Filled, to cavity flooded, the immediate response will be to gravity feed the Refueling Water Storage Tank (RWST). This will provide some amount of flow to the core and delay or prevent core uncovery. In parallel with initiating gravity feed, actions will also be taken to initiate feed and bleed cooling by establishing pumped injection into the RCS using FLEX equipment per FSG-14, *Shutdown RCS Makeup* (Reference 144).

If available, the S/Gs are the preferred mechanism for core cooling. If conditions can be established for S/G heat transfer using natural circulation, including achieving RCS integrity, then RCS core cooling utilizing feed and bleed is not necessary. If RCS integrity cannot be restored and/or conditions cannot be established for S/G heat transfer using natural circulation, then available S/Gs are utilized to supplement core cooling. Analysis RWA-1323-004, *Ginna RELAP5 ELAP Analysis for Mode 5* (Reference 93), shows that available S/Gs will provide effective heat removal if S/G tubes have not been drained, and at least some heat removal due to reflux cooling if S/G tubes have been drained. Any amount of secondary side heat removal that can be established reduces the RCS feed and bleed requirements and increases coping time until long term recirculation core cooling has to be established.

<u>Mode 5, Loops Not Filled and Pressurizer Manway NOT Removed</u>
See Phase 2 for mitigation strategies.

<u>Mode 5, Loops Not Filled and Pressurizer Manway Removed</u>
The Pressurizer Manway vent path provides a vent area of 1.396 ft^2 (CALC-NOTE-69, Reference 146). This vent path alone will prevent RCS pressurization (i.e., less than 2 psig) if RHR cooling is lost later than 90 hours after shutdown (for 140^0F initial water temperature) or 85 hours after shutdown (for 100^0F initial water temperature. (NSL-0000-005, *Thermal Hydraulic Analysis of the Loss of RHR Cooling While the RCS is Partially Filled,* Reference 34).

DA-NS-2006-019 (Reference 33) documents that gravity feed from the RWST has the capability to provide a large volume of water quickly to restore level in the RCS during mid-loop (Mid-loop is defined as water level below the top of the hot leg (25 inches) operation and that gravity feed is effective if the RCS Pressure is less than 27 psig. Figure 3, Peak Cold Leg Pressure, shows that at 48 hours after shutdown, peak RCS cold leg pressure is less than 8 psig and gravity feed from the RWST is available.

The Phase 1 strategy to maintain core cooling and heat removal is to locally open MOV-856, RHR Pump Suction from RWST. Specific flow requirements have been determined in RWA-1323-004, *Ginna RELAP5 ELAP Analysis for Mode 5* (Reference 93). The analysis evaluated cases with a PORV vent and with the pressurizer manway removed.

Mode 5, Low Loop Level
The strategy to maintain core cooling and heat removal with Low Loop Level is similar with the Pressurizer Manway removed except that an Operator in communications with the Control Room is stationed in the Auxiliary Building by MOV-856 during the drain down process or anytime the loop level is less than 64 inches, to refill the RCS.

Mode 6 with Refueling Water Level < 23 Ft with the Reactor Vessel Head Removed
The intent of this strategy to inject available borated water sources into the refueling cavity to obtain refueling water level ≥ 23 ft. or until boil off of the refueling water starts. At this time, unborated water can be used to maintain refueling water level.

Inject borated water into the RCS to establish refueling water level ≥ 23 ft. Depending on refueling cavity level, opening MOV-856 and gravity draining from the RWST may be effective. Otherwise utilize the new Alternate RCS Injection pump taking suction from the RWST to inject available borated water into the RCS / refueling cavity (See Phase 2). DA-ME-15-006, *FLEX Timeline Analysis* (Reference 30), addresses gravity fill effectiveness.

Mode 6 with Refueling Water Level ≥ 23 Ft
Technical Specification Basis for the R.E. Ginna Nuclear Power Plant B3.9.4, Residual Heat Removal (RHR) and Coolant Circulation-Water Level ≥ 23 ft., (Reference 27) states that with no forced circulation cooling, decay heat removal from the core occurs by natural convection to the heat sink provided by the water above the core. A minimum refueling water level of 23 ft. above the reactor vessel flange provides an adequate available heat sink. Due to the water volume available in the RCS with a water level ≥ 23 ft. above the top of the reactor vessel flange, a significant amount of time exists before boiling of the coolant would occur following a loss of the required RHR pump. Design analysis DA-ME-98-115, *Time to Boil Following Loss of RHR During Shutdown (18 Month Cycle)* (Reference 73), documents that at 100 hours after shutdown the time to boil is 5.15 hours, and the time to core uncovery is 73.52 hours.

See Phase 2 for mitigation strategies.

5.5 Key Reactor Parameters

- SG Pressure – PI-468, PI-469, PI-482, PI-478, PI-479, and PI-483
- SG Level Narrow Range (NR) – LI-461 and LI-472; Wide Range (WR) – LI-505 and LI-507
- RCS Hot Leg Temperature – TI-410A-1 and TI-409A-1
- RCS Cold Leg Temperature – TI-410B-1 and TI-409B-1
- RCS Pressure Wide Range (WR) – PI-420-2
- Core Exit Thermocouple (CET) – CETA * and CETB *
- Pressurizer Level – LI-426 and LI-428
- Reactor Vessel Level Indication System (RVLIS) – LI-490B * and LI-490A *
- Source Range Detectors N-31 and N-32
- Refueling Water Storage Tank (RWST) Level – LI-920 and LI-921
- DC Bus Voltage – EI/PG and EI/PA

* If not disconnected for refueling

Procedure FSG-7, *Loss of Vital Instrumentation or Control Power* (Reference 81), identifies instrumentation to take field (local) readings (i.e. containment splice boxes) of necessary parameters, along with guidance to repower instruments of necessary parameters at the instrument racks if field wiring is intact.

5.6 Phase 2

Mode 5, Loops Not Filled and Pressurizer Manway NOT Removed
RCS Heat Removal will be by RCS Bleed and Feed. RWA-1323-004, *Ginna RELAP5 ELAP Analysis for Mode 5* (Reference 93), was performed with the PORV vent path that shows the vent path is adequate for a mitigation strategy. FSG-14, *Shutdown RCS Makeup* (Reference 144), provides actions to establish RCS makeup flowpaths during shutdown conditions (Modes 5 and 6).

A partial core cooling and heat removal strategy that may be utilized is to fill available S/Gs to provide a limited heat sink function and additional time before boiling of the coolant occurs. RWA-1323-004 includes cases with S/Gs available that shows feed and bleed (steam) of available S/Gs provide a limited heat sink function and reduces the amount of boiling to containment. AP-ELEC.4, *Loss of All AC Power while on Shutdown Cooling* (Reference 117), and FSG-3, *Alternate Low Pressure Feedwater* (Reference 100), implement S/G cooling for this event.

Mode 5, Loops Not Filled and Pressurizer Manway Removed
The Phase 2 strategy to maintain core cooling and heat removal with the Pressurizer Manway removed is similar with the Manway not removed.

Mode 5, Low Loop Level
The Phase 2 strategy to maintain core cooling and heat removal with Low Loop Level is similar with the Pressurizer Manway removed.

Mode 6 with Refueling Water Level < 23 Ft with the Reactor Vessel Head Removed
The intent of this strategy to inject available borated water sources into the refueling cavity to obtain refueling water level ≥ 23 ft. or until boil off of the refueling water starts. At this time, unborated water can be used to maintain refueling water level.

Inject borated water into the RCS to establish refueling water level ≥ 23 ft. utilizing the new Alternate RCS Injection pump taking suction from the RWST to inject available borated water into the RCS / refueling cavity.

At this point, the primary strategy is the same as Mode 6 with Refueling Water Level ≥ 23 ft.

Mode 6 with Refueling Water Level ≥ 23 Ft
If necessary to add borated water to the refueling cavity, the new permanently installed high pressure Alternate RCS Injection pump taking suction from the RWST and discharging to the Safety Injection System will be the primary connection point for RCS boration. A portable diesel engine powered high pressure injection pump connectable from the RWST to the Safety Injection System will be the alternate method. FSG-14, *Shutdown RCS Makeup* (Reference 144), provides guidance for maintaining Refueling Cavity level using the RWST, SAFW DI Water Storage Tank, or Lake Ontario.

Alternate RHR

Following a seismic or tornado missile event there is a possibility of flooding the Auxiliary Building Subbasement due to failure of non-qualified tanks and piping. A sump pump will be used to dewater the subbasement if this occurs. The sump pump is capable of dewatering the subbasement in less than 11 hours.

The Alternate RHR strategy will be implemented per FSG-5, *Initial Assessment and FLEX Equipment Staging* (Reference 109), Attachment I prior to depleting the RWST. The Alternate RHR strategy uses the Reactor Coolant Drain Tank Pumps (canned motor pumps), after pumping out the Auxiliary Building Subbasement, to circulate water from the RCS hot leg, through both RHR heat exchangers, and back to the RCS cold leg. A FLEX pump is used to circulate water from the lake to the CCW side of the RHR Heat Exchanger through hosing and a bonnet adapter on valve 760A. The lake water is discharged near deer creek through hoses connected to a bonnet adapter at valve 760B. The strategy is justified in DA-ME-15-005, *FLEX RHR/CCW/SW Hydraulic Model*, (Reference 136) and DA-ME-15-011, *FLEX Mode 5 RHR Strategy* (Reference 147).

5.7 Phase 3

The Phase 3 strategy for core cooling and heat removal, including postulated flow paths, is basically the Phase 2 strategy supplemented by equipment available from the NSRC.

Prior to depleting the RWST inventory, a mobile boration unit supplied from the NSRC can be utilized to provide an indefinite source of water for Phase 3 boron control/RCS injection. The preferred source of water to supply the mobile boration unit will be the new SAFW DI Water Storage Tank. To refill the SAFW DI Water Storage Tank, any existing source of demineralized water on site will be preferentially used until the NSRC water treatment system arrives. The bounding FLEX scenario to refill the SAFW DI Water Storage Tank will be to deploy a FLEX diesel driven portable pump with a hard suction hose to take suction from the Discharge Canal and, via a discharge hose connected to the SAFW DI Water Storage Tank, refill the SAFW DI Water Storage Tank. When the NSRC water treatment system arrives, water will be pumped from the discharge canal through the water treatment system to the SAFW DI Water Storage Tank. Boron supplied from the NSRC with the mobile boration unit will be available to mix with the preferential water source for RCS boration/makeup. NSRC delivered portable diesel driven pumps provide backup capability to the on-site FLEX pumps.

Connections are available to supply the 480 Volt vital buses from an NSRC supplied D/G and for connecting NSRC supplied portable pumps and the NSRC supplied mobile boration and water processing units.

6 Maintain Containment

6.1 Objectives

In the long-term, containment pressure may rise due to leakage from RCS adding heat to containment. Provide a connection to containment spray header or alternate capability or Analysis. Due to the long-term nature of this function, the connection does not need to be a permanent modification. However, if a temporary connection, e.g., via valve bonnet, then this should be pre-identified. (Reference 4)

6.2 Acceptance Criteria

Containment pressure will be maintained below the design pressure of 60 psig and Containment temperature will be maintained below the containment design temperature of 286°F (UFSAR Table 3.11-1, Reference 25).

6.3 Strategies

With an ELAP, containment cooling is lost and over an extended period of time containment temperature and pressure can be expected to slowly increase. An analysis has been performed to determine the containment pressure profile during an ELAP / LUHS event, and to justify that the instrumentation and controls in containment which are relied upon by the Operators are sufficient to perform their intended functions. Analysis RWA-1403-001, *GOTHIC FLEX Containment Analysis* (Reference 94), shows that during an ELAP / LUHS, mitigation strategies are necessary at some point in time to manage the containment pressure profile and maintain containment integrity. This analysis uses GOTHIC 8.0, has cases for Modes 1 and 5, and was benchmarked against previous LOCA analyses.

Ginna is not crediting containment spray pumps to lower containment pressure/temperature in response to the ELAP conditions.

<u>Water Hammer</u>
Water hammer is not a concern upon re-establishing flow to the CRFC's (DA-ME-15-013, *FLEX Miscellaneous Calculations*, Reference 138). Ginna took a conservative approach and analyzed for column closure water hammer under DA-ME-2002-061, *Resolution of Generic Letter 96-06 Water Hammer Issues Using EPRI Technical Basis Reports (EPRI 1003098 & 1006456)* (Reference 148), in response to GL 96-06 even though the occurrence did not appear credible for the GL 96-06 conditions. During an ELAP is it recognized that the CRFC's may generate more steam than considered in DA-ME-2002-061 and it is feasible that all the piping upstream and downstream of the CRFC's could be voided when flow is established. Upstream piping may be voided due to drainage necessary for the strategy to replace 4628/4641 with adaptor inserts to allow hose connections. Downstream piping may be voided given that it may be many hours after initiation of the event to establish CRFC cooling flow. The CRFC's may be voided due to high containment temperature and steaming in the CRFC's.

The two water hammer phenomena of potential concern are referred to as column closure water hammer (water hammer that can occur when flow is established with a void present) and condensation induced water hammer (water hammer than can occur by trapping steam bubbles in cold water/piping with resulting accelerated/decelerated water volumes). Water hammer occurrence following an ELAP would reasonably be expected to be bounded by the DA-ME-2002-061 analysis for the following reasons:

- DA-ME-15-005, *FLEX RHR/CCW/SW Hydraulic Model* (Reference 136), predicts flow rates within 10% of those used in the DA-ME-2002-061 column closure water hammer evaluation.
- To re-establish flow to the CRFC's following an ELAP, the steam will be vented and a significant amount of air will be introduced to the system. This air will significantly reduce the column closure water hammer such that the DA-ME-2002-061 analysis remains bounding.
- DA-ME-2002-061 determined that condensation induced water hammer was not credible given that pipes were expected to run full when flow was re-established. The DA-ME-15-005 flow rates are slightly more than the DA-ME-2002-061 flow rates such that similar refill conditions would be expected.
- When the CRFC's are refilled following an ELAP event it is reasonable to presume that there may be a higher steam content than after the GL 96-06 event given the longer duration of the ELAP. This two phase mixture tends to attenuate water hammers such that the DA-ME-2002-061 analysis remains bounding.

6.4 Phase 1:

Containment Isolation Following ELAP

Containment isolation boundaries are provided with actuation and control equipment appropriate to the valve type. For example, air-operated and diaphragm (Saunders patent) valves are generally equipped with air diaphragm Operators, with fail-safe operation ensured by redundant control devices in the instrument air supply to the valve. Solenoid valves are also designed for fail safe operation. Motor-operated valves are capable of being supplied from reliable onsite emergency power as well as their normal power source. Closed systems, manual valves, and check valves, of course, do not require actuation or control systems. These non-automatic isolation boundaries are used in lines that must remain in service, at least for a time, following an accident. These are closed manually if and when the lines are taken out of service. (Reference 25, Section 6.2.4.3.1)

Containment Temperature and Pressure Response

Monitor containment status. Containment temperature and pressure are expected to remain below design limits for at least 72 hours.

For Mode 1, the analysis shows that with no operator actions, containment pressure will slowly increase to less than 20 psig over 72 hours and containment temperature will slowly increase to 220°F over the same 72 hours. Since 20 psig is below containment design pressure of 60 psig (UFSAR Table 3.11-1, Reference 25) and 220°F is below the containment design temperature of 286°F (UFSAR Table 3.11-1), no mitigation actions are necessary to maintain or restore containment cooling during Phases 1 or 2.

6.5 Key Containment Parameters

- PI-945, Containment Pressure (0-60 psig)
- PI-947, Containment Pressure (0-60 psig)

Procedure FSG-7, *Loss of Vital Instrumentation or Control Power* (Reference 81), implements a strategy to take a field (local) reading of containment pressure at a containment pressure transmitter using a pressure test gauge, along with guidance to repower a containment pressure instrument if field wiring is intact. PT-945, CNMT Press XMTR, is located on the middle level of the Auxiliary Building and is therefore protected from tornado or missile damage. The sensing line for PT-945 would be available to attach a pressure gage and take local readings in accordance with FSG-7.

Containment Temperature:
Measuring temperature of the containment atmosphere is not required for purposes such as validating the qualification range of measurement instruments located in the containment or establishing the survivability of penetration seals or other equipment. As described in UFSAR Section 6.2.1.5.4, (Reference 25), containment temperature instrumentation is "not required nor designed to function during or after a safe shutdown earthquake." Containment temperature is not identified as required instrumentation for safe shutdown from tornado missile events (UFSAR Section 3.3.3, Reference 25), and is not designated as Station Blackout Coping Equipment (SBO-PROGPLAN, Reference 32).

Analysis RWA-1403-001 (Reference 94) and the strategies to limit containment pressure show that containment temperatures do not challenge the qualification range of measurement instruments located in containment or the survivability of penetration seals or other equipment. For Mode 1, containment temperature does not exceed 220°F in the first 72 hours, and for Mode 5, containment venting will limit containment temperature to less than 250°F, which are below the containment design temperature of 286°F (UFSAR Table 3.11-1, Reference 25).

For determining the impact of adverse containment conditions on instrument indication in containment, the applicable Emergency Operating Procedures use containment pressure, not temperature. For example ECA-0.0, *Loss of All AC Power* (Reference 22), states: "NOTE: Adverse CNMT values should be used whenever CNMT pressure is greater than 4 psig or CNMT radiation is greater than 10+05 R/hr."

6.6 Phase 2:

No mitigation actions are necessary, or planned, to maintain or restore containment cooling during Phase 2 for Modes 1 through 4. Containment status will be monitored. Containment temperature and pressure are expected to remain below design limits for at least 72 hours.

For Mode 5 (bounding for Mode 6), RWA-1403-001 shows that operator actions are required to vent containment within 12.8 hours from the start of the ELAP / LUHS event to prevent exceeding 60 psig in containment. To minimize the impact on RCS makeup strategies of pressurizing containment in Modes 5 and 6, and the resulting temperature increase, actions will be taken during Phase 2 to maintain containment pressure less than 7 psig and containment temperature less than 250°F by venting containment through Containment Leak Test MOV 7444 and Personnel and Equipment Hatch Inner Equalizing Valves; or by opening the Containment Purge Exhaust Valve.

6.7 Phase 3:

For Modes 1 through 4, to minimize challenging instrument operation in containment, actions can be taken during Phase 3 to maintain containment pressure less than 20 psig, which is below the containment design pressure of 60 psig. At approximately 35 hours from the start of the beyond-design-basis external event (BDBEE), equipment provided from a NSRC can be available to power one or more Containment Recirculation Fans (CRFs) and supply cooling water from Lake Ontario to one or more Containment Recirculation Fan Coolers (CRFCs). RWA-1403-001 shows that one CRF and associated CRFC placed in service at 35 hours will reduce containment pressure and temperature. Procedure ECA-0.0, *Loss of All AC Power* (Reference 22), directs performing FSG-12, *Alternate Containment Cooling* (Reference 118), to restore containment cooling using NSRC supplied equipment. The NSRC equipment will be used to repower Containment Recirculation Fans and supply water to Containment Recirculation Fan Coolers if Containment temperature is greater than 200°F or Containment pressure is greater than 15 psig.

For Modes 5 and 6, the restoration of core cooling, as described under the strategy to Maintain Core Cooling & Heat Removal (Modes 5 & 6), will alleviate the need to vent containment during Phase 3.

The bounding strategy for supplying an indefinite source of water of Phase 3 containment cooling will be to deploy a diesel driven portable pump provided by the NSRC, with a hard suction hose to draft from Lake Ontario, and with the discharge hose connected to the Containment Recirculation Fan Cooler (CRFC) supply side (outside of Containment) via a fire hose type connection. Hose adaptor inserts were designed and fabricated to be placed in the location of butterfly valves 4628 and 4641 on the supply side of the B and C CRFC's. This arrangement provides lake flow rates consistent with Design Basis heat removal flow requirements per DA-ME-15-005, *FLEX RHR/CCW/SW Hydraulic Model* (Reference 136). Existing safety-related discharge piping returns CRFC discharge water back to the Lake. A D/G provided from the NSRC can power one or more CRFs.

7 Maintain Spent Fuel Pool Cooling

7.1 Objectives

Makeup to the SFP from portable injection sources must be provided. The various baseline capabilities must include: (Reference 4)

- Provide makeup to the SFP via hoses on the refueling floor that exceeds SFP boil-off to support long-term cooling of spent fuel with sufficient makeup.
- Provide makeup via connection to SFP cooling piping or other alternate location that exceeds SFP boil-off and provide a means to supply SFP makeup without accessing the refueling floor.
- Ensure a Vent pathway for steam & condensate from SFP. Steam from boiling pool can condense and cause access and equipment problems in other parts of plant.
- Provide spray capability via portable monitor nozzles from the refueling deck using a portable pump for cooling of spent fuel if leakage from the SFP exceeds makeup capability. A minimum of 200 gpm to the SFP, or 250 gpm if overspray occurs, consistent with 10 CFR 50.54(hh)(2) must be provided.

7.2 Acceptance Criteria

No fuel damage will occur. Coping times will be calculated such that they preclude fuel damage, including maintaining two-phase water level above the top of the active fuel.

There will be no return to criticality once the loss of all AC power has occurred. To ensure that the reactor remains subcritical, a limit of Keff less than 0.99 (subcritical) is set. The level of 0.99 for subcriticality was chosen because it will provide some margin to account for the best estimate reactor physics parameters assumed in the analysis.

7.3 Strategies

During an ELAP / LUHS event, SFP cooling capability is lost which, in the long term, can result in SFP boiling and loss of adequate SFP water level for protection of the spent fuel, as well as for maintenance of sufficient radiation shielding if no operator action is taken. Following a loss of SFP cooling, the SFP will heat up to a bulk temperature of 212^{0}F, at which time heat removal from the SFP will be due to boiling of the water with the steam removing the heat from the SFP. In these circumstances, a minimum water level of 5'-9" feet above the top of the fuel has been determined to provide adequate short term shielding.

The initial SFP conditions are:

- All boundaries of the SFP are intact
- Although sloshing may occur during a seismic event, the initial loss of SFP inventory does not preclude access to the refueling deck around the pool.
- SFP cooling system is intact, including attached piping.
- SFP heat load assumes the maximum design basis heat load.

The basic FLEX strategy for maintaining SFP cooling is to monitor SFP water level and provide makeup water to the SFP sufficient to maintain the normal SFP water level.

With the maximum expected SFP heat load immediately following full core offload, with SFP water level required to be approximately 277', the SFP will reach a bulk boiling temperature of 212^{0}F in approximately 5 hours, and boil off to a level 5'-9" (Level 2 value of 257'-0") above the top of fuel in approximately another 40 hours (for a total of 45 hours) unless additional water is supplied to the SFP. A flow of 53 gpm will replenish the water being boiled. For a partial core offload during a typical refueling outage, and with the minimum allowed SFP water level at 261', the SFP will reach a bulk boiling temperature of 212^{0}F in approximately 5 hours, and boil off to a level 5'-9" above the top of fuel in another approximately 16 hours (for a total of 21 hours) unless additional water is supplied to the SFP. A flow of 27 gpm will replenish the water being boiled.

The FLEX strategy during Phase 1 of an ELAP / LUHS event for SFP cooling is to utilize the SFP level instrumentation installed in response to Order EA-12-051 (Reference 2) to monitor the SFP water level and stage a portable diesel driven pump for the addition of makeup water to the SFP as it is needed to restore and maintain the normal level in Phase 2. Under Phase 3 (using off-site NSRC supplied equipment), portable equipment and consumables will be used to reinforce and secure for an indefinite coping time the measures implemented during Phase 2.

A graphic representation of the Phase 1 to Phase 3 strategies for maintaining SFP Cooling is shown below.

Maintain Spent Fuel Pool Cooling

______________ Phase 1 (21 hrs. to 45 + hrs.)

______________ Phase 2

______________ Phase 3

0 6 12 18 24 30 36 42 48 54 60 66 72 + hrs.

7.4 Phase 1:

The Phase 1 strategy will be to monitor SFP level to ensure coverage. The modification to install a new level indication with integral backup power supply will allow for remote monitoring. Water addition is not required before the end of Phase 1. There are no Phase 1 actions required that need to be addressed

7.5 Key SFP Parameters

- LI-310, SFP Wide Range Level Indicator (NE)
- LI-311, SFP Wide Range Level Indicator (SE)

LI-310 and LI-311 are powered from independent, non-safety-related, 120VAC power feeds with indication available in the SAFW Bldg. C-cell Lithium batteries provide backup power for a minimum of one-hundred-thirty-one (131) hours when normal 120VAC power is not available. LI-311 may be powered from the SAFW DG.

7.6 Phase 2:

SFP level is normally maintained between 276'-1.5" and 277' (O-6.1, *Auxiliary Operator Rounds and Log Sheets*, Reference 36). For off normal conditions where SFP level is temporarily lowered (such as maintenance, transfer slot filling evolutions or emergency conditions), operation using the lower suction has been evaluated. This configuration has been shown to be acceptable as long as the SFP is maintained at an elevation greater than 261 ft and the pool temperature is less than 150°F (UFSAR Section 9.1.3.2.3, Reference 25).

Technical Requirements Manual (TRM) Section TR 3.7.7 (Reference 28) requires that the SFP temperature be maintained ≥ 50^{0}F and ≤ 150^{0}F, and that two SFP cooling loops shall be FUNCTIONAL, each commensurate with the SFP heat load. TRM Section TR 3.9.4 requires that during the removal of all irradiated fuel assemblies from the reactor to the SFP, SFP water temperature shall be ≥ 50^{0}F and ≤ 150^{0}F and two SFP cooling systems shall be OPERABLE, each commensurate with the SFP heat load and with the use of an associated table, the combination of Screenhouse bay temperature and time after shutdown shall be met.

The Precautions and Limitations in procedure S-9, *SFP Cooling System Operation* (Reference 37), states that only the A train of SFP cooling has been analyzed for using only the lower SFP cooling suction and that if the use of only the lower suction is required, then the B and Standby Trains of SFP Cooling must be secured. This operational restriction precludes draining the SFP to elevation 261 ft during full core offloads as there would be only one SFP cooling system considered operable.

<u>Full Core Offload</u>

With a full core offload and initial SFP temperature of 150^{0}F, the time to 212^{0}F in the SFP is 4.9 hours with an associated boil-off rate of 53 gpm. The SFP contains approximately 255,000 gallons of water, with a depth of approximately 40 feet and the top of the fuel assemblies stored in the spent fuel storage racks approximately 26 feet below the surface of the water (UFSAR Section 9.1.3.4.3). With a boil-off rate of 53 gpm and approximately 6,352 gallons per foot of SFP water level (Reference 74), it will take approximately 2 hours to boil off 1 foot of SFP water level.

During a full core offload with initial SFP temperature at 150^{0}F and SFP water level in the normal range, it will take approximately 45 hours before makeup is required using the SFP Level 2 value (257'-0") determined for the response to NRC Order EA-12-051, *Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation* (Reference 2).

<u>Partial Core Offload</u>

Analysis 109682-M-021, *Spent Fuel Cooling System EPU Evaluation*, Table 7, Total Heat Load as a function of Time Reference 44), documents that the heat load for a partial core offload at 100 hours after shutdown is 12.91 MBtu/hr, which is 50.3% of the full core offload heat load. For a partial core offload with initial SFP temperature at 150^{0}F and SFP level at elevation 261 ft, it will take approximately 21 hours to reach the SFP Level 2 value (257'-0"). (5 hours to 212^{0}F plus 16 hours to boil-off 4 feet of SFP level)

<u>Makeup to the SFP</u>

Maintaining the SFP full at all times during the ELAP event is not required; the requirement is to maintain adequate level to protect the stored spent fuel and limit exposure to personnel onsite and offsite. Procedure FSG-11, *Alternate SFP Makeup and Cooling*, (Reference 103) provides multiple strategies for establishing a diverse means of SFP makeup.

Primary Strategy

The primary SFP makeup strategy is accomplished using a medium pressure portable FLEX pump with water supply from Lake Ontario. A medium pressure portable FLEX pump will be moved from its storage location into a location near the northwest corner of the Screen House. Non-collapsible suction hose will be directed into Lake Ontario and discharge hose routed to the edge of the SFP and tied down. Sufficient flow will be established to recover and maintain SFP level. (Attachment 2, Figure 5)

Alternate Strategy 1

An alternate SFP makeup strategy is accomplished using a medium pressure portable FLEX pump with water supply from Lake Ontario. A medium pressure portable FLEX pump will be moved from its storage location into a location near the northwest corner of the Screen House. Non-collapsible suction hose will be directed into Lake Ontario and an alternate makeup flow path to the SFP can be establish by spraying the SFP with Blitz fire nozzles located within 75 feet of the SFP. Sufficient flow will be established to recover and maintain SFP level.

Alternate Strategy 2

Another alternate strategy in FSG-11 provides direction to fill the SFP at a flanged connection point at V-8662. This valve is located in the Auxiliary Building Basement and allows for a fill path at other than the SFP walkway. Access would be through the East Stairwell and across the Auxiliary Building Basement.

Vent Pathway for Steam & Condensate from SFP

Calculation CALC-2014-0006, *Auxiliary Building Environmental Conditions during ELAP* (Reference 149), evaluates the temperature response of Auxiliary Building areas (which includes the SFP area) in response to a loss of forced ventilation during an ELAP. The purpose of this analysis is to establish the necessary mitigating actions and required timing of those actions to support the FLEX Overall Integrated Plan (OIP). This GOTHIC calculation evaluates the bounding extreme high and low outside air temperature cases. Compensatory actions are required to maintain the Auxiliary Building within acceptable temperatures. These actions include opening doors and backdraft dampers (Tornado Dampers).

ECP-15-000585-CN-001, *Use of CPB Roll Up Doors in Lieu of Tornado Dampers* (Reference 150), compared the flow rate through the backdraft dampers with flow rates through Auxiliary Building (AB) to Cask Processing Building (CPB) doors to determine if CPB doors may be used in lieu of tornado dampers for venting. ECP-15-000585-CN-001 concludes that the CPB roll up doors provide better Auxiliary Building ventilation than the Auxiliary Building Tornado dampers. It is therefore reasonably concluded that if the AB/CPB doors are opened in lieu of the Auxiliary Building tornado dampers, that the results of CALC-2014-0006 for extreme hot conditions remain bounding and use of the AB/CPB roll up doors is an acceptable alternative.

The temperature limits for the Auxiliary Building Operating level and above are driven by the limits for the spent fuel level indicator and associated equipment. There are no significant operator actions to be taken on the operating floor of the Auxiliary Building (only traversing the area and opening doors/dampers). For this reason, there are no explicit acceptance criteria for temperatures at this level. All lower level temperatures where work is being performed should be below 110 degrees Fahrenheit which is an acceptable temperature per NUMAR 87-00. NEI 12-06 allows for reasonable judgments for beyond design basis scenarios; therefore, short durations that cause the temperature to slightly exceed 110 degrees Fahrenheit are deemed acceptable for operator comfort.

FSG-5, *Initial Assessment and FLEX Equipment Staging* (Reference 109), initiates action to provide vent paths for the Spent Fuel Pool Area. This includes opening doors in the Auxiliary Building and Canister Preparation Building, as well as the Auxiliary Building tornado damper.

7.7 Phase 3:

The same strategies employed in Phase 2 can be employed in Phase 3 using NSRC equipment.

8 Safety Functions Support

8.1 Objectives

The strategies for this section involve support equipment that facilitates, but does not directly implement, the safety function strategies. This includes:

- Vital Batteries
- Lighting,
- HVAC,
- Battery Room Hydrogen Control,
- Debris removal, equipment transport, and fuel transport equipment,
- UHS access,
- Diesel Fuel, and
- Communications

8.2 Phase 1

8.2.1 Vital Batteries

Design analysis DA-EE-97-069, *Sizing of Vital Batteries A and B,* (Reference 53) shows that the Ginna station batteries are adequate to sustain power to the current load profiles for the duration of a four hour station blackout, using a temperature of 55°F. In addition, ECA-0.0, *Loss of All AC Power,* (Reference 22) provides load shedding guidance to the Operators for preserving battery capacity and maintaining required voltage levels.

DA-EE-2001-028, *Vital Battery 8 Hour Capacity,* (Reference 55) was subsequently performed and documents an 8 hour capacity given the load shedding directed by procedure ECA-0.0 (describes loads in the Control Room) and ATT-8.0, *Attachment DC Loads* (Reference 46) (with locations and load descriptions). The timeline for shedding the DC loads is 60 minutes. The current load shedding does not impact defense-in-depth or redundancy as these loads do not impact mitigation strategy equipment or instrumentation available after an ELAP event.

DA-EE-2001-028, Attachment 3, lists the loads removed from Battery A. DA-EE-2001-028 provides the direct current (dc) load profile (in table format) with the required loads for the mitigation strategies to maintain core cooling, containment, and spent fuel pool cooling. This analysis is conservative because it applies 50% of the calculated load reduction to Battery A, and only during the period from 12 min to 245.5 min. 50% of the calculated load shedding is conservatively small in that the load shedding is assumed to take place anytime from 12 min to 245.5 min. This analysis does not consider the effects of load shedding for Battery B. Battery B is shown to be adequately sized for an 8-hour SBO without procedural load shedding. (SBO-PROGPLAN Paragraph 7.2.2 (Reference 32))

The minimum dc bus voltage required to ensure proper operation of all required electrical equipment is 108.6 V. This ensures that devices supplied by the batteries have adequate voltage levels after accounting for line losses between the battery terminals and the devices (Technical Specification Basis B.3.8.6, Battery Cell Parameters; Reference 27). Design Analysis DA-EE-99-047, *125 VDC System Loads* *and Voltages* (Reference 14), provides a detailed analysis supporting this minimum voltage number.

8.2.2 Emergency Lighting

As described in UFSAR, Rev 24, Section 9.5.3, Lighting Systems (Reference 25): Fixed emergency lighting units are provided in safety-related areas and other areas which contain fire hazards to facilitate emergency operations, manual fire-fighting, and access to and egress from each designated fire area. The lighting units are 8-hour rated [but are not seismically qualified]. In addition to the fixed lighting systems, portable battery-powered hand lights are provided. Ginna safe shutdown panels are located in several areas of the plant. The lighting at the safe shutdown areas has been determined to be sufficient to perform all required safe shutdown tasks. This determination was made by a lighting survey conducted in conjunction with 10 CFR 50 Appendix R compliance efforts. The Control Room 125-V dc emergency lighting system comes on for loss of ac power [does not load shed by FLEX]. The Control Room emergency lighting fixtures are fed from either the A or B station batteries. In the event of loss of either battery there is a transfer switch in the Control Room by which the operators can manually switch the emergency lighting feed from one train to the other. Should loss of either battery occur in the emergency lighting mode, an 8-hour-rated emergency light fixture located near the transfer switch shall remain functional to provide sufficient lighting to perform the transfer. The 125-V dc power supply up to the point of termination at the emergency lighting fixtures is Class 1E and Seismic Category I. The emergency lighting fixtures are standard. A prototype fixture has been seismically tested in accordance with IEEE 344-1975 to ensure continued operation of the fixtures in the event of an earthquake. In addition, an analysis of the seismically reinforced suspended ceiling has been performed to ensure that the ceiling, including the normal and emergency lighting fixtures, does not create a hazard to Control Room personnel or safety-related equipment during a seismic event.

Lighting in the SAFW Annex Building is automatically powered from the SAFW D/G when in operation. Initial lighting in the SAFW Building Room will be from 8-hour Appendix R battery powered lighting, with portable flood lights being available to be deployed. The door to the SAFW Annex can be opened to help with lighting in the SAFW feed room.

8.2.3 HVAC

Analyses of multiple plant areas have been completed to evaluate the effects of loss of heating ventilating and air conditioning (HVAC) during an ELAP event.

GOTHIC calculations were performed as follows and results incorporated into mitigation strategies:

- RWA-1316-001, *FLEX Intermediate Building GOTHIC Heat Up Analysis* (Reference 151). This includes TDAFW pump and SRV/SV areas, which are located in the Intermediate Building.
- RWA-1403-001, *GOTHIC FLEX Containment Analysis* (Reference 94)
- RWA-1433-001, *Ginna Standby Auxiliary Feedwater Room Heat-Up Analysis* (Reference 152)
- CALC-2014-0006, *Auxiliary Building Environmental Conditions during ELAP* (Reference 153)

For ELAP GOTHIC calculations, the maximum and minimum outside ambient temperature assumed is 100°F and -16°F respectively (Reference Ginna UFSAR section 2.3.2.2). The calculations assume reasonable ambient temperature in the associated rooms prior to the loss of all AC power. The GOTHIC models simulate actions such as opening of doors or installation of fans, as necessary, to obtain airflow. Equipment and HVAC strategies are based on the results of these calculations, to ensure that temperatures remain within personnel and equipment limits.

ELAP specific GOTHIC analyses were not performed for the Battery Room/Relay Room/Control Room. DA-ME-15-012, *FLEX HVAC for Control Room and Battery Rooms* (Reference 154) used Mathcad 14.0 to predict heating and cooling needs for the Control Room and Battery Rooms during ELAP conditions (with extreme hot and cold weather).

Control Room, Relay Room, and Battery Rooms Habitability
Plant specific analyses were performed in August 1990 (Reference 59) and December 15, 1993 (Reference 60) to determine the maximum expected station blackout temperatures for the Battery Rooms, Relay Room, and the Control Room with the following results:

Area	Temperature	Required Operator Action
Control Room	115.9°F	a. Open doors to turbine deck
		b. Open cabinet doors
		Note: Flow through ceiling tiles have replaced selected solid tiles to eliminate the need for Operators to remove tiles during a blackout.
Battery Room 1A	108.2°F	None
Battery Room 1B	106.2°F	None
Relay Room	103°F	None

Ginna's design basis vital station battery sizing calculation DA-EE-97-069, "*Sizing of Vital Batteries A and B*, (Reference 53) utilizes a minimum Battery Room ambient temperature of 55°F. This temperature was utilized for both the station blackout analysis (4-hour coping period) as well as the SI sequence analysis. Ginna has also performed a special case analysis to verify the capacity of the station batteries for 8 hours under DA-EE-2001-028, *Vital Battery 8-Hour Capacity* (Reference 55). A more realistic minimum Battery Room ambient temperature of 65°F is used for this analysis. Elevated temperatures are not considered in these analyses as they actually improve battery performance by lowering the internal resistance of the battery as well as speeding up the internal chemical reactions.

As discussed in section 7.5.3.1 of DA-EE-97-069, the 55°F ambient temperature is conservative and would not be seen in the Battery Rooms. DA-ME-99-033, *Vital Battery Temperatures during Station Blackout Event*, (Reference 155) has demonstrated that the Battery Room temperatures will not drop below 65°F during an 8-hour period.

Therefore, a 65°F minimum ambient temperature was used in the extended SBO analysis. The DA-ME-99-033 calculation uses a set of very conservative assumptions (e.g., inverter heat loads not credited, which would add several degrees to the rooms). Using the 55°F (65°F for the extended SBO analysis) ambient temperature in the battery sizing calculations provides conservative margin in the analysis. Therefore, the station battery is shown, through the existing design analyses, to be able to perform its function for the duration of an ELAP event.

Intermediate Building (IB) Habitability

A GOTHIC calculation has been performed for both the TDAFW Pump and the ARV areas of the IB for the Ginna SBO Program (Reference 32). The results of these calculations indicate that with doors S37F, S44F, and SD/55 opened within 30 minutes, the ambient temperature of TDAFW Pump area is between 110°F and 115°F (Reference 58). With this result, equipment operability is not considered to be of concern. Calculations utilizing the NUMARC 87-00 methodology performed for the ARV area have yielded a resultant ambient temperature of between 117°F and 122°F (Reference 58) with doors S37F, S44F, and SD/55 opened within 30 minutes. Operator safety concerns with habitability in the ARV area of the Intermediate building caused a caution statement at the beginning of ECA-0.0 (Reference 22) to be written. The caution states that, "Due To Potentially Extreme Environmental Conditions, Caution Should Be Used When Entering The Intermediate Bldg For Local Actions." Protective clothing (ice vests) may be required by the Operators at the Operators discretion when occupying these areas to perform manual actions, such as TDAFW flow Control Valve throttling, ECA-0.0. The ice vests are not considered to be required station blackout coping equipment and are not proceduralized, but are regularly inspected being treated as ordinary safety equipment. (Reference 32, Section 7.2.4). The calculations for the TDAFW Pump and ARV areas of the IB show stable temperatures at the 4 hour SBO coping time.

Calculation RWA-1316-001, *FLEX Intermediate Building GOTHIC Heat Up Analysis* (Reference 151), documents the development and results of a GOTHIC model of the Ginna IB under an ELAP / FLEX scenario. The model evaluates the building temperatures consistent with the plant's current coping and mitigations strategies and assesses the effect of potential operator actions. RWA-1316-001 concludes that the IB GOTHIC model above predicts conservatively high temperatures for the TDAFW Pump and ARV areas, and that once temperatures are reduced by opening of doors S37F, S44F, and SD/FF, steady state temperatures of approximately 117°F at the ARVs and 110°F at the TDAFW Pump are maintained.

Service Building Habitability

This is a relatively large open area with no significant heat source located in the proximity of the coping equipment (CSTs and associated level transmitters). Therefore, no significant ambient temperature rise is anticipated.

Auxiliary Building (RWST area) Habitability

Minimal heat loads would be present in this area during a station blackout. This area was analyzed assuming a LOCA and a simultaneous loss of ventilation. The results demonstrate that the ambient temperature rise in this area is nominal and will not preclude operator habitability or equipment operability. However, with an ELAP event, the loss of SFP cooling will result in SFP boiling and the release of steam into the Auxiliary Building. This impact is addressed under the SFP Cooling safety function.

SAFW Building Annex
RWA-1433-001, *Ginna Standby Auxiliary Feedwater Room Heat-Up Analysis* (Reference 152), documents the SAFW Building and SAFW Annex temperature response for HELBs, Appendix R cases, and Fukushima/FLEX cases. The calculation includes assessment of temperatures of key components within the SAFW building. SAFW ventilation is established under ATT-5.5, *Attachment SAFW with Suction from DI Water Storage Tank during SBO* (Reference 97). SAFW pumps depend on ambient cooling such that ventilation is adequate to ensure temperatures are acceptable. The new permanent RCS Injection pump in the SAFW Building will depend on ambient cooling. The selected pump motor has Type H insulation such that it is qualified for well beyond predicted room temperatures for thousands of hours.

ECP-13-000975-015-7B-01, *Design Change Technical Evaluation,* (Reference 156) documented acceptable SAFW Annex D/G air system flow resistance to satisfy radiator flow requirements. RWA-1433-001 modeled ventilation for the Annex D/G. Case 6 simulated FLEX conditions. The analysis outputs were provided as maximum temperatures for different room elevations. Annex D/G temperature constraints are satisfied by comparison of ECP-13-000975-015-7B-01 requirements against RWA-1433-001 predictions. One temperature of potential interest is the engine air intake. ECP-13-000975-015-7B-01 documents the engine will derate if the air intake temperature exceeds 122°F. The GOTHIC analysis identifies a max air temperature of 123°F below 10 ft. elevation (air intakes are at approximately 7 foot elevation). The engine air intake temperature is expected to be significantly less than the max prediction of 123°F given the location of the engine air intakes in the room air flow. The engine air intakes are upstream of the engine and face the incoming outside air such that the engine intake air is not expected to be heated significantly.

RWA-1433-001 (Reference 152), a Gothic model analysis of the SAFW Annex interior temperatures, including limiting cold conditions, determined that additional heating must be provided to maintain temperatures above 40F to prevent water from freezing. As a result, a 15KW electric heater was installed in the Annex D/G Room (ECP-13-000975, Reference 157). The analysis shows that no additional heat is required in the Annex, aside from that being provided in the D/G Room. The Annex heater is thermostatically controlled to maintain room temperatures above that required and can be powered from the SAFW D/G if needed.

To support SAFW equipment functionality during potential freezing conditions ECP-13-000995, "DDSAFW Annex Building – Mechanical Scope," (Reference 157) installed vendor-designed heat tracing on the SAFW DI Water Storage Tank sample lines, tank suction piping, tank return piping, and recirculation piping. During an ELAP, the heat trace installed in these areas can be powered from the SAFW D/G. Furthermore, the DI Water Tank Recirculation Pump and the DI Water Tank Heater, which can maintain tank water temperature above 40°F, can be powered by the SAFW D/G during an ELAP. As a result, freezing of these areas during a station blackout is not a concern.

The Alternate RCS Injection Pump, powered from the SAFW D/G, utilizes the RWST as a source of water for RCS makeup. Initially, the Alternate RCS Injection Pump suction and discharge piping is filled with unborated DI water. As a result, Boron precipitation is of no concern during this time. However, upon initiation of the system, borated water from the RWST is injected into the reactor via Safety Injection piping. Per the UFSAR (Reference 25), the maximum boric acid concentration within the RWST is approximately 1.75 wt% boric acid. At 32°F the solubility limit of boric acid is 2.2%; therefore, the concentration of boric acid in the RWST is well below the solubility limit at 32F. Considering that CALC-2014-0006 (Reference 149) determined that the Auxiliary Building would remain above freezing (i.e. 41°F) during cold conditions, Boron precipitation is of no concern.

8.3 Phase 2

8.3.1 Vital Batteries

Primary Strategy

The primary strategy will be to power one or more of the protected battery chargers for the 125 VDC batteries from the 1 MW SAFW D/G to ensure vital instrumentation remains powered. Temporary cables will be run from the 1 MW SAFW D/G connections in the SAFW Annex to a portable distribution panel and/or to a distribution panel in the Waste Gas Compressor (WGC) Room. From the portable distribution panel cable can be routed to one battery charger on each train. From the distribution panel in the WGC Room cable can be routed to breakers on MCC C and MCC D to power one battery charger for each train. There are two battery chargers available to each of the station batteries, both with a capacity of 200 amps at 132 Volts DC and requiring up to 58 amps at 480 Volts AC.

Alternate Strategy

The alternate strategy will be implemented in the event that the 1 MW SAFW D/G cannot be used to provide power to the battery chargers. A FLEX 100 KW FLEX D/G capable of delivering 150 amps at 480 Volts 3-phase will be connected to one or more of the protected battery chargers for the 125 VDC batteries to ensure vital instrumentation remains powered. This alternate strategy will use two methods similar to the 1 MW SAFW D/G. To power the distribution panel in the WGC Room, the 100 KW FLEX D/G will be transported to outside the SAFW Annex overhead door. Temporary cables will be routed from the 100 KW FLEX D/G to a junction box in the SAFW Annex to feed the distribution panel in the WGC Room and from the distribution panel in the WGC Room to battery charger breakers for each train on MCC C and MCC D. To power the portable distribution panel the 100 KW FLEX D/G will be transported to the TSC area. Temporary cables will be routed from the 100 KW FLEX D/G to the portable distribution panel and from the portable distribution panel to one battery charger on each train.

8.3.2 HVAC

Control Room and Battery Rooms Habitability

ELAP specific GOTHIC analyses were not performed for the Control Room and Battery Rooms. DA-ME-15-012, *FLEX HVAC for Control Room and Battery Rooms* (Reference 154) determined that for extremely cold conditions, two 1500 Watt heaters placed in service by 8 hours post event would keep the Control Room above 40°F for 72 hours. For extremely hot conditions, one 3500 cfm blower placed in service by 8 hours post event is predicted to keep the Control Room below 120°F for 72 hours and is predicted to reduce the Control Room to below 105°F by 72 hours.

For the Battery Rooms during extremely cold conditions, if normal ductwork is intact, then the DC powered fan is adequate to circulate warm are back to the Battery Rooms and maintain Battery Room temperatures above 60°F. If normal ductwork is not intact then it may be necessary to throttle the DC fan or use a smaller/variable speed fan to limit air flow to approximately 400 cfm to achieve a room temperature of at least 50°F. For extremely hot conditions, "A" Battery Room temperature is predicted to be acceptable if fresh is taken into the Air Handling Room (AHR) and blow to the "A" Battery Room using the DC powered fan and the air is not recirculated back to the ARH, but is discharged to ambient. "B" Battery Room is cooled by using an approximately 3500 cfm fan to reduce battery room temperature to less than 105°F or a 700 cfm fan to maintain less than 120°F. For all conditions it is recommended that ventilation be established prior to 8 hours. Ventilation for the Battery Rooms is established under FSG-4, *ELAP DC Bus Load Shed/Management* (Reference 76).

FSG-5, *Initial Assessment and FLEX Equipment Staging*, (Reference 109) contains guidance/ recommendations to mitigate actions associated with extreme heat and cold.

Battery Room Hydrogen Control
DA-EE-99-068, *Vital Battery Room Hydrogen Analysis* (Reference 62), documents that under worse case conditions, without ventilation, the 0.8% normal hydrogen concentration limit would not be exceeded until 28.9 hours and that the unacceptable hydrogen concentration limit of 2% would not be exceeded until 73.3 hours, with all batteries being equalized. Ventilation to both Battery Rooms is available from a single DC fan that must be manually started. FSG-4, *ELAP DC Bus Load Shed/Management*, (Reference 76) starts normal Battery Room ventilation (DC powered vent fans) after establishing temporary power to the station battery chargers. FSG-4 also directs using temporary Battery Room ventilation if required. FSG-5, *Initial Assessment and FLEX Equipment Staging*, (Reference 109) directs using portable fans for Battery Room ventilation. Guidance for Battery Room ventilation is also provided in Alarm Response AR-C-13, *Battery Rooms Loss of Ventilation* (Reference 158).

8.3.3 UHS Access

The DDSAFW DI Water Storage Tank provides ~24 hours of feed water for the S/Gs (DA-ME-14-020, *Deionized Water Tank Inventory Requirements*, Reference 159). This tank is protected from all events (seismic, tornado and flood), and is used as a heat sink until the ultimate heat sink is available. Emergency Operating Procedure ATT-5.5, *Attachment SAFW with Suction from DI Water Storage Tank during SBO*, (Reference 97) starts the SAFW pumps and is accomplished within 43 minutes of event initiation. FSG-3, *Alternate Low Pressure Feedwater*, (Reference 100) FSG-6, *Alternate SAFW DI Water Storage Tank Makeup*," (Reference 99) and FSG-12, *Alternate CNMT Cooling*, (Reference 118) all have steps directing use of Lake Ontario (UHS). FSG-11, *Alternate SFP Makeup and Cooling*, (Reference 103) directs using Lake Ontario for Spent Fuel Pool makeup or spray and is directed by ECA-0.0, *Loss of All AC Power* (Reference 22). In the area of the discharge canal there are multiple options to place a hose into the discharge canal to provide makeup to the DDSAFW DI Water Storage Tank or S/Gs if the preferred area (by the grating) is blocked.

FLEX suction hoses have a strainer installed on the end of the hose. Each strainer has ~3.7 X the surface area of the non-collapsible suction hose. Strainer perforation diameter is 3/8". There are 19 holes per row and 50 rows around the diameter of the strainer, giving a surface area of ~105 in^2. Non-collapsible suction hoses are 6" diameter giving a surface area of ~ 28 in^2. There are two suction strainers available. In the unlikely event that one becomes clogged there would be a brief interruption to shut down the pump, swap strainers, and restart the pump. Monitoring of pump flow and pressure would indicate a possible clogged suction strainer. FSG-5, *Initial Assessment and FLEX Equipment Staging,* (Reference 109) directs staging of debris removal equipment. FLEX pumps with flexible suction hoses can be maneuvered to access Lake Ontario water at various places on the discharge canal.

The water chemistry of Lake Ontario has minimal effect on long term heat transfer in the Steam Generators (NWT 167, Use of Lake Ontario Water in Steam Generators During Hot Shutdown attached to June 23, 1981 letter to NRC). Lake Ontario water is used to feed S/Gs when condensate grade water is not available per ER-AFW.1, *Alternate Water Supply to the AFW Pumps* (Reference 160). By letter dated June 17, 1999 (Reference 161), the staff concluded that the licensee's approach (i.e., use of Condensate Storage Tanks and then Lake Ontario) demonstrates that it can achieve and maintain hot shutdown for 72 hours following a seismic event. By letter dated September 29, 1981 (Reference 162), the staff issued a letter to Ginna regarding Systematic Evaluation Program (SEP) Topics in which the staff concluded that the licensee should provide procedures that should caution operators on the long-term use of service water to feed the S/Gs. The condenser Hotwell has ~30,000 gallons of DI water available and can be gravity filled from the Condensate Storage Tanks. The NSRC can provide a portable filtering/demineralizer system to provide filtered or condensate grade water from Lake Ontario or other onsite sources such as the yard fire loop.

During a flood, access to the ultimate heat sink will be temporarily unavailable due to floodwater on site. Results of the NTTF Recommendation 2.1, Flooding Reevaluation (Reference 42), show that the persistence of the flood is approximately 10 hours. The onsite water sources are sufficient to supply water for this timeframe.

Frazil ice at Ginna has historically occurred at the Intake Structure. The intake structure is not credited for FLEX. Frazil ice at the suction of hoses dropped into the discharge canal for FLEX or SAFER pumps is reasonably expected to not be a concern requiring special equipment for the following reasons:

- Frazil ice blockage has been managed effectively at Ginna by accelerating and decelerating the water going through the intake structure by changing level in the Screenhouse. This agitation has historically been effective at disrupting the frazil ice and re-establishing normal flow rates. For FLEX pumps, the length of hose dropped into the discharge canal is short enough to allow operators to physically agitate the hose to disrupt frazil ice if it were to occur. Alternatively the drafting pumps have variable speed engines and discharge valves that could be used to accelerate/decelerate flow similar to the intake structure strategy.
- Frazil ice has occurred at Ginna during late night hours. Operators would be cognizant of the potential for frazil ice during extreme cold conditions and cognizant of the potential vulnerability during late night hours. Margin is available in the FLEX response times and integrated flows/heat removal associated with FLEX/SAFER pumps to accommodate brief periods of flow degradation from FLEX/SAFER pumps for frazil ice management.

Potential icing over of the discharge canal could be effectively managed by on-site personnel using available equipment. If the ice is thin then it could be broken using readily available lengths of piping or boards. Options for accessing the discharge canal if the ice is thick include but are not limited to use of the debris remover to break up the ice, accessing the water in the Screenhouse bays, or accessing the water in the discharge tunnels via removal of manways.

FSG-5, *Initial Assessment and FLEX Equipment Staging,* (Reference 109) provides a precaution that if potential freezing conditions exist, strategies for use and protection of vulnerable FLEX equipment should be evaluated. Attachment C, Additional Strategies for Extreme Weather Conditions, provides strategies for extreme weather conditions. Strategies for protection include creating a continuous flow path such that freezing of vulnerable FLEX equipment (i.e., hose, pumps, etc.) will not occur and actions to take should the discharge canal exhibit signs of freeze over. In addition, pumps and associated hosing can be drained when not in use to prevent freezing.

8.3.4 Debris Removal / Transport Equipment

Ginna Station has designated a Case 621F Pay loader and a Ford F350 4-wheel drive (equipped with a snow plow) as the debris removal/ transport equipment. The Case 621F Pay loader is stored outside to the south (near the White Barn), outside of the Protected Area. The Ford F350 4-wheel drive is stored inside the L-Building, inside of the Protected Area. These specific locations provide over 1040 ft. of separation to satisfy the tornado "diverse locations" storage requirements for FLEX equipment per NEI 12 - 06. The bounding case is to use the Case 621F Loader to provide debris removal capabilities in the event of a tornado event that passes through the Protected Area. Based on NEI 12-06 guidance regarding acceptable separation distance and tornado travel path, it is assumed that the Ford F350 located on site is unavailable because it is not stored within a tornado missile hardened structure. It is also assumed that if a tornado event was to impact the Case Loader, it would not directly impact the F350 stored in the L-Building. A tornado event is judged bounding for debris removal efforts for other beyond design basis events, including snow, high winds, and floods.

8.3.5 Diesel Fuel

8.3.5.1 Storage

Offsite D/G Fuel Oil Storage Tank (FOST) A and Offsite D/G FOST B have 18,000 gallons working capacity in each tank. The minimum storage volume maintained between the two tanks is 19,936 gallons. This volume of offsite diesel fuel oil along with the volume of diesel fuel oil in the D/G A & B FOSTs supports 7 days of operation of one Emergency D/G at rated load of 2000 kW (Reference 66). DA-ME-14-005, *Reasonable Protection Evaluation of Offsite Fuel Storage Tanks,* (Reference 163) determined that the Offsite FOSTs are reasonably protected, except for the external flood. ER-SC.2, *High Water (Flood) Plan,* (Reference 11) directs personnel to "PROTECT the offsite fuel storage tanks and fuel transfer building by VERIFYING Vehicle Barrier System blocks are in place on the west side of the building." Fuel Oil can be accessed by the manway or if it assessed that the "Pump house" is intact, electrical connection points and a transfer switch exist that can be used to power the installed pump and refill the fuel trailers. For the external flood, plugs are inserted into the vent lines to prevent flood water from entering the tanks. The strategy is described in ER-SC.2. With the implementation of the above protective strategy in ER-SC.2, the tanks are "Reasonably Protected" in accordance with NEI 12-06 from all postulated BDBEE's.

Diesel fuel is available onsite from the protected D/G A and D/G B FOSTs. Normally, a minimum of 10,000 gallons will be available after an ELAP/LUHS event, unless one of the diesel FOSTs is removed from service for required maintenance. For that short duration, a minimum of 5,000 gallons will be available.

DA-ME-14-003, *Fukushima Fuel Consumption Analysis*, (Reference 24) provides fuel consumption information for Phase 1 and Phase 2 equipment. All Phase 1 and Phase 2 mitigation equipment contain at least 6 hours of diesel fuel. The minimum amount of diesel fuel and gasoline that are required to power FLEX equipment for 72 hours is 9,010 gallons of diesel fuel and 68.2 gallons of gasoline. The volume of diesel fuel accounts for an additional 1,000 gallons of fuel for conservatism. The total minimum volume of protected diesel fuel onsite is 32,000 gallons.

On-Site fuel oil storage tanks (located in the Owner Controlled Area) is safety related fuel that is controlled in accordance with the Site's Fuel Oil program. Receipt of fuel oil for the two commercially procured portable fuel oil trailers will be from the same vendor as received for the safety related tanks.

8.3.5.2 Transport and Transfer

Travel paths for the fuel handling equipment are the same as the travel paths for the portable FLEX equipment, and are evaluated in GN-WP-01, *BDBEE Debris Removal for Ginna Station* (Reference 110). Refueling of portable FLEX equipment, including the SAFW D/G, will be accomplished by using two (2) - 990 Gallon towable fuel trailers. Refueling times and actions were incorporated into the timelines for the Phase 2 Staffing Study. The Staffing Study indicated that all tasks were able to be accomplished with available personnel. The capacity of a refueling trailer is 990 gallons. The fuel oil tank for the SAFW D/G is 660 gallons. With a complete refill of the SAFW D/G, 330 gallons of fuel would remain to fill an operating FLEX Pump (171 gallons working capacity) and 100 KW D/G (144 gallons working capacity). Fuel will be drawn from the FOST's using small engine driven pumps and discharging to the refueling trailers.

FSG's do not identify fuel oil consumption rates for specific equipment. Operators/ station personnel will monitor equipment operation and refuel as necessary. FLEX Pumps, FLEX 100 KW D/G and the SAFW D/G all have fuel gages installed to aid in monitoring. Pre-alarms also exist on the SAFW D/G for Low Fuel Oil Level as advanced warning.

FSG-5, *Initial Assessment and Flex Equipment Staging*, (Reference 109) directs establishing diesel fuel source and refueling means. Attachment G, Refueling the Fuel Tank Trailers, provides the guidance for filling the fuel tank trailers from the outside diesel fuel oil storage tanks or from the Emergency D/G fuel oil storage tanks.

FSG-105, *FLEX Support Equipment – FLEX Fuel Tank Trailer (TBD01A / TBD01B)*, (Reference 164) provides operating guidance for the fuel tank trailer.

8.3.6 Emergency Lighting

Lighting in the Standby Auxiliary Feed Annex Building will be automatically powered from the Standby Auxiliary Feed Diesel Generator when in operation.

Initial lighting in the Standby Auxiliary Feed Room will be from 8-hour Appendix R battery powered lighting, with portable flood lights being available to be deployed.

FSG-5, *Initial Assessment and FLEX Equipment Staging* (Reference 109), Attachment F contains lighting strategies to provide for emergency lighting to support Operator actions, including the following items stored in robust locations:

- Large portable "Smith Light" LED battery operated work lights
- Additional flashlights with a supply of batteries.
- Hard hat head lamps with a supply of batteries.

8.3.7 Communications

Onsite communications will be performed using station radios in the talk around mode. A portable radio repeater stored in a protected location will be deployed for better reception.

Offsite communications will utilize satellite phones staged in the Control Room and Technical Support Center, with extra satellite phones and batteries stored in an armored Sea Van. If the installed satellite dish does not survive, a portable satellite dish available in robust storage will be deployed.

Battery chargers for portable communications equipment will be powered from on-site generators.

During the NEI 12-01 Phase 2 Staffing Assessment, a tabletop assessment of Operations personnel performance of local actions, such as operation of the S/G ARVs was performed. In discussion of their actions, it was stated that a high noise area was expected and that they would relocate to an area outside of the Intermediate Building to communicate with the Control Room. Instructions would be provided in the lower noise area and then performed locally at the valves.

8.3.8 Heat Tracing

Heating sources (heaters, tracing) for equipment used in ELAP mitigation systems and strategies are self-contained (i.e., provided by Phase 1 and Phase 2 power generation equipment). Low ambient temperature conditions were considered in determining the sizing of the heaters and/or tracing. FSG-5, "Initial Assessment and FLEX Equipment Staging," (Reference 109) states that if potential freezing conditions exist, strategies for use and protection of vulnerable FLEX equipment should be evaluated. Strategies for protection include creating a continuous flow path such that freezing of vulnerable FLEX equipment (i.e. hose, pumps, etc.) will not occur. In addition, pumps and associated hosing can be drained when not in use to prevent freezing.

Diesel Driven FLEX Pumps (3), the portable Alternate RCS Injection pump, the air compressors, and the FLEX 100 KW Diesel Generator are all equipped with Engine Block Heaters and Battery tenders. Two Pump units and the 100 KW D/G are stored in a commercial structure with the 3rd Flex Pump stored in a Robust Structure that is Flood / Tornado / Earthquake proof, and is temperature controlled as well.

For the 100 KW D/G the design temperature specs for the control unit indicate a range of minus 40°F to 158°F with an engine derate indicated for ambient temperatures greater than 122°F. This temperature range is within those experienced at Ginna Station.

For the FLEX Pump diesel engine, there is no max ambient temperature indicated in the specs. Only if the operating (coolant) temperature indicates greater than 234°F is it recommended that load be reduced on the engine. For cold weather concerns a block heater is recommended for temperatures down to 0°F, which is currently used.

8.3.9 Key Parameters

FLEX equipment have installed local instrumentation needed to operate the equipment. Use of these instruments is described in the associated procedures for use of the equipment. These procedures are based on inputs from the equipment suppliers, operation experience, and expected equipment function in an ELAP.

8.4 Phase 3

Electrical Power
D/Gs from the NSRC can power can be used to repower buses and/or equipment. A connection point for the NSRC 4160V FLEX D/G is described in FSG-5, *Initial Assessment and FLEX Equipment Staging* (Attachment I, Establishing Long Term Core Cooling), and FSG-12, *Alternate CNMT Cooling* (Attachment C, Align Temporary Electrical Power Supply to CNMT Fan Coolers), which provide directions for connecting the NSRC 4160V FLEX D/G to Bus 16 Station Service Transformer Cubicle real panel bus bars, including a figure of the bus bar arrangement.

UHS Access
The NSRC can provide a portable filtering system to provide filtered water from Lake Ontario, or other onsite sources such as the yard fire loop.

9 Aggregation of FLEX Strategies

An aggregation of FLEX strategies was performed in DA-ME-15-006, Fukushima Timeline Analysis (Reference 30). This involved consideration of the aggregate set of on-site and off-site resource considerations for the applicable hazards. That is, all of the considerations related to protection of FLEX equipment, deployment of FLEX equipment, procedural interfaces, and utilization of off-site resources. This has established the best overall strategy for the storage and deployment of FLEX capabilities over a broad set of beyond-design-basis conditions for the applicable hazards.

FLEX equipment connections are protected against external hazards. Ginna has located all FLEX connections in seismically robust structures (SC-1 or evaluated otherwise). In addition, any areas that plant operators require access to deploy, or control the capability, are located in, or are on the exterior of, seismically robust structures. The following structures, which are utilized during FLEX implementation, are Safety Related, Seismic Category 1 Structures per UFSAR Table 3.2-1 (Reference 25):

- Containment
- Auxiliary Building
- Control Building
- Intermediate Building
- Standby Auxiliary Feed Water Building
- Diesel Generator Building

The following structures, which are utilized during FLEX implementation, are non-safety related; however, they are considered seismically robust for the following reasons:

- Turbine Building - per footnote "j" of UFSAR Table 3.2-1, the Turbine Building was analyzed during the SEP and it was determined that the building could meet Seismic Category 1 requirements without failure. Those portions of the building required to maintain its overall structural integrity are now considered Seismic Category 1.
- Standby Auxiliary Feedwater Annex and Associated Concrete Pad - the concrete pad and associated enclosure building are designed using the safe-shutdown earthquake as a design input. The structure is designed to withstand SSE loads.

The event which causes flooding at Ginna is caused by extreme regional precipitation which has days of warning time associated with it (NEI 12-06 Table 6-1). The Ginna Battery Charger connections, RCS connections, and Auxiliary Feedwater Connections are protected from the design basis flood.

Final Validation, Verification and Timeline Checks of Procedures and Operator Actions

The final validation, verification and timeline checks of procedures and operator actions during an ELAP were performed to the completed procedures. This includes the timeline for initiating feedwater to the SGs. The *R. E. Ginna Nuclear Power Plant NEI 12-06 FLEX Validation Plan* (Reference 79) shows that the actions for an ELAP can be completed as planned.

Local Manual Actions

Local manual actions are employed throughout much of the plant. HVAC calculations have been performed for all areas requiring access. Results are described below. There are flashlights and hard hat lights, along with large quantities of batteries, stored in robust protected locations. These will be made available to plant personnel as needed to perform local actions. A communications test of the radio system was performed, utilizing the new protected repeater. Communications was excellent throughout the areas where communication to perform local mitigation actions is required. All areas requiring access have multiple egress and exit points.

1. Standby AFW Building Annex – the local actions taken in this room are the initiation and control of Standby AFW flow, initiation of Alternate RCS Injection, and monitoring of Spent Fuel Pool level. HVAC calculations indicate there will be no adverse environmental conditions within this room to inhibit the performance of local actions. The temperature limits in these areas are 60°F to 104°F.
2. Auxiliary Building – several manipulations are expected to occur in this building. When initiating Alternate RCS Injection, four manual valves must be manipulated. When repowering MCC C and D to provide for battery charging and accumulator isolation valve closure, cables must be deployed from the Waste Gas Compressor room to the motor control centers. When dewatering the Auxiliary Building sub-basement and aligning Reactor Coolant Drain Tank pump flow and FLEX pump flow to the 760 A and B bonnet-to-hose adapters, cabling and hoses must be run in various sections of the Auxiliary Building. Also, running hose to the edge of the spent fuel pool, or, alternatively, to valve 8662 for spent fuel pool makeup is performed in the Auxiliary Building. HVAC calculations have been performed which demonstrate that environmental conditions at the operating floor peak at about 125°F. The time duration for actions in this area is less than 1 hour. At lower levels of the Auxiliary Building, where actions could have several hours duration, the peak temperature remains below 110°F.
3. Intermediate Building – The Atmospheric Relief Valves must be locally controlled. With timely opening of doors, HVAC calculation demonstrates that peak temperatures are limited to 117-122°F. Other actions in the Intermediate Building include taking of local readings for vital instrumentation, and the use of an air compressor to vent the Safety Injection accumulators. HVAC calculations indicate the peak temperatures in these areas are 110-115°F.
4. Control Room – Many manipulations are performed within the control room. HVAC calculations demonstrate that with the timely opening of doors, peak temperatures are limited to 116°F.
5. Relay room/annex – the radio repeater system is stored in the annex. The antenna, tripod, and cabling would be deployed via local actions form that room. HVAC calculations indicate the peak temperature in that room would be limited to 103°F.

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11 Acronyms

AB	Auxiliary Building
AC	Alternating Current
AFW	Auxiliary Feedwater
ARV	Atmospheric Relief Valve
BDBEE	Beyond-Design-Basis External Event
BOL	Beginning of Life
CENG	Constellation Energy Nuclear Group, LLC
CST	Condensate Storage Tank
DC	Direct Current
D/G	Diesel Generator
DI	Demineralized
ECP	Engineering Change Package
ELAP	Extended Loss of AC Power
EOL	End of Life
EPRI	Electric Power Research Institute
EPU	Extended Power Uprate
FLEX	Diverse and Flexible Coping Strategies
FOST	Fuel Oil Storage Tank
FSG	FLEX Support Guideline
ft.	feet
gpm	gallons per minute
hr.	hour
IB	Intermediate Building
KW	Kilowatt
LOCA	Loss of Coolant Accident
LUHS	Loss of Ultimate Heat Sink
MBtu	Million British thermal units
MFP	Main Feedwater Pump
MOV	Motor Operated Valve
mph	miles per hour
MW	Megawatt
NEI	Nuclear Energy Institute
NRC	Nuclear Regulatory Commission
NSRC	National SAFER Response Center
NSSS	Nuclear Steam Supply System
NUMARC	Nuclear Management and Resources Council
OBE	Operating Basis Earthquake
OEM	Original Equipment Manufacturer
pcm	percent mil
PIM	Pooled Inventory Management
PM	Planned Maintenance
PMF	Probable Maximum Flood
PORV	Power Operated Relief Valve
ppm	parts per million
PWROG	Pressurized Water Reactor Owner's Group
RCCA	Rod Cluster Control Assembly
RCP	Reactor Coolant Pump

RCS	Reactor Coolant System
RFO	Refueling Outage
RG	Regulatory Guide
RG&E	Rochester Gas and Electric Corporation
RHR	Residual Heat Removal
RWST	Refueling Water Storage Tank
SAFER	Strategic Alliance for FLEX Emergency Response
SAFW	Standby Auxiliary Feedwater
SBO	Station Blackout
SDM	Shutdown Margin
SEP	Systematic Evaluation Program
SFP	Spent Fuel Pool
S/G	Steam Generator
SI	Safety Injection
SR	Safety Related
SS	Safety Significant
SSE	Safe Shutdown Earthquake
SUP	Structural Upgrade Program
TBD	to be determined
TDAFW	Turbine Driven AFW
TS	Technical Specifications
TSC	Technical Support Center
UFSAR	Updated Final Safety Analysis Report
UHS	Ultimate Heat Sink
USI	Unresolved Safety Issue

Table 1 – PWR Portable Equipment Phase 3

List portable equipment	*Performance Criteria*	*Notes*
Medium Voltage Generators (2) with Cable / Electrical	4160 VAC, 1 MW	2 MW by operating generators in parallel.
Low Voltage Generator with Cable / Electrical	480 VAC, 1000 KW	The unit is derated from 1100 KW
High Pressure Injection Pump	60 gpm at 2000 psi	With Suction & Discharge Hose / Mech. Connections
S/G/RPV Makeup Pump	500 gpm at 500 psi	With Suction & Discharge Hose / Mech. Connections
Low Pressure / Medium Flow Pump	2500 gpm at 300 psi	With Suction & Discharge Hose / Mech. Connections
Low Pressure / High Flow Pump	5000 gpm at 150 psi	With Suction & Discharge Hose / Mech. Connections
Mobile Lighting Towers (3)	440,000 lumens	440,000 Lumens / 30 ft. height
Diesel Fuel Transfer	264 gallon	With 30 gpm AC Pump & 25 gpm DC Pump
Fuel Air-Lift Container	500 gallon	2" Cam Lock
Portable Fuel Transfer Pump	60 gpm	With 0.5 Micron Filter / Suction and Discharge Hose
4160 VAC Distribution System	4160 VAC, 1200 Amp	
Mobile Water Treatment System	500 gpm mechanical filtration with a 250 gpm brackish water reverse osmosis system. Output water quality meets the following: • Specific Conductivity ≤ 0.08 μS/cm • Dissolved Oxygen ≤ 100 ppb • Chloride ≤ 1 ppb • Sulfate ≤ 1 ppb • Sodium ≤ 0.5 ppb • Silica ≤ 10 ppb • TOC < 100 ppb	Includes interconnecting hoses and 480 VAC Generator with an electrical output of 150 KW at 0.8 power factor and leads and ground cables.
Mobile Boration System	1000-gallon tank capable of heating a boric acid solution of up to 7750 ppm to 130°F in less than 4 hours.	Unit includes agitator, heaters and controls, hoses and power supplies.

Attachment 1 – Sequence of Events Timeline for an ELAP/ LUHS

Action item	Elapsed Time	Action	Time Constraint Y/N	Remarks / Applicability
	0	Event Starts	NA	Plant @100% power
1	1 min	Operators initiate a manual reactor trip.	N	Ensures a reactor trip is initiated within 1 minute of blackout initiation.
2	5 min	Dispatch Equipment Operator to Throttle S/G A & B ARVs.	N	See remarks for 'Throttle S/G A & B ARVs' below.
3	6 min	Dispatch Equipment Operator to establish SAFW to S/Gs using 1 MW SAFW D/G.	N	See remarks for 'Establish SAFW to S/Gs using 1 MW SAFW D/G prior to S/G dryout to maintain heat sink' below.
4	20 min	Dispatch Equipment Operator to commence DC Load Shedding.	N	See remarks for 'DC Load Shedding' below.
5	30 min	Throttle S/G A & B ARVs	Y	Throttle S/G A and B ARVs per ECA-0.0 (Ref. 23) Step 3 RNO in order to establish and maintain RCS Temperature at 547°F.
6	30 min	Open Control Room & All Reactor Protection and Control System Rack Doors in the Control Room. Open selected vital area doors.	Y	Time critical action is to open Control Room and all Reactor Protection and Control System Rack Doors in the Control Room, and to open select vital area doors to limit max temperatures.
7	43 min	Establish SAFW to S/Gs using 1 MW SAFW D/G prior to S/G dryout to maintain heat sink.	Y	RWA-1323-003 (Ref. 57) determined that the time to S/G dryout from nominal conditions, with conservative decay heat levels, occurs at 43 minutes.
8	1 hr.	DC Load Shedding	Y	Following loss of all AC power, the station batteries are the only source of electrical power. The station batteries supply the DC buses and the AC vital instrument buses. Since AC emergency power is not available to charge the station batteries, battery power supply must be conserved to permit monitoring and control of the plant until AC power can be restored. The intent of load shedding is to remove all large non-essential loads as soon as practical, consistent with preventing damage to plant equipment.
9	1 hr.	Declare ELAP	N	Declaration of ELAP shall be made when it is recognized or determined that restoration of power to mitigate the effects of a SBO cannot not be performed. ECA-0.0 (Ref. 22) directs the Operator to try and restore power to any train of AC emergency buses very quickly after a loss of all AC power. One hour is sufficient time for the Operators to recognize or determine that off-site power or on-site emergency power restoration is unlikely and that an ELAP should be declared.
10	1 hr.	Establish Long Term RCS Inventory Control.	N	FSG-1 (Ref. 83) can be entered to restore RCS Inventory using an alternate makeup strategy.

Action item	Elapsed Time	Action	Time Constraint Y/N	Remarks / Applicability
11	1 hr.	Dispatch Equipment Operator to commence repowering Battery Chargers and establish Battery Room ventilation.	N	See remarks for 'Repower Battery Chargers' and 'Provide Battery Room ventilation for hydrogen control' below.
12	2 hrs.	Commence RCS Cooldown – maintain maximum cooldown rate in the RCS cold legs not to exceed 100°F/hr.	N	TB-15-1 (Ref. 128) recommends that cooldown should be initiated within 2 hours after a loss of all RCP Seal Cooling occurs. Cooldown rate should be 50°F/hr. to 100°F/hr.
13	4 hrs.	RCS cold leg temperature less than 450°F	Y	TB-15-1 (Ref. 128) recommends that an RCS cold leg temperature of less than 450°F be achieved within 4 hours to maintain RCP seal integrity. See further discussion regarding Action Item 12 below.
14	4 hrs.	Degas Main Generator.	N	Generator degassing should be started to ensure that DC seal oil backup pump can be stopped in four hours to decrease DC loading on the TSC Battery (non-vital).
15	6 hrs.	Dispatch personnel to set up for refueling 1 MW SAFW D/G and other equipment as necessary.	N	See remarks for 'Commence refueling 1 MW SAFW D/G and other equipment as necessary' below.
16	8 hrs.	Repower Battery Chargers.	Y	DA-EE-2001-028 (Ref. 55) documents that the vital batteries have an adequate capacity for an 8-hour event assuming the load reductions listed in procedure ECA-0.0 (ATT-8.0, Ref. 46)) are implemented.
17	8 hrs.	Commence Alternate RCS Injection.	Y	See the Phase 1 discussion for mitigation strategy Maintain RCS Inventory Control / Long Term Subcriticality for a discussion of this time constraint.
18	9 hrs.	Dispatch personnel to set up for SFP Makeup/ Cooling and to Refill SAFW DI Water Storage Tank.	N	See remarks for 'Commence SFP Makeup/ Cooling' and 'Refill SAFW DI Water Storage Tank below.
19	12 hrs.	Commence refueling 1 MW SAFW D/G and other equipment as necessary.	Y	DA-ME-14-003 (Ref. 24) documents that the 1 MW SAFW D/G must be refueled in 12 hours.
20	21 hrs.	Commence SFP Makeup/ Cooling.	Y	For the limiting case of starting SFP level and heat load, it takes 21 hours to reach Level 2.
21	24 hrs.	RCS temperature and pressure is less than 350°F and 400 psig.	Y	TB-15-1 (Ref. 128) recommends that after 24 hours, an RCS temperature and pressure of less than 350°F and 400 psig should be achieved to maintain RCP seal integrity. See further discussion regarding Action Item 12 below.
22	24 hrs.	Refill SAFW DI Water Storage Tank.	Y	FSG-6 (Ref. 99) provides a method of refilling the SAFW DI Water Storage Tank.
23	48 hrs.	Provide Battery Room ventilation for hydrogen control.	N	DA-EE-99-068 (Ref. 62) documents that under worse case conditions, without ventilation, the 0.8% normal hydrogen concentration limit would not be exceeded until 28.9 hours and that the unacceptable hydrogen concentration limit of 2% would not be exceeded until 73.3 hours, with all batteries being equalized.

Discussion of time constraints identified in Attachment 1.

- 1 minute (min), Operators initiate a manual reactor trip. This is not a FLEX time constraint as NEI 12-06 initial conditions assume no failures beyond the event induced failures and the loss of all AC power. A scenario related to station blackout, although not technically part of the *Station Blackout Rule*, 10 CFR 50.63 (Reference 6) baseline assumptions as defined by NUMARC 87-00 (Reference 47) (in that non-vital power is available), has been evaluated. The Ginna Operators have been trained on this possible scenario and are procedurally directed to manually trip the reactor when these conditions exist. Plant and engineering personnel met on November 2, 1995 to discuss an apparent vulnerability identified during simulator exercises related to meeting the Station Blackout Rule. Based on Ginna's plant-specific arrangement, a loss of voltage to safeguards buses 14 and 16 does not result in a reactor trip or reactor coolant pump trip. If not tripped by the operator, the RCP's would continue to run without any seal cooling. This lack of seal injection and component cooling could cause seal failure Loss of Coolant Accident's (LOCA's) at both reactor coolant pumps after a relatively short period of time. The plant would eventually trip due to temperature related equipment failures and enter into a station blackout after a loss of non-vital power, which is normally supplied from the turbine generator. This scenario is similar to the station blackout considered in our PRA (Probabilistic Risk/Safety Assessment), but was not specifically evaluated, since the station blackout scenario includes a loss of the 115kV offsite system. Qualitatively, however, the risk from this scenario is estimated to be significantly greater than the evaluated station blackout, due to the more severe consequences. SBO-PROGPLAN Paragraph 2.4.3 (Reference 32); A-601.10 (Reference 17).
- 30 min, Throttle S/G A & B ARVs. Throttle S/G A and B ARVs per ECA-0.0 (Reference 22) Step 3 RNO in order to maintain RCS Temperature at 547°F (NEI Phase 2 Staffing Assessment, (Reference 107). The concern is that the 7228-B high temperature O-rings in select RCP B seal locations are only qualified to 550°F. These O-rings may be exposed to 556.3°F RCS Tcold water during BDB ELAP scenarios when S/Gs are at saturated conditions at the lowest S/G Safety setpoint of 1085psig. It is necessary to take prompt action to establish RCS Tavg at 547°F during ELAP scenarios to reduce Tcold to approximately 530°F to minimize time RCP seal O-rings are exposed to temperatures above 550°F.
- 30 min, Operators Open Control Room & All Reactor Protection and Control System Rack Doors in the Control Room, and open selected vital area doors. Calculations performed for the control room area (References 59, 60) indicate that the ambient temperature will be up to 116°F after a four hour SBO in this area if the Control Room door is opened. SBO-PROGPLAN Paragraphs 4.1.10 & 4.1.11 (Analysis support 4 hr coping period) (Reference 32); A-601.10 (Reference 17); ECA-0.0 (Reference 22). Calculations performed for the TDAFW pump area (Reference 58) indicate that the ambient temperature will be between 110°F and 115°F after a four hour SBO in this area if doors S37F, S44F, and SD/55 are opened within 30 minutes. Calculations performed for the Atmospheric Relief Valve (ARV) area indicate that the ambient temperature in this area for continued occupancy with an expected maximum temperature between 117°F and 122°F with doors S37F, S44F, and SD/55 opened within 30 minutes after a four hour station blackout. However, no specific manual actions are required in the ARV area for an SBO. This cannot be

assumed for an ELAP / LUHS event. A-601.10 (Reference 17); SBO-PROGPLAN Paragraph 7.2.4 (Reference 32) (Analysis supports 4 hr. coping period).

- 43 min, Establish SAFW to S/Gs prior to S/G dryout to maintain heat sink. RWA-1323-003, *Ginna RELAP5 ELAP Analysis for Mode 1*, (Reference 57) determined that the time to S/G dryout from nominal conditions, with conservative decay heat levels, occurs at 43 minutes. Table-tops/walkthroughs were performed to validate that the time critical action could be accomplished as required. Restoration of feed to the S/Gs was completed by 43 minutes.
- 1 hr., DC Load Shedding. Following loss of all AC power, the station batteries are the only source of electrical power. The station batteries supply the DC buses and the AC vital instrument buses. Since AC emergency power is not available to charge the station batteries, battery power supply must be conserved to permit monitoring and control of the plant until AC power can be restored. The intent of load shedding is to remove all large non-essential loads as soon as practical, consistent with preventing damage to plant equipment. ATT-8.0 (Reference 46); NEI 12-01 Phase 2 Staffing Assessment Report (Reference 107); ECA-0.0 Background Information (Reference 54).
- 1 hr., Declare ELAP. Declaration of ELAP shall be made by the Shift Manager when it is recognized or determined that restoration of power to mitigate the effects of a SBO cannot be performed. ECA-0.0 directs the Operator to try to restore power to any train of AC emergency buses after a loss of all AC power. One hour is sufficient time for the Operators to recognize or determine that off-site power or on-site emergency power restoration is unlikely and that an ELAP should be declared. The NEI 12-01 Phase 2 Staffing Assessment (Reference 107) determined that the Shift Manager will declare an ELAP as early as T = 16:54.
- 1 hr., Establish Long Term RCS Inventory Control. The NEI 12-01 Phase 2 Staffing Assessment (Reference 107) determined that FSG-1, Long Term RCS Inventory Control, (Reference 83) can be entered to restore RCS Inventory using an alternate makeup strategy when an ELAP is in progress, PRZR level is less than 13% [40% adverse CNMT], and time and personnel are available to perform this strategy.
- 2 hrs., Commence RCS Cooldown – maintain maximum cooldown rate in the RCS cold legs not to exceed 100^0F/hr. In order to ensure RCP No. 2 seal component temperature limitations are maintained, Westinghouse Technical Bulletin TB-15-1, *Reactor Coolant System Temperature and Pressure Limits for the No 2 RCP Seal* (Reference 128), recommends that a RCS cooldown be performed following all loss of all seal cooling events. The cooldown should be initiated within 2 hours after a loss of seal cooling occurs. The cooldown rate should be the typical emergency response guideline (ERG) rate of 50 to 100°F/hr. to a cold leg temperature of less than 450°F in 4 hours and after 24 hours, an RCS temperature and pressure of less than 350°F and 400 psig should be achieved.
- 4 hrs., Degas Main Generator. Generator degassing should be started to ensure that DC seal oil backup pump can be stopped in four hours to decrease DC loading on the Technical Support Center Battery. ECA-0.0 (Reference 22); ECA-0.0 Background Information (Reference 54).
- 8 hrs., Repower Battery Chargers. Vital Battery Capacity given load shedding in ECA-0.0. DA-EE-2001-028 (Reference 55) documents that the vital batteries have an adequate capacity for an 8-hour event assuming the load shedding listed in procedure ECA-0.0 (ATT-8.0, Reference 46)) is implemented. This analysis is conservative because it applies 50% of the calculated load reduction to Battery A, and only during the period from 12 min to 245.5 min. 50% of the calculated load

shedding is conservatively small in that the load shedding is assumed to take place anytime from 12 min to 245.5 min. This analysis does not consider the effects of load shedding for Battery B. Battery B is shown to be adequately sized for an 8-hour SBO without procedural load shedding. SBO-PROGPLAN Paragraph 7.2.2 (Reference 32).

- 8 hrs., Commence Alternate RCS Injection. See the Phase 1 discussion for mitigation strategy Maintain RCS Inventory Control / Long Term Subcriticality for a discussion of this time constraint. PA-PSC-0965, *PWROG Core Cooling Position Paper* (Reference 41); WCAP-17601-P (Reference 19); CALC-2014-0002 (Reference 20).
- 12 hrs., Commence refueling 1 MW SAFW D/G and other equipment as necessary. DA-ME-14-003, *FLEX Fuel Consumption Analysis*, (Reference 24) documents that the 1 MW SAFW D/G must be refueled in 12 hours assuming 60% load and 81% initial fuel level. O-6.1, *Equipment Operator Rounds and Log Sheets* (Reference 36), verifies that the SAFW D/G Fuel Oil Tank Level has a minimum value of 535 gallons (81%).
- 21 hrs., Commence SFP Makeup / Cooling. With the maximum expected SFP heat load immediately following full core offload, with SFP water level required to be approximately 277', the SFP will reach a bulk boiling temperature of 212^{0}F in approximately 5 hours, and boil off to a level 5'-9" (Level 2 value of 257'-0") above the top of fuel in approximately another 40 hours (for a total of 45 hours) unless additional water is supplied to the SFP. A flow of 53 gpm will replenish the water being boiled. For a partial core offload during a typical refueling outage, and with the minimum allowed SFP water level at 261', the SFP will reach a bulk boiling temperature of 212^{0}F in approximately 5 hours, and boil off to a level 5'-9" above the top of fuel in another approximately 16 hours (for a total of 21 hours) unless additional water is supplied to the SFP. A flow of 27 gpm will replenish the water being boiled.
- 24 hrs., Refill new SAFW DI Water Storage Tank. FSG-6, *Alternate SAFW DI water Storage Tank Makeup*, (Reference 99) provides a method of refilling the SAFW DI Water Storage Tank by taking suction from Lake Ontario and discharging through a fill connection at the tank. This will allow SAFW Pumps to continue operation.
- 48 hrs., Provide Battery Room ventilation for hydrogen control. This is not a time constraint as establishing battery room ventilation occurs when the battery chargers are energized within 8 hours of event initiation. DA-EE-99-068, *Vital Battery Room Hydrogen Analysis* (Reference 62), documents that under worse case conditions, without ventilation, the 0.8% normal hydrogen concentration limit would not be exceeded until 28.9 hours and that the unacceptable hydrogen concentration limit of 2% would not be exceeded until 73.3 hours, with all batteries being equalized.

Attachment 2 – Figures

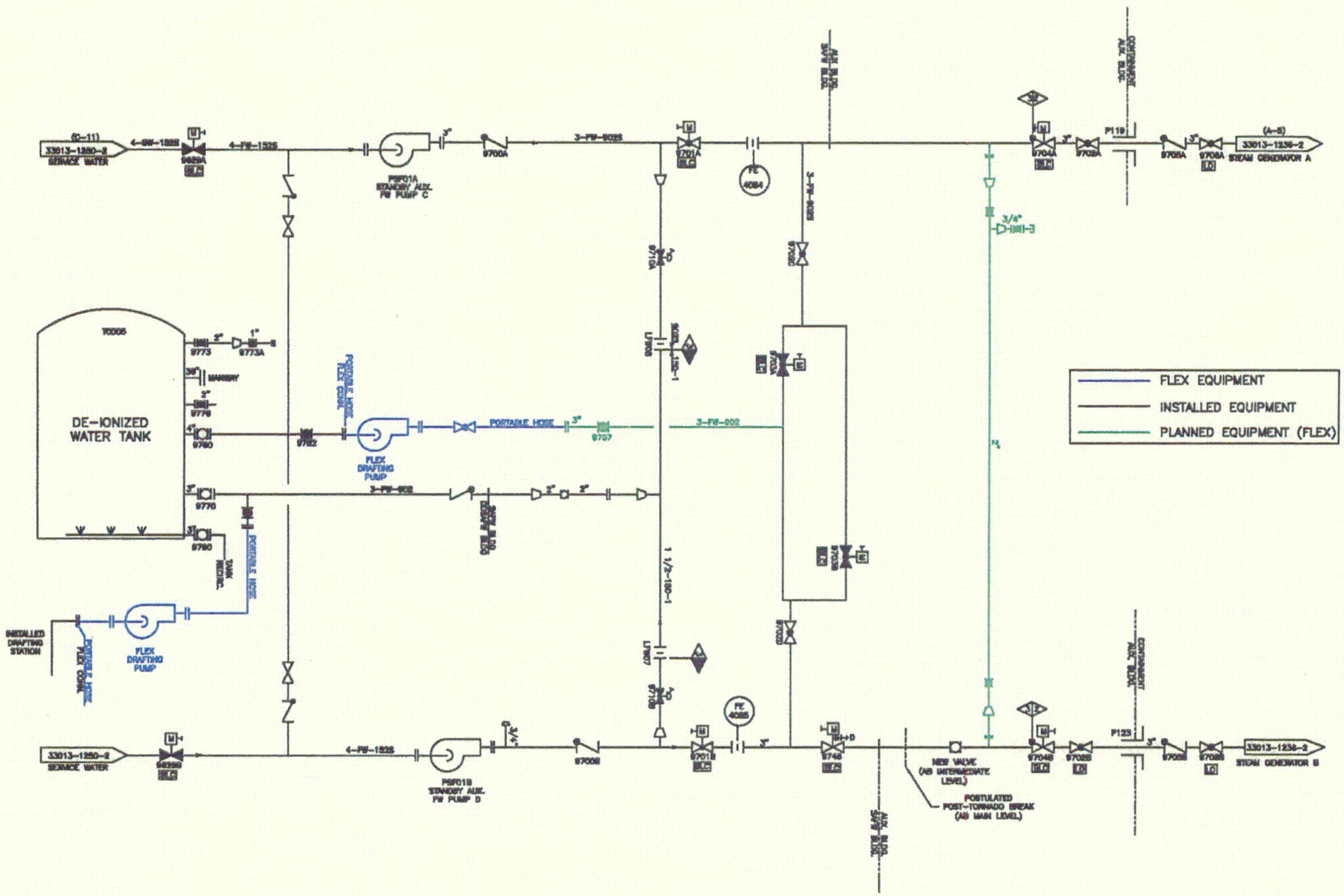
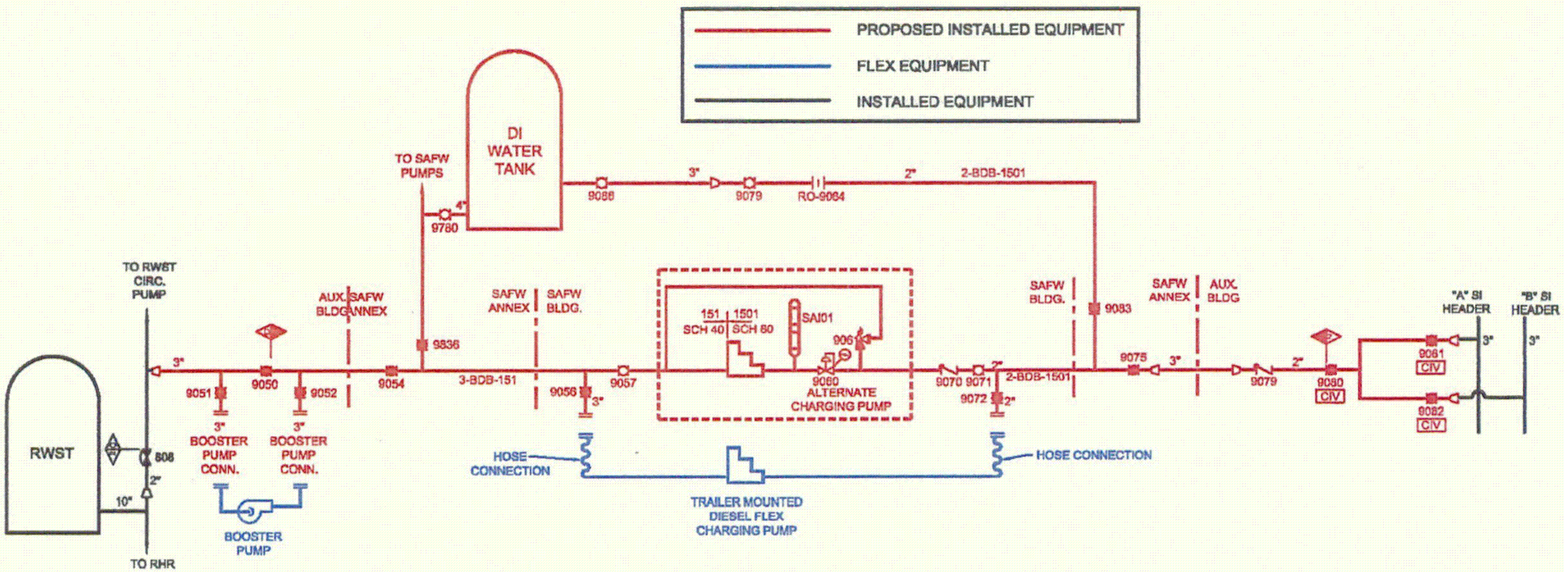


FIGURE 1: FLEX SAFW SYSTEM PUMPS AND CONNECTIONS



ALTERNATE CHARGING P&ID

FIGURE 2: FLEX ALTERNATE RCS INJECTION PUMPS AND CONNECTIONS

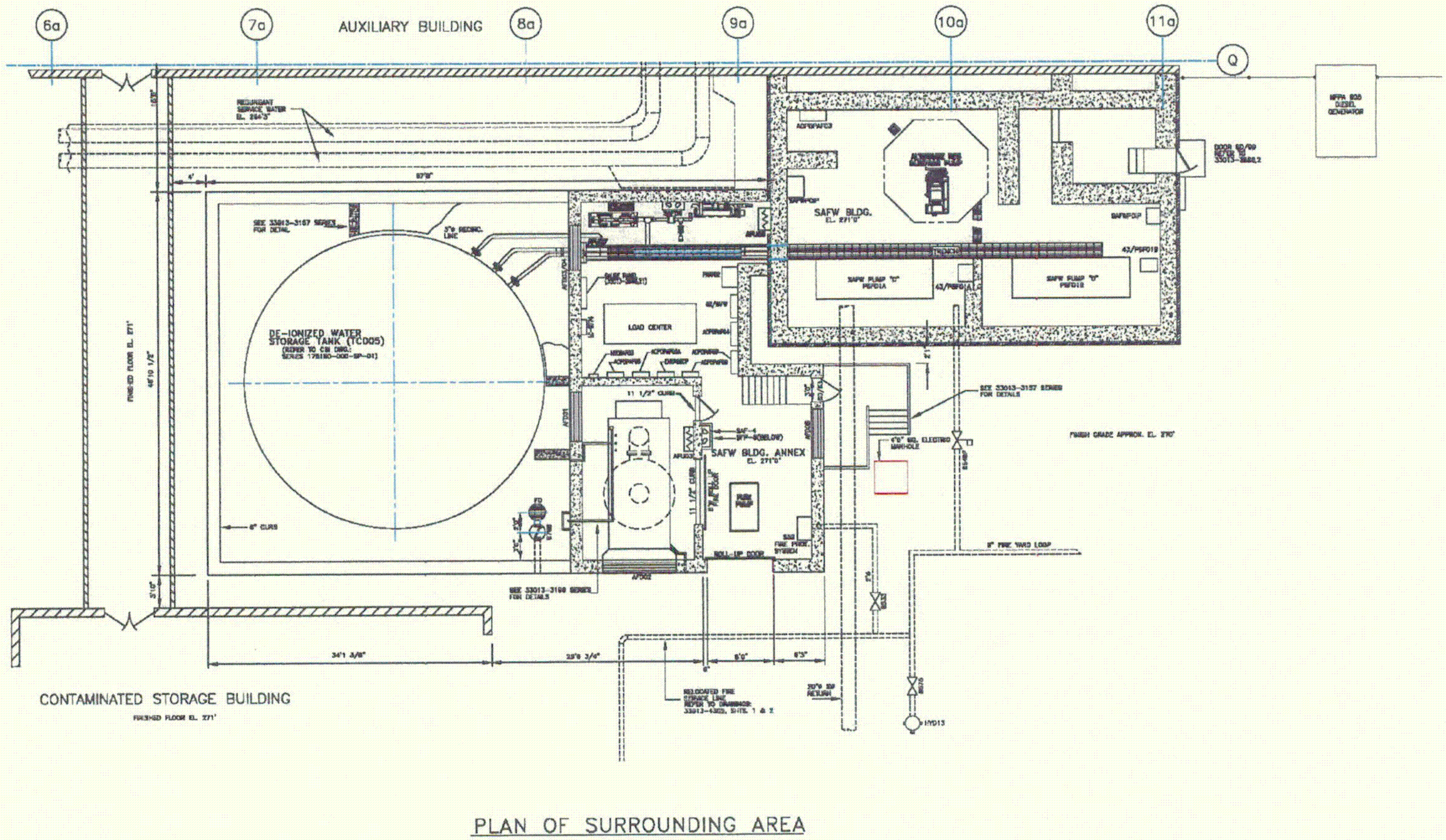


FIGURE 3: SAFW / ALTERNATE RCS INJECTION / ANNEX BUILDING

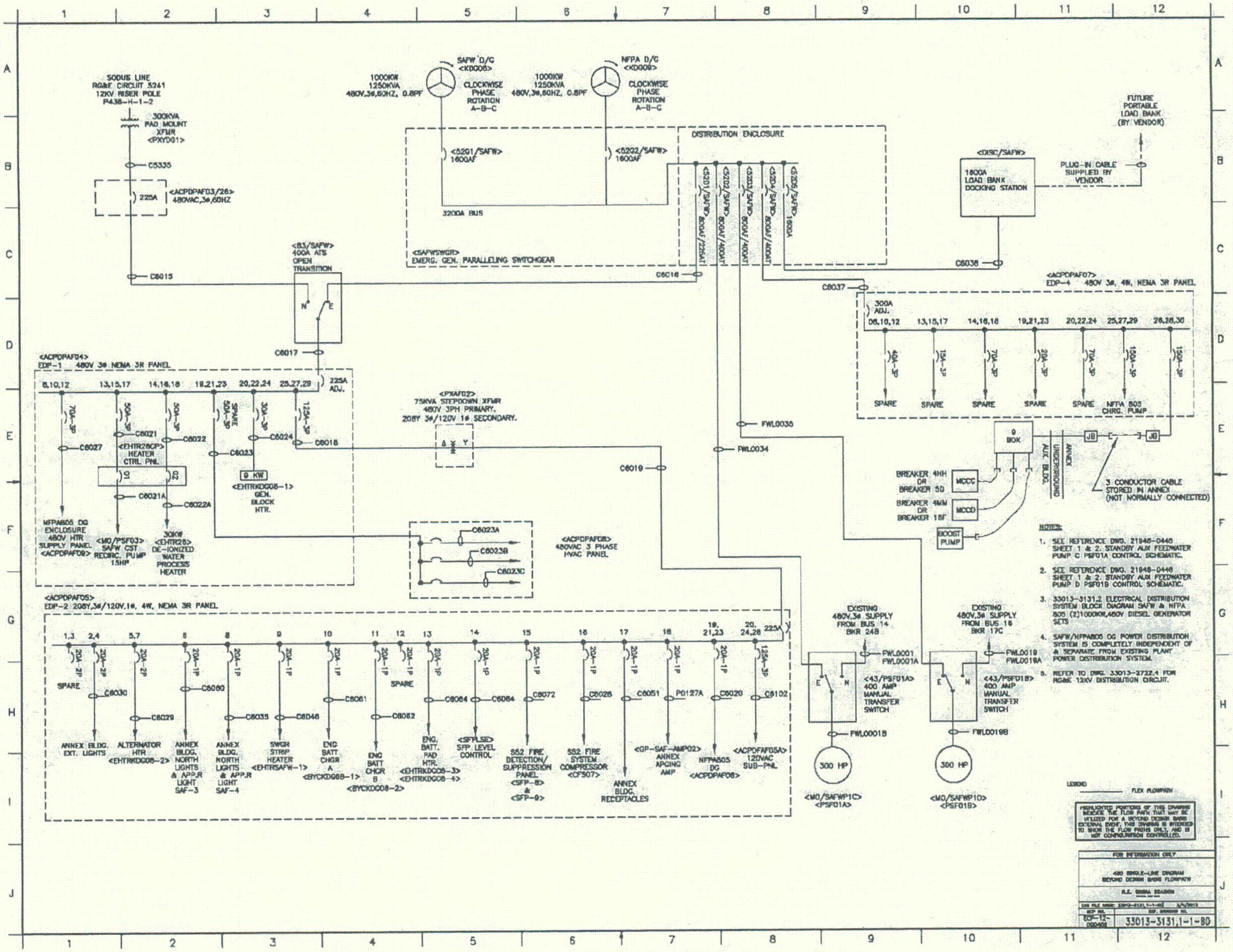


FIGURE 4: 480 VAC SINGLE LINE DIAGRAM BDBEE FLOW PATH

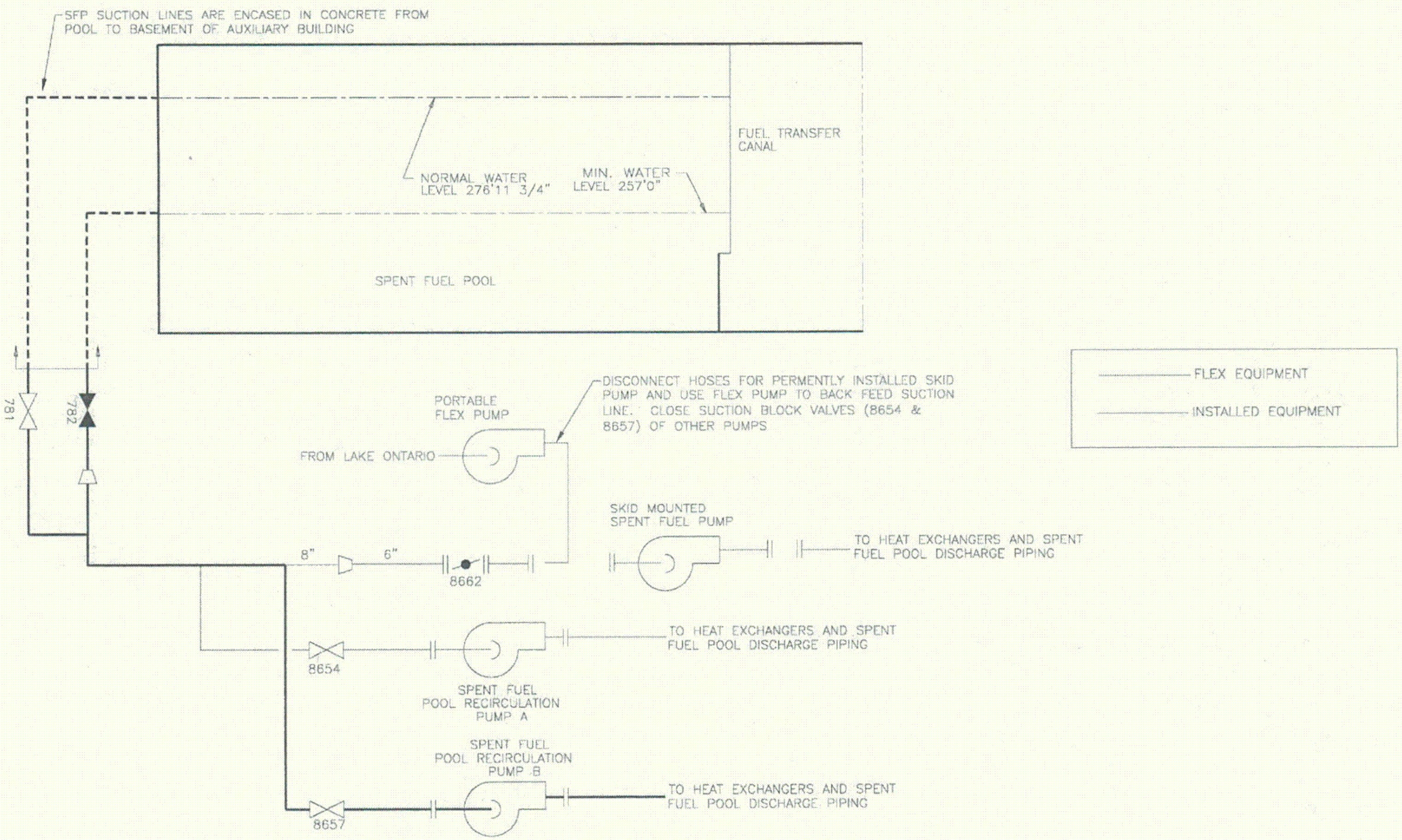


FIGURE 5: FLEX SFP MAKEUP OPTION TO SFP COOLING SYSTEM

FIGURE 6: STAGING AREA 'A'

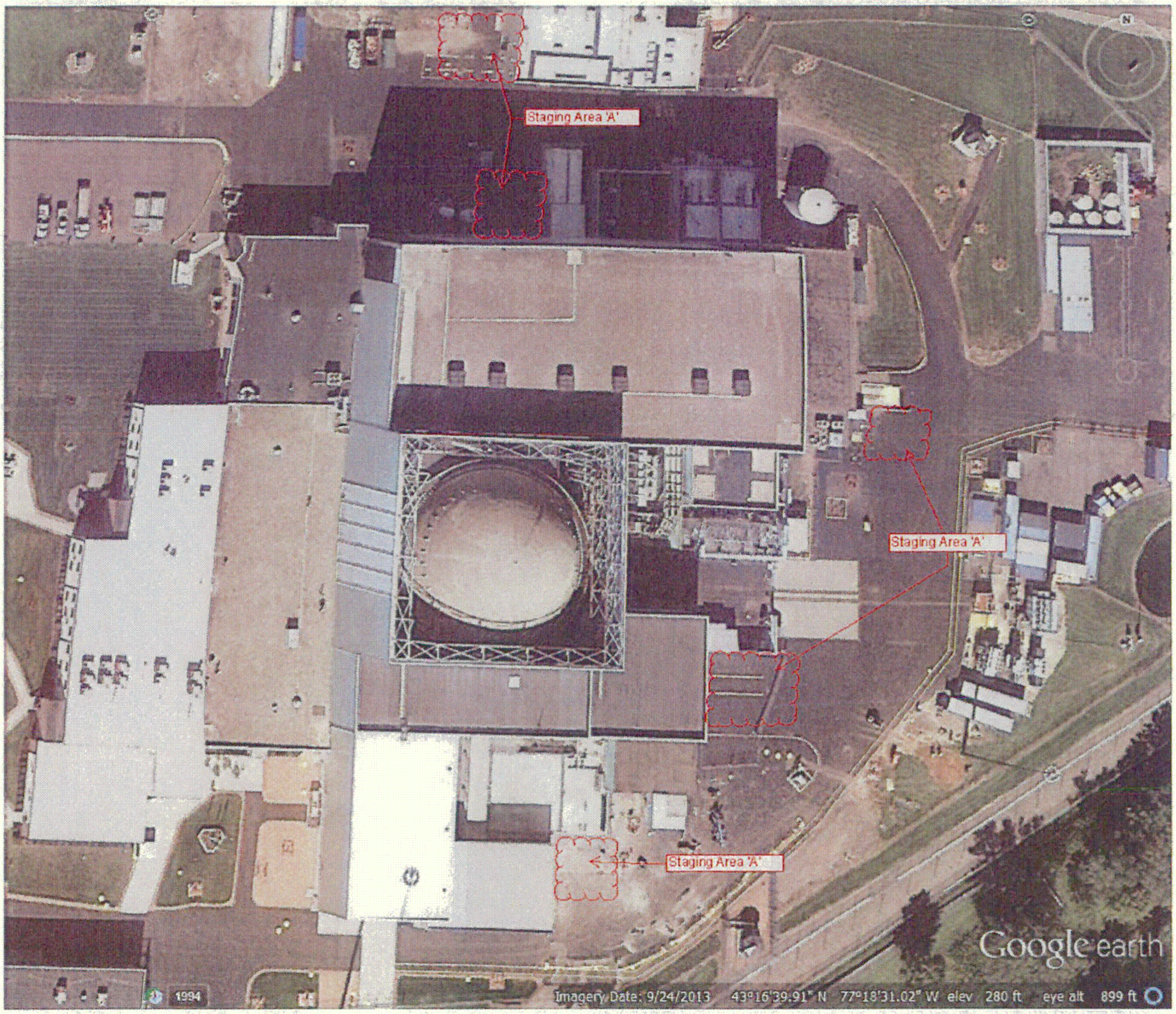


FIGURE 7: STAGING AREA 'B'

FIGURE 8: STAGING AREA 'C'